CHARACTERISTICS ASSOCIATED WITH PERSISTENCE AND RETENTION AMONG FIRST-GENERATION COLLEGE STUDENTS MAJORING IN SCIENCE, TECHNOLOGY, ENGINEERING, OR MATH

by

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ABSTRACT

Persistence and retention of college students is a great concern in American higher education. The dropout rate is even more apparent among first-generation college students, as well as those majoring in science, technology, engineering, and math (STEM). More students earning STEM degrees are needed to fill the many jobs that require the skills obtained while in college. More importantly, those students who are associated with a low-socioeconomic background may use a degree to overcome poverty. Although many studies have been conducted to determine the characteristics associated with student attrition among first-generation students or STEM majors, very little information exists in terms of persistence and retention among the combined groups. The current qualitative study identified some of the characteristics associated with persistence and retention among first-generation college students who are also STEM majors. Participants were juniors or seniors enrolled at a regional 4-year institution. Face-to-face interviews were conducted to allow participants to share their personal experiences as first-generation STEM majors who continue to persist and be retained by their institution.

Tinto’s Theory of Individual Departure (1987) was used as a framework for the investigation. This theory emphasizes personal and academic background, personal goals, disconnecting from one’s own culture, and institutional integration as predictors of persistence. The findings of the investigation revealed that persisting first-generation STEM majors are often connected to family, but have been able to separate that connection with that of the institution. They also are goal-driven and highly motivated and have had varied pre-college academic experiences. These students are academically integrated and socially integrated in some ways, but less than their non-first-generation counterparts. They are
overcoming obstacles that students from other backgrounds may not experience. They receive support from their families and institution, but have diverse academic backgrounds. The findings show that a culmination of many characteristics have enabled the participants to persist and be retained by their institution.
DEDICATION

I would like to dedicate this dissertation to my family. To my husband I offer gratitude for exhibiting a great deal of patience during the past years as I moved through the doctoral program. I am also appreciative of my autistic son who tried to understand what I was doing during those long nights and weekends of research. He knew it was important to me, and that was enough for him. They both sacrificed a great deal for my endeavours. My parents and in-laws were supportive in their words and actions, including sitting with my son. Without them, this dissertation would not have been possible.
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CHAPTER I

INTRODUCTION

When higher education in America began centuries ago, there was little concern for student retention (Berger, Ramirez, & Lyons, 2012), which is often referred to as an institution’s ability to help move students from one stage in their degree attainment to the next (Tinto, 1993). Retention is often coupled with the term persistence, meaning the steps taken by the student to ensure that he continues the journey from first-year college student to college graduate (Berger, Ramirez, & Lyons, 2012). The definitions used by higher education researchers are varied, which may be the cause for confusion (Davis, 2010). Despite the disarray in terminology, the lack of college student retention is now an issue of great concern in the United States (Kuh, Kinzie, Schuh, Whitt, & Associates, 2010).

Students enter college for different reasons. Many intend to earn a degree, whether it be for monetary gain or as a basis for overall happiness (Success, 2016), while others enter college with aspirations of gaining a certificate or to increase their skills for a specific job (Tinto, 1993). With approximately two out of every three high school graduates in the United States attending college the following year, it would seem that there would be more degree attainment; however, many of them are not graduating (McPherson & Schapiro, 2008). There is a need on a global level for college students to continue their studies, receive essential skills to succeed, and meet the demands of jobs requiring a higher education (Kuh et al., 2010). On a national level, it has been noted that although the United States experienced a steady rise in the number of college graduates over a thirteen-year period, it is still lower than some other countries with more than half the population (i.e. Japan) (Organization for Economic Cooperation and Development [OECD], 2014). Despite the addition of many
programs to increase the acceptance of students from diverse backgrounds (Seidman, 2012),
along with counseling and ACT help (McDonnough, 1994), a problem with student attrition
remains. In the late twentieth century, 8% of college students departed from their institutions
after only one year (Tinto, 1993). Today, the numbers do not appear promising. It has been
reported that for every three college freshman students, one will not return the following year

The dropout rate among American college students is higher than any of the other
discovered that less than 50% of the freshman college students in America completed college
programs and earned a degree within a five-year period. Since that time, the United States
Department of Education has adopted a six-year completion time for four-year degrees. This
is due to the fact that not all college students attend full-time, which means they may take
longer to earn a degree (Carey, 2004). According to the National Center of Educational
Statistics (2016), 789,743 students were retained in 2014 at four-year public institutions. In
2006, the statistics revealed that 912,401 students were retained at the same institution type.
Quite a decrease in retention occurred over an eight-year period. Some of these students were
not only in their first year of college but also were first in their families to attend college.

A great number of students in higher education may be categorized as first-
generation (first-gen) college students (Choy, 2001). In 1989, at least 43% of new college
students were considered first-generation; although this data is not recent, researchers
continue to use it as a basis for comparison (Chen & Carroll, 2005). Based on a Consumer
Intelligence Research Partners (CIRP) report in 2006 involving 271,441 newly enrolled
freshmen from 393 four-year colleges and universities, approximately 47.2% of students’
mothers did not graduate from college and 47.1% of students’ fathers did not earn a degree
(Pryor, Hurtado, Saenz, Santos, & Korn, 2007). The problem with knowing exactly how
many students are first-generation is due to universities not knowing how to count them; probably because they still do not know how to define them (Davis, 2010). Regardless of how they are defined, first-gen students belong to a group that is in need of resources. If these students are blended into a category with other student groups, it is likely that their unique needs may be ignored (Davis, 2010).

Concern for STEM major retention has raised awareness in higher education discussions, as well. Too many are beginning college with aspirations of earning STEM degrees but change their major after only one or two years of coursework (Seymour & Hewitt, 1997). Those whose parents have jobs in STEM fields are much more likely to go to college with an interest in pursuing a degree in STEM fields as well (Harwell, 2012); but there are not enough STEM graduates to cover the many job offerings in the United States (Packard, 2016). The National Science Board (2010) has stressed the demand for more well-educated students in STEM fields to help America compete with other nations. Several other countries are ahead of the United States in the number of engineering and natural science degrees granted (Hearne, Henkin, & Dee, 2011). It has been suggested that researchers now attempt to discover how to change the trend (Packard, 2016).

In order to find a solution to a dilemma, researchers first must realize there is one (Merriam, 2009). A problem with inadequate retention among first-generation college students has been identified; and several possible factors are linked to this problem. Some of these factors include the lack of cultural capital (McCarron & Inkelas, 2006), the lack of institutional connectedness (i.e. engagement) (Tinto, 2012a), being underprepared for demanding college courses (Ward, Siegel, & Davenport, 2012), and insufficient faculty support (Perry, 1970). The latter two have been recognized as having a possible effect on majors of science, technology, engineering, and math (STEM) as well (Kokkelenberg &
Therefore, persistence and retention of both first-gen students and STEM majors may be affected by similar challenges.

One element that may hinder persistence and retention among first-gen students, cultural capital, is a resource that many of them cannot claim. Their parents lack the ability to share experiences or offer advice about college when they have not experienced it themselves (Davis, 2010). In 1973, Bourdieu provided an explanation for cultural capital as the benefits that children of college graduates may possess. They generally receive parental support but not the type that prepares the student for his or her college life (McCarron & Inkelas, 2006). This has a tendency to cause them to struggle on a personal level with lack of confidence (Engle, Bermeo, & O’Brien, 2006).

Counselors may assist in remedying some of the deficits first-gen students have due to their lack of understanding of college preparation (Barry, Hudley, Cho, & Kelly, 2008). Many first-generation college students are disadvantaged when they enter college because they lack the characteristics that most of their non-first-generation peers have acquired (Stebleton & Soria, 2012). Often they are underprepared for the rigor of college courses (Choy, 2001). Many do not take more advanced classes in high school, such as Advanced Placement (AP) courses, because they were not offered to them, they lacked the confidence to excel, or they felt no need to consider the challenge (Pascarella, Pierson, Wolniak, & Terenzini, 2004). This is also true among students who enter science, technology, engineering, or math fields and do not persist to graduation. Once their freshman year begins, they realize they cannot handle the demand of the courses and drop out (Packard, 2016).

The first step in increasing a student’s chances of college success involves planning. When first-gen students who have an interest in STEM fields are encouraged to take more advanced high school courses, they are more likely to be prepared for the rigor college courses offer (Erbes, 2008). Planning for these students should begin even before they reach
high school (Ward, et al., 2012). With more involvement in advanced high school STEM courses, students may develop skills in mechanics and reasoning, which is a predictor of success in STEM-related fields. This includes more exposure to laboratory experiences that connect course information to real-life applications (Ackerman, Kanfer, & Beier, 2012). First-generation students may benefit from guidance through the steps of finding a college right for them and applying for admission (Ward, et al., 2012). Furthermore, unless they have had strong support from high school counselors or teachers, first-gen students may be less likely to successfully maneuver through college to completion (Bryan, Moore-Thomas, Day-Vines, & Holcomb-McCoy, 2010).

Along with counselors, high school teachers can aid in the success of first-generation students and potential STEM majors by overseeing their progress in their courses. If they notice learning weaknesses, they might step in to offer assistance, such as tutoring (Whalen & Shelley, 2010). When students interested in STEM fields keep their grade point average (GPA) high, they tend to have more success in college (Thompson & Bolin, 2011). Increased rigor in high school courses is important in preparing students for challenging college courses. High school GPA often correlates with a college student’s ability to persist (AStin & Oseguera, 2012). Some students do not have access to more advanced high school courses due to lack of funding or other resources, such as trained teachers (Erbes, 2008). In such cases, grants from organizations, such as the National Science Foundation, have helped provide schools this level of instruction. This is especially important for increasing the numbers of minorities and women studying in STEM fields (National Science Foundation, 2017). Colleges and universities also may help students transition from high school into college by offering on-campus research programs during the summer (Gibson & Bruno, 2014). Such programs may help students gain confidence in their career choice (Whalen &
Shelley, 2010). Should more academic help be necessary once a student arrives on her college campus, tutoring services may prove to be a valuable resource (Padron, 1992).

Of all the factors aiding student persistence and retention, student engagement may be one of the most critical. Involving a college student, both academically and socially, has proven to be an effective indicator of college student retention and satisfaction with the student’s institution (Tinto, 2012a). Tinto (1987, 1993, 2012a & b) suggested that for students to be successful in college, they must be connected to their institution in such a way that they become part of a college community. This begins with a welcoming college campus environment. When college students feel a sense of belonging in their environment, they become more connected with the college culture (Kuh, 2008; Packard, 2016). For example, living on campus allows students to form more social connections with other students, as well as with the faculty who teach them; thus leading to a greater chance for student retention. By living on campus, students are generally closer to their classes and campus activities (Warburton, Bugarin, & Nunez, 2001). Social integration may take on more than one form: formal and informal (Tinto, 1987). Formal integration may include activities involved with clubs and organizations like fraternities or sororities. Informal social integration, on the other hand, includes the interactions the student has with campus friends, even in study groups. According to Tinto (1987), connecting with others who have similar values about higher education allows students to enhance their institutional commitment, thus leading to persistence.

College students also benefit from making connections with faculty. These connections may help college students feel more included in the college culture and aid in retention (Chickering & Gamson, 1987; Heiserer & Parette, 2002). When a college student experiences positive interactions with faculty, a critical support system automatically arises (Perry, 1970). These relationships allow students to feel more at ease to ask questions when
necessary, which may affect their retention (Wilson, Ryan, & Pugh, 2010). Researchers have devised several theories about positive student-faculty relationships. One such example, cognitive development theory (Perry, 1970), suggests that college instructors be more supportive of and encouraging to their students in order to help increase student achievement. Almost three decades later, Astin (1999) formulated the student involvement theory, which posits that when students turn their energy toward their academic achievement they are truly engaged. He emphasized the idea that institutions should spend more time connecting their students to the institution, both academically and psychologically, and less time on how and what is being taught. The final result of these ideologies is student retention.

Much of the literature considers persistence and retention among first-generation students or STEM majors. When STEM majors are also first-gen students, they experience obstacles in more than one area. According to ACT Research and Policy (2013) only six out of every ten first-gen students complete a bachelor's degree in six years. Less than 50% of college students majoring in STEM fields earn a degree (National Academy of Sciences, National Academy of Engineering, and Institute of Medicine, 2005). “This significant drop out rate is a disservice to students and a challenge for society in general” (Christe, 2013, p. 22).

**Statement of the Problem**

First-generation college students have been recognized as being disadvantaged in several areas: lacking academic preparation (Choy, 2001), not understanding how institutions are different (Davis, 2010), and not knowing how to pay for their education (Ward et al., 2012). They often are not as prepared academically for college because they do not take more rigorous high school classes that help prepare them for college level courses (Choy, 2001). Even though first-gen students who are of low socioeconomic status often have similar post-secondary interests as their peers who are of higher income status, many of them do not know
how to find the right institution for their personal needs or educational goals (Ward et al., 2012). Not all first-gen students are from low-income families, but when financial status is also an issue first-gen students typically have additional problems with college (Davis, 2010). First-gen students with low-income status are almost 25% more probable to depart from college after their first year (Engle & Tinto, 2008). Those who do persist, may do so as a possible means of escaping poverty. They have seen the struggles faced by those in their community and want to experience a change for themselves (Ochberg & Comeau, 2001). These students are often disadvantaged due to insufficient direction from those who are knowledgeable about the college process (Ward et al., 2012).

Almost half of the college students in the United States do not persist to graduation (American Institutes for Research, 2010). Although a slight increase in graduation rates among public four-year institutions occurred a couple of years ago, too many are not completing programs (Velez, 2014). Another study shows that more first-gen students graduate from regional public institutions than any other college type (Comparative Alumni Survey, 2003) (See Appendix C). While 55% of continuing-generation college students earn a degree within six years, only 11% of first-gen students do the same (Engle & Tinto, 2008). Employees of college institutions may view student departure as incompetence; however, those who depart from their institutions may have a completely different explanation for leaving (Tinto, 2012a). Studies have shown that these students experience more obstacles than college students whose parents had college experiences they could share with their children (I’m first: College is my opportunity, 2014). Although more evidence has been obtained concerning the struggles experienced by first-gen students, there is still not enough known about them. It is possible that their institutions do not see the obstacles these students encounter as an obvious concern (Ward et al., 2012). With more and more of these students
desiring to earn a college degree, a greater understanding of their needs is necessary to help them succeed (Davis, 2010).

Another problem that needs to be addressed is the lack of persistence and retention among STEM majors. According to Ward, Siegel, and Davenport (2012), students in math and science are not as prepared academically. A bigger problem exists when first-gen students, women, and minorities are concerned. Less that 25% of computer science and engineering degrees are earned by women (Rattan, Good, Dweck, 2012). Even fewer African-Americans are earning STEM degrees at only 7% (Wilson et al., 2012). In 2009, degrees in engineering and the natural sciences were earned by only 2.7% of African-Americans and 2.2% of Hispanics (National Science Foundation, 2017). When these students do not enter STEM fields due to negative stereotypes, businesses may miss out on realizing their abilities and prevent them from excelling in a career they might enjoy (Aronson, Lustina, Good, Keough, Steele, & Brown, 1999). Diversity in STEM fields results in more productivity. When people from different backgrounds come together to solve problems, various perspectives due to lived experiences are brought to the table. Therefore, broadened creativity produces outcomes that are more persuasive than if they had come from a single-race or gender team (Oyserman, Bybee, Terry, & Hart-Johnson, 2004).

Ironically, some of the same issues faced by STEM majors seem to also negatively impact first-generation college students (Christe, 2013; Ward, Siegel, & Davenport, 2012). Despite these issues, some first-gen students learn how to be successful through all the confusion (Davis, 2010). There are cases in which underprepared students can progress through remediation courses and be successful college students (Horn & Bobbit, 2000). Although there are many statistics indicating a problem with lack of retention among first-gen students and STEM majors, there is very little research that suggests what drives these students to persist.
There is a gap in the research that examines why first-gen college STEM majors are persisting and being retained when so many of them are not (Harackiewicz, Canning, Tibbetts, Giffen, & Blair, 2014). The students involved in this study are considered first-generation if neither parent completed a college degree (Hand & Payne, 2008). It is apparent that first-gen STEM majors are at a disadvantage. Unfortunately, when STEM fields are exclusive to students from specific backgrounds, this may be inadvertently preventing the discovery of individuals with many talents to offer. In order for the United States to be a strong force in STEM fields, it may be profitable to include a variety of students (Ong, Wright, Espinosa, & Orfield, 2011). Therefore, more research is necessary to confirm what these students need to successfully graduate from college. This may be accomplished by investigating the experiences of first-generation STEM majors who are persisting and being retained by their institution.

**Purpose of the Study**

Given the problems noted, the current study sought to better understand the characteristics associated with first-gen STEM majors who are persisting and being retained by their institution. For the purpose of this study, Seidman’s (2005) definition of retention was used: “student attainment of academic and personal goals, regardless of how long the student [was] at the college” (p. 21). At this time, there is not enough information from research to conclude what characteristics, both personal and institutional, aid first-gen students majoring in STEM fields in persistence and retention. There is, however, a considerable amount of data that show the reasons why students associated with being first-generation or a STEM major alone are not being retained. For those who do maneuver through their college coursework and obtain a degree, it is uncertain what characteristics have enabled their persistence and retention having been both first-gen students and STEM majors. There are questions that need to be addressed about what causes these students to keep going.
until they achieve their higher education goals. Even though it is clear what is happening, it is anticipated that this study will answer how and why some students are persisting and being retained by their institutions.

The lack of college student persistence may have a negative effect on the students financially. There is a considerable decrease in income for most students who do not earn a college degree (Schuh, 2005). When fewer students earn STEM degrees, the job market also suffers. Each group has its own setbacks. Combining a STEM major with a first-gen student brings about greater challenges. Research proposes that they are at a disadvantage compared to their peers whose parents have college experience (McCarron & Inkelas, 2006). As a result, first-gen students often cannot claim to possess a true understanding of college. One study that analyzed the number of graduates between 1988 and 2000 found that 44% fewer first-generation students earned a degree, compared to their peers whose parents had a college education (United States Department of Education, 2000). The United States also has a low graduation rate among STEM majors. Researchers have stated that educating adequate STEM graduates to fill job positions is becoming a topic of precedence in the United States (Chen & Soldner, 2013), yet the country is still falling behind in the acquisition of college graduates in the areas of science, technology, engineering, and math (Hearne et al., 2011).

Although institutions of higher education in America have increased access for all students, first-generation college students “represent a common thread” among all institution types “that remains largely unnoticed and poorly understood despite all of the research on students that has emerged in the past decades” (Ward et al., 2012, p. xiii). By understanding the characteristics that enable students to persist and be retained, stakeholders and policymakers can create plans to help first-gen STEM students move through college with greater confidence and ease. Successful degree attainment may also result in a better financial future for those students who are from low-income backgrounds. It is possible that the results
of this study will help fill the gap that exists in understanding how first-gen students majoring in a STEM field may be more successful in their pursuit of a higher education. First-generation students will benefit from this study by helping them understand what pre-college steps should be taken to prepare them for the transition from high school student to college student. It will also help them understand the critical need for academic and social integration in college that will aid in their persistence.

Significance of the Study

According to Harackiewicz et.al. (2014), many of the students who enter college as science majors do not continue in that major because they experience difficulties as early as freshman biology. They also have reported that almost 20% of college students are considered first-generation, yet past research has failed to recognize the characteristics associated with persistence and retention among first-gen STEM majors. Several researchers have acknowledged that first-gen students are at-risk (Bowen, Kurzweil, & Tobin, 2005; Saenz, Hurtado, Barrera, Wolf, & Yeung, 2007) because they tend to depart from their initial aspirations of college (Sirin, 2005).

It is anticipated that the results of this study will provide clearer perceptions of the characteristics associated with the persistence and retention of first-generation college students who are also STEM majors. It is also desired that this information helps other researchers, faculty, and institutional policymakers make more informed decisions about ways to support STEM majors who are first-generation students. Although there is a plethora of information about student retention, there is very little that highlights specific problems faced by this unique group of students, as well as what allows them to succeed. Finally, this investigation may provide potential first-gen STEM majors information about how to prepare for college and persist to graduation.
Research Questions

This study focuses on one overarching question pertaining to first-generation students who are STEM majors. This is also supported by other questions that may provide information needed to understand the phenomenon of persistence and retention among first-generation college STEM majors. These questions are designed to help describe precisely what the study will endeavor to determine (Maxwell, 2005).

Q. How do first-generation college STEM majors persist in spite of the obstacles they face?

Sub-Questions:

1.1 How do you feel your personal beliefs about higher education help with persistence?
   a. How does personal motivation help you persist?
   b. How does the belief that a higher education will satisfy your personal goals help you persist?

1.2. How do you feel your supporting relationships help your persistence?
   a. How do family members help you persist?
   b. How do your friends help you persist?

1.3. How do you feel your high school experiences have helped you persist?
   a. How did academic courses help your persistence?
   b. How did your high school counselors or teachers play a role in your persistence?

1.4. How do you feel your institution contributes to your persistence?
   a. How have faculty members helped in your persistence and retention?
   b. How have institutional resources helped you persist?
   c. How has your involvement in the institution helped you persist?
   d. How has financial aid helped your persistence?
Summary

This dissertation is presented in five chapters. Chapter one states the problem which is the lack of persistence and retention among first-generation college students and STEM majors. Research questions used to investigate the problem are presented. The first chapter also includes the purpose and significance of the study. The purpose was to investigate the characteristics that enable first-generation STEM majors to persist and be retained by their institution. The study is significant because there is not enough known about first-gen STEM major persistence and retention characteristics to know how to aid this unique group. By understanding why and how some first-gen STEM majors persist and are retained, those who struggle may be offered more support before and during college, especially students belonging to underrepresented groups. Chapter two includes a literature review of first-generation college students in addition to research on science, technology, engineering, and math (STEM) majors. The second chapter also contains an explanation of the theoretical framework used - Tinto’s Theory of Individual Departure (1987). Chapter three explains the methodology used, which includes the research design, research questions, procedures for data collection, researcher bias, and data analysis. The fourth chapter presents the results from the study. Finally, chapter five summarizes the findings and results from the study, as well as offers recommendations for practitioners and suggestions for future research.
CHAPTER II
REVIEW OF THE LITERATURE

Following World War II, there was a rise in the economy in the United States that allowed those who were not considered wealthy the opportunity to attend college. This was partially due to the implementation of the GI Bill in 1944 (Greenberg, 2004). Although the higher education doors have swung open for women, minorities, and those with disabilities, more work needs to be done to better understand how to help all students succeed in college (Kuh et al., 2010). One such student group that needs consideration when discussing college retention is that of first-generation (first-gen) college students, often referred to as those whose parents did not earn a college degree (Hand & Payne, 2008). First-gen students are often associated with groups that have not been widely represented, such as racial minorities (Ward, Siegel, & Davenport, 2012).

Identifying first-generation college students may be difficult for some colleges and universities (Packard, 2016). There are a couple of ways in which they might know who does and does not fit into this category. The student could disclose the information stating his or her status as an FGC student, but the institution does not know if the information is true. To be absolutely certain, the parents of the student must provide valid documentation that they did not earn a college degree (Davis, 2010). What is next for the institution? Identifying first-gen students may be one step toward ensuring that these students get what they need to succeed (Packard, 2016) because more of them are dropping out before they can earn a degree (United States Department of Education, 2000).

According to a report from the American Institute for Research, almost 50% of United States college students do not persist to graduation by the end of their sixth year (Velez,
The problem is even more noticeable among first-gen students (Choy, 2001) with only 11% graduating (Engle & Tinto, 2008). Unfortunately, these students deal with obstacles that non-first-generation students often do not (Jehangir, 2010). They may begin their journeys as highly motivated individuals then find themselves attempting to keep their heads above water. In some cases, these students may even possess symptoms of sadness or isolation (Lippincott & German, 2007). They are likely not experiencing college in the same way as other students. Many colleges are aware that first-gen students need more assistance with fitting in; however, there are cases in which these students manage college life well and are not probable drop-outs (Lohfink & Paulsen, 2005).

The evidence is apparent that there is a problem with persistence and retention among first-gen college students. Several features have been recognized that may be the cause for this conflict: lack of parental understanding of college, insufficient high school counseling, academic deficiency, and lack of college information or funding. For instance, a parent who does not have any personal college experience is not capable of mentoring his or her child about college situations and is often hesitant about his child going to college. Students whose parents attended college may provide valuable advice for their children about how to succeed (Schultz, 2004). Some potential college students attend high schools in which proper counseling for college is not available or they do not have peers with similar aspirations of college from whom they can seek support. With support systems in place prior to college, students may be more likely to persist (Capriccioso, 2014). High school also provides critical academic preparation. It has been confirmed that first-gen students often are not academically prepared for college because they do not take high school classes that are more challenging, especially in math and science (Choy, 2001). In some cases, students are not offered advanced courses, especially in low-socioeconomic areas. Students who fall into the low socioeconomic category and are first-gen students tend to have a desire that is equivalent to
their peers who are in higher income brackets. Despite this, many do not have the resources necessary to find the right college or know how to pay for their education. Having such odds against them, some first-gen students are disadvantaged even before they set foot onto a college campus (Ward et al., 2012).

Similar obstacles have emerged with students majoring in science, technology, engineering, or math (STEM). Two factors are often noted as reasons for the lack of STEM major retention: difficulty in managing the demands of the courses and inefficacy (Byars-Winston et al., 2008). STEM fields have had a major impact on our nation since World War II. The United States economy and defense system experienced a great advantage when citizens received widespread education at that time (Davis, 2010). Since then a high attrition rate among STEM (science, technology, engineering, and math) majors has developed. This is an issue known worldwide but seems to trend more within the United States (National Science Board, 2010). It has been predicted that the greatest increase in future jobs will be associated with science, technology, engineering, and math (STEM), which require a higher education (Carnevale, Smith, & Strohl, 2010).

The following literature introduces research that has been published in the areas of attrition, persistence, and retention among first-generation college students and science, technology, engineering, and math (STEM) majors, and includes some factors that may affect their success. Definitions of first-generation college student are considered, along with a discussion about why these students attend college despite their many set-backs. The following characteristics that possibly affect persistence and retention are addressed: parental education, marginalization, lack of academic preparation, guidance, institution types, and engagement. The literature on first-gen students will proceed with findings on STEM majors. A lack of STEM majors in the United States begins the discussion that leads into possible predictors of STEM retention; followed by institutional influence on STEM majors, which
includes effects of student/faculty relationships, and resource access. Finally, theories are presented that consider student departure and student involvement as potential explanations for student persistence and retention or lack thereof.

**First-Generation College Students**

Several definitions have been used to explain the meaning of a first-generation college student (Lightweis, 2014; Stebleton & Soria, 2012). Collier and Morgan (2008) define first-generation college students as those students whose parents did not receive a higher education at a four-year institution. Other sources may include those students whose parents did not attend college at all or did not finish their college education (I’m first: College is my opportunity, 2014). It is still unclear how to define first-gen students, which has led Davis (2010) to posit the use of various definitions. The problem is that when specific groups are not well understood, they stand the chance of being ignored (Lohfink & Paulsen, 2005). Regardless of how they are defined, research proposes that these students experience more obstacles than college students whose parents had practical knowledge of college (I’m first: College is my opportunity, 2014).

Some characteristics that have been noted more often in first-gen students than their non-first-generation counterparts is that they are usually non-traditional in age, are of a racial minority and/or non-English speaking, are not dependent upon their parents for funds, are single parents, and are disabled in some way (Bui, 2002). First-gen students are also typically less prepared academically and most often must work to pay for college and living expenses (Jehangir, 2010). However, assuming that all first-gen students come from low-income families leaves out a very important group, those belonging to white middle-class America (Ward et al., 2012). Therefore, university professionals should not associate all of the difficulties first-gen students experience with that of low-income status because they do not all belong to a specific socioeconomic category (Davis, 2010).
Engle and Tinto (2008) noted that it is much more probable that first-gen students who are also of low socioeconomic status will stray away from their institution after only one year. Although the majority of first-gen students are considered underrepresented (women, minorities, and disabled), many others do not fall into these categories (Davis, 2010). First-gen students are being recognized as a group that is in need of assistance (Ward et al., 2012) because they are considered an at-risk group for failure of completion (Engle & Tinto, 2008).

First-generation college students comprise a considerable number of students in American higher education. Between the years of 1992 and 2000, 22% - 46% of college students enrolled in the United States were first-generation (Choy, 2001). This number varies depending on how the term first-generation college student is defined. When referring to students whose parents did not attend an institution of higher education, the number may be much lower than if the definition includes students whose parents attended college but did not earn a college degree. Regardless of how the definition fits, the needs of these students may be ignored by some institutions (Hand & Payne, 2008). For the purpose of this study, a first-generation college student will be considered if his or her parents did not earn a degree (Hand & Payne, 2008), thus allowing the inclusion of participants who have not benefited from parental experience in college persistence.

**Reasons for Attending College.**

Most students enter college with intentions of earning a degree; however, some do not anticipate the same outcome (Polinsky, 2003). Some college students begin courses at one institution with the determination to finish their college education at another institution (Tinto, 2012a & b). First-generation college students attend college for many reasons, as well. One example may be their wish to overcome the trials or struggles they have experienced in their families due to lack of education. Some may even choose to attend college because they have personal goals and want to prove to themselves or their families
that they can be successful in higher education (Ward et al., 2012). The college experience may be a new concept in the families of first-gen freshmen, but something drives them to engage in that experience. Many of these students tend to perceive their college education as a means of bettering themselves financially (Prospero & Vohra-Gupta, 2007). When college students are not successful, there tends to be a negative impact on their personal income; college students who do not graduate typically earn less money (Schuh, 2005; Seidman, 2009). According to the Association of American Colleges and Universities (2007), a higher education is the prerequisite for financial independence in such an evolving global economic system.

**Parental Education.**

A college student’s achievement may correlate with the parent’s level of education (United States Department of Education, 2000) (See Appendix D). It has been discovered that a parent’s lack of higher education may have a negative effect on the outcome of his or her child’s higher education experience. If parents attended college for only a short time, they are not likely to understand the need for their child to spend time connecting with their institution (Shultz, 2004). According to Oldfield (2007), these students often do not know how to exist in the culture to which they are accustomed while involving themselves in their new culture of higher education. They enter the realm of higher education with little to no prior experience upon which to base this new learning arena (Ward et al., 2012). Parents who did not attend college do not have personal knowledge to share concerning the processes of admission, coursework, and responsibilities (Bourdieu, 1973). This can cause confusion about how to be an active participant in the college culture (Stebleton & Soria, 2012).

First-generation college students lack what is known as cultural capital. This term was initially used in 1973 by Bourdieu in describing the levels of education obtained by individuals from various socioeconomic backgrounds. According to Bourdieu (1973), parents
who have had experience in college channel information about college life to their children. This may help prepare them for their own college experience. On the other hand, students whose parents did not attend college for a considerable length of time do not have the advantage of learning about the details of college from their parents that may be critical to a new college student (McCarron & Inkelas, 2006). They may receive verbal, or even monetary, support from their parents, but they do not understand the steps needed to proceed through college and be successful. Instead, first-gen students must rely on high school counselors, teachers, and student services to help them find their way. Even the application process can be a challenge for first generation college students. Also, students whose parents did not attend college may not possess the motivation or aspirations to earn a higher education. This is especially so if the parents do not view higher education as necessary for sustainability (Ward et al., 2012). It is more probable these parents do not understand the importance of student involvement in their college success (Murphy & Hicks, 2006). Not knowing the institution’s expectations of them as a college student can be a daunting experience. Students who do not know how to travel those critical avenues in finding help for various reasons are more likely to drop out (Kuh et al., 2012).

**Marginalization.**

First-generation college students are “frequently marginalized on their campuses, treated with benign disregard, and placed at a competitive disadvantage because of their invisibility” (Ward et al., 2012, p. xiii). Some ethnic groups, such as Hispanics and African-Americans, are often marginalized; first-generation college students typically deal with this as well (Hand & Payne, 2008). In comparison to their non-first-generation peers, first-gen students often lack important pre-college resources that help them mentally prepare for the college experience. They are often unique regarding grade point average (GPA), the amount of academic preparation, and socioeconomic status (Ward et al., 2012). Students who belong
to populations that have often been overlooked in higher education do not typically engage themselves in more intense academic circles such as group study sessions and freshman orientation classes. When the social aspect of higher education is taken out of the picture, students miss out on opportunities to form valuable relationships (Kuh, 2008). This may have an impact on first-gen student persistence and retention.

Many researchers have associated first-gen students with racial minorities (Davis, 2010); however, white middle-class students dominate the first-gen student numbers. Because white middle-class students are not usually expected to be labeled as first-generation, they may be camouflaged in higher education discussions (Stuber, 2011). Although they are not considered underrepresented in terms of socioeconomic status, white middle-class first-gen students experience some of the same deterrents to graduation as college students from a lower socioeconomic backgrounds. Therefore, the success of first-generation college students is a concern associated with a diverse group of individuals (Forbus, Newhold, & Mehta, 2011.)

**Lack of Academic Preparation.**

When it comes to preparing for college, first-gen students are at a disadvantage compared to their non-first-generation peers in that most do not grasp what is required of them academically (Stebleton & Soria, 2012). Many lack the education needed to get them ready for freshman courses and may benefit from tutoring (Padron, 1992). In low socioeconomic areas, where educational resources are not available, students who aspire to go to college may not have upper level or advanced placement (AP) courses to help them develop skills to aid them in college (Pascarella et al., 2004) or may not have teachers who are trained to teach critical problem-solving skills (Ward et al., 2012). Even when AP courses are available, these students tend to shy away from them (Pascarella et al., 2004). Some have
the motivation and aspiration to attend college, but potentially lack the cognitive abilities to manage college courses (Ward et al., 2012).

First-generation college students have self-reported having poor English and mathematics skills, as well a lack of study skills (Stebleton & Soria, 2012). For this reason, first-gen students are more likely to require remedial courses (Jenkins, Miyazaki, & Janosik, 2009). The number of students who are being remediated at the secondary level has been reduced; however, those students who expect they will require extra academic help in college has been consistent for the past three years (Eagan, Stolzenberg, Bates, Aragon, Suchard, & Rios-Aguilar, 2016). First-gen students do not usually possess a great deal of confidence in their preparedness for college or their capabilities and often do not ask for assistance from their professors (Jenkins, Miyazaki, & Janosik, 2009). Furthermore, when they are at more expansive research universities, the problem is magnified by large class sizes and faculty unavailability (Kim, 2009).

Guidance.

First-generation college students are not a rare group (Ward et al., 2012). Nevertheless, these students are at a disadvantage compared to their non-first-generation peers due to challenges that are sometimes difficult to overcome (Jehangir, 2010). Keeping these students in college is an ongoing problem even though some progress has been made by colleges and universities (Engle & Tinto, 2008; Pascarella et al., 2004). Success for these students is the culmination of many factors - one being guidance. Getting first-gen students enrolled in college is only one step. Once enrolled, they must pass through territory that is uncharted and unfamiliar to them (Ward et al., 2012).

Many first-gen students lack the education needed to get them ready for freshman courses and may benefit from additional counseling (Padron, 1992). Planning for success begins before students ever set foot onto a college campus. High school counselors (Barry,
Hudley, Cho, & Kelly, 2008) and teachers can play a major role in helping first-gen students prepare for their higher education future (Ward et al., 2012). Once there, these students may feel more connected to their institutions when just a single faculty or staff member offers them encouragement. This could be a critical factor in a student’s college retention (Chickering & Gamson, 1987; Heisserer & Parette, 2002). First-gen students are less likely to ask for help (Jenkins et al., 2009) but may respond to an instructor who is more cognizant of the obstacles these students may face (Arendale, 2010). Student support may also include suggestions in the management of financial and academic responsibilities. On the other hand, faculty members may be less able to assist students with psychological problems, making moral decisions, being flexible, and developing other personal effectiveness skills that could aid in their college success (Sternberg, 2013).

**Institution Types.**

It has been documented that most first-generation college students do not enroll in four-year institutions initially (Chen & Carroll, 2005). Instead, community colleges receive the majority of first-gen students. Community colleges serve a diverse population of students: full-time workers, students with families, single parents, non-traditional (older) students, and those with fewer funds for higher education (Byrd & MacDonald, 2005). Their purpose is to assist the people within a community to reach their higher education goals while continuing to maintain their personal responsibilities (Hardy & Katsinas, 1995). Smaller institutions, even those that are four-year institutions, have been found to be a better fit for first-gen students (Byrd & MacDonald, 2005). A 16% difference was discovered between graduates of public 4-year institutions and regional institutions, with 52% of first-gen students graduating (Comparative Alumni Survey, 2003).

Regardless of the institution type in which they enroll, in order for first-gen students to maneuver through college successfully, the institution must be cognizant of their special
needs. Colleges and universities play a major role in the retention of first-generation college students. If these institutions wish to keep their enrollment high, they will find ways to help these students effectually transition from high school into higher education then give them the tools necessary to succeed throughout their college experience (Ward et al., 2012). These students are at a disadvantage over their non-first-generation peers in that they do not know how to access resources or move through the steps required to be a successful college student (Stebelton & Soria, 2012). Although many first-gen students do belong to underrepresented ethnic groups, institutions should be careful not to expect this in every case (Davis, 2010). Stuber (2011) found that since many first-gen students are from white, working-class families, they are often overlooked by institutions; they are viewed as a “racial majority and socioeconomic minority” (p. 120). Whether they are from a racial minority or majority, first-gen students face some of the same hurdles in higher education (Forbus, Newhold, & Mehta, 2011).

**Student Engagement.**

The United States’ student attrition rate is above all other industrialized nations (Harvard Graduate School of Education, 2011). A study involving first-generation college students who began college in 2003 showed that 57% earned a degree within six years (National Association of Independent Colleges and Universities [NAICU], 2011). This study reveals that these students are much more likely to quit than their non-first generation peers. Those who enrolled and had to leave for some time before returning was 30%. According to Engle and Tinto (2008), this trend could very well be linked to their lack of engagement in college life. Most do not involve themselves in study groups, interact with other students or their professors, participate in activities outside of class meetings, or use services designed to support them in their college endeavors.
First-generation college students find it difficult to maneuver through the college materials and the social aspects of the campus. Discovering how to be a college student is a critical part of succeeding (Collier & Morgan, 2008). Since most of these students do not live on campus, they are more physically disconnected from their institution and other college students (Pascarella et al., 2004). When they do not become engaged in their college culture, their chances of being retained to degree completion are greatly reduced (Astin, 1999). In many cases, first-gen students find it difficult to embrace the college culture because they cannot add to their commitments. Kuh (2008) found that academic engagement is lacking among many of them mainly due to other responsibilities that involve work and family. These students also have reported feelings of stress and depression more often than their non-first-generation college peers (Stebleton & Soria, 2012). Not knowing how to fit into one’s institution may lead to negative feelings about the entire college process (Davis, 2010).

College student engagement may be a predictor of student retention (Tinto, 1993). In his model of institutional departure, Tinto emphasized this idea. In 1999, Astin’s student involvement theory surfaced which suggests that students are truly involved in their educational achievement when they are physically and mentally engaged in the process of the college experience. He further proposed that institutions should pay less attention to how and what is being taught and more attention to how students are connecting to the institution. This idea is not new to the literature when considering student achievement. According to Kuh (2008), the design of the college campus environment can have a positive impact on a student’s ability to connect with his or her institution. When the learning environment feels welcoming, it allows students to embrace their place in that setting. They may, therefore, embrace their college culture and become more engaged. Underrepresented students, such as first-generation, tend to be more successful when they feel as though they belong at their institution (Packard, 2016).
Science, Technology, Engineering, and Math Majors

There is concern that students in the United States are not prepared for STEM fields that meet the demands of the nation and the world (Purnamasari, 2012), lagging behind nine other countries for the number of college students graduating with degrees in natural sciences and engineering (Hearne et al., 2011). It has been predicted that there will be more job offerings in the future in STEM fields than ever before. Anyone interested in these jobs must first gain special skills and earn a degree (Packard, 2016). According to the results of several studies in recent years, fewer than 50% of students who enter college as STEM majors actually make it to graduation (Higher Education Research Institute, 2010; National Academy of Sciences, 2005; Perna, Lundy-Wagner, Drezner, Gasman, Yoon, Bose, & Gary, 2009; Veenstra, Dey, & Herrin, 2008). Shortfalls in the actual number of successful STEM majors are worthy of investigation (Soldner et al., 2012).

The success of science, technology, engineering, and math (STEM) majors is a concern among both the academic and scientific communities. Established businesses also share this concern (Kuenzi, 2008). In 2005, motivational influences were offered to universities in an effort to increase STEM majors. Although the number of students entering college as STEM majors has increased, the number of graduates in STEM fields has not changed a great deal (Thompson & Bolin, 2011). Fortunately, there are researchers in the United States who are investigating these issues of attrition rates among STEM majors (Higher Education Research Institute, 2010).

In 2009, the Georgia Institute of Technology (Georgia Tech) gained a greater understanding about STEM majors. This institution carefully selects its students based on high school grade point average (GPA), SAT scores, and other application factors. Out of 14,700 applications received in the fall of 2012, only 2,400 students were accepted. From 1999 to 2004, more than 20% of the students who entered Georgia Tech as a STEM major
did not follow through to completion. Almost 16% of the students who did earn a degree during that time had changed their major from a STEM field to one outside of those subject areas. Over a ten-year period, 28% of the students who entered Georgia Tech did not receive a baccalaureate degree. They either changed their major or were not retained (Georgia Institute of Technology, 2012).

Three years later, professors of psychology from Georgia Institute of Technology and Rice University researched the factors that may predict the success of STEM majors at Georgia Institute of Technology. Before beginning the study, statistics were obtained from the National Center of Education Statistics in 2012 concerning the dropout rate at Title IV institutions. Title IV institutions are those in which students are allowed to receive Pell Grants and other federal programs for college financial aid. According to the statistics, more than 25% of the students who are studying to complete a degree or certificate for the first time are not following through to completion within a six-year period (Ackerman, Kanfer, & Beier, 2012).

With the decline in college graduates in STEM fields to fill job vacancies, finding ways to interest freshman college students to consider STEM fields is a significant issue. Making certain that these students are well-trained for careers that require specific skills is also a concern. Problems sometimes appear early in these students’ college schedules. Following a negative experience in one of their science, technology, engineering, or math (STEM) courses, they often change their majors. (Hearne et al., 2011). The perspectives of college students pursuing STEM degrees regarding the difficulty of courses are not well-documented (Whalen & Shelley, 2010). There is much more evidence focusing on the high school rankings or ACT scores of STEM students and their ability to move through the college coursework. Although there is strong indication that these factors play a role in the persistence of STEM students in college, they may not reveal the whole story behind why
STEM students are retained. Many researchers agree that more investigation is needed concerning the elements that affect the success of students in STEM fields (Thompson & Bolin, 2011).

Around the time of World War I, a college student who would graduate was often predicted by tests that measure intellectual abilities (Ackerman, 1996). Much discussion has led to the possible need to consider other aspects of student success, such as students’ ability to understand and visualize spatial relationships among specific objects as well as the ability to solve mechanical problems (Wai, Lubinski, & Benbow, 2009; Webb, Lubinski, & Benbow, 2007). According to Ellingson and McFarland (2011), there is an accuracy issue when self-report instruments are used to determine college admissions. However, these instruments might aid in identifying students who are at-risk for attrition so the institution may find ways to help them reach their academic goals (Kahn, Nauta, Gailbreath, Tipps, & Chartrand, 2002).

**Predictors of STEM Major Retention.**

There are many factors to be considered when discussing STEM major retention. Although there has not been a great deal of research in the area of STEM retention, it has been indicated that students who continue to move forward as STEM majors have the motivation to succeed for personal or financial reasons. Some students are driven to complete a degree in a STEM field to earn a higher salary. Support from family, peers, or college faculty may also make a strong motivational impact to persist in a STEM major. Before a student ever sets foot on a college campus, his success in high school courses paves the way for future courses. More rigorous high school science, technology, engineering, and math courses better prepare college STEM majors for the more demanding college classes. Students who are exposed to more hands-on laboratory experiences tend to make connections
and successfully complete the goals of the course, thus aiding in overall college success (Erbes, 2008).

Intelligence is often used as a measurement tool for predicting success in STEM courses (Ackerman & Kanfer, 2005). Retaining math and science majors, specifically, may be correlated with where students are ranked in high school, along with their scores in reading and math on the ACT (Scott, Tolson, & Huang, 2009). Colleges holding onto STEM majors may be the result of all of the above factors or only one. Each case is not one-size-fits-all. According to Ackerman and Kanfer (2005), there is a greater prediction of student retention when multiple traits are considered together, rather than isolating one specific trait.

The best means of predicting the successful retention of students has been an ongoing debate. From aptitude tests that focus on verbal and mathematical abilities to tests that consider student abilities beyond aptitude, researchers have attempted to solve the mystery of what pushes a student to be successful. It has been suggested that spatial abilities should be considered when predicting the success of STEM majors. Spatial abilities involve the perception of how objects are related by their size and shape and how they are positioned. Mechanical knowledge and reasoning skills may also be indicators of success in STEM fields (Ackerman et al., 2012).

Studies relating to STEM majors have revealed possible predictors of retention. Some of the characteristics considered have been gender, demographics, class rank, and ACT scores. Two particular studies involved students at large research institutions (Thompson & Bolin, 2011; Whalen & Shelley, 2010). STEM major retention was the focus of research conducted at a large public institution in Texas. This seven-year study included data on “gender, ethnicity, country of origin, and high school ranking” (Thompson & Bolin, 2011, p. 19). It also sought to ascertain how many students depart from college, change majors, and earn a degree. The three most declared majors at this university were used in the analysis of
student retention: science, technology, engineering, or math (STEM); business; and education. The researchers found that many students who change their majors from STEM to other majors typically moved into business or education. It was concluded that more students who enter college as a STEM major switch to some other major as compared to those who declare business and education majors (Thompson & Bolin, 2011).

Unfortunately, there were many STEM majors who dropped out of college by the end of the seven-year study. High school ranking proved to be a significant indicator of success of STEM majors in this study and whether they changed majors or dropped out completely. As the high school ranking decreased, the drop-out rate increased. In contrast, the percentage of students who switched majors decreased, as did the percentage of students who graduated. The greatest number of drop-outs occurred during the first year. The second and third years had significantly fewer. Then, a change is noted in the subsequent years as the drop-out rate increased slowly (Thompson & Bolin, 2011).

A correlation was recognized between ethnicity and students graduating with STEM majors. The Thompson and Bolin (2011) study found that the Asian population had twice as many STEM graduates (34%) as whites (17%), while only 12% were African-American and 11% were Hispanic. Although this study does not consider first-generation college (FGC) students, it does pave the way for considering the success of minority students, who could quite possibly fit into the category of first-generation. This in no way means that all African-Americans and Hispanics are also first-gen students. For reasons to be determined, STEM majors are entering college with a desire for careers in science, technology, engineering, or math then change to other areas of concentration such as business or education (Thompson & Bolin, 2011).

Another study conducted by Whalen and Shelley (2010) examined retention and graduation rates among freshmen enrolled in a “Midwestern research university with very
high research activity as defined by the Carnegie Foundation for the Advancement of Teaching” (p. 47). This quantitative study set out to determine which factors could predict the retention and graduation of STEM majors (48% of the participants) versus non-STEM majors. The factors taken into consideration included gender, demographics, grades, and student aptitude. It also considered the likelihood of underrepresented students (females and minorities) in science, technology, engineering, or math (STEM) majors to be retained in comparison to those not in that category.

This study focused on the use of Astin’s (1993) I-E-O model, which includes elements such as input, environment, and output. His model includes characteristics like gender, ethnicity, residency (in or out of state), language credits received in high school, student rank in high school, and ACT scores. There are also environmental factors to be considered in using this model.

As an extension of Astin’s (1993) model, Whalen and Shelley (2010) examined factors such as length of on-campus residency, learning community activity, loans and gifts received, work study aid, average need budgeted, and major while at this university. Based on the variables analyzed, grade point average (GPA) was the greatest predictor of retention and graduation. The probability of retaining male, non-minority, students was 74.6%; whereas females and minority STEM majors had the least probability of being retained. Out-of-state students were retained less frequently at only 47.2% than in-state students, as were students who lived off campus. Whalen and Shelley (2010) attribute this to the lack of social integration for those not living on campus. Furthermore, the degree of financial aid received was a predictor of retention; with work-study aid having the most impact (Whalen & Shelley, 2010). This is probably because it combines institutional support with the students’ financial needs (Pascarella & Terenzini, 2005).
As a result of this study, Whalen and Shelley (2010) addressed the need for more qualitative research to discover other elements that result in inadequate retention among STEM majors. They suggest implementing better counseling and planning for students expecting to be STEM majors as early as middle school. This will enable students to be placed in courses that will give them the skills needed to prepare for entry into STEM courses in college. It will also allow counselors and teachers to gauge the progress of students to check for possible lack of critical cognitive abilities. Whalen and Shelley (2010) also suggest utilizing transition programs from high school to college. Such programs may increase the likelihood that females and minorities become STEM majors and are retained to graduation.

Even with the many studies in student retention, according to Ackerman, Kanfer, and Beier (2012), there has not been enough progress in the development of psychological tests that might enable future college students to know if STEM fields are suited for them. One way to determine who is likely to become a STEM major is to look at the parent’s career in a STEM field (Takruki-Rizk, Jenson, & Booth, 2008). Although interest in a subject is an indication of a student’s intended major, it does not ensure retention (Packard, 2016).

**Student/Faculty Relationships.**

Reform in STEM undergraduate instruction is greatly needed. Fortunately, United States educators and those who impact public policy have become more attentive to selecting and retaining students in the areas of science, technology, engineering, and math (STEM) (Baskin, 2012). Institutional support for STEM majors has proven to have a big impact on student success (Pascarella & Terenzini, 2005). This type of support may include the implementation of upperclassmen as peer tutors to provide support to freshman students when faculty members are not available (Budny, Cheryl, & Beth, 2010). Forming the foundation of institutional support are its professors (Pascarella & Terenzini, 2005). Faculty mentoring programs have proven to positively impact student motivation and increase the
interactions students have with professors who acknowledge and value their interests (Griffin, Perez, Holmes, & Mayo, 2010). Positive student-faculty relationships have shown to be contributory to STEM student retention. This idea was illuminated by a survey developed by Wilson, Ryan, and Pugh (2010) that recognizes the attributes that distinguish positive student-faculty relationships. College students agree that they are more likely to ask questions when the instructors are approachable. There may be evidence that positive student-instructor relationships have an effect on retention of STEM majors; however, there is a lack of research for how to alter the ideas of professors in science, technology, engineering, and math concerning their role in student retention (Hong & Shull, 2010). Fortunately, a professor whose concentration is in science is capable of appreciating advice offered by research evidence (Christe, 2013). With this being said, college professors may be the link to what improves STEM major retention (Wilson, Ryan, & Pugh, 2010).

Perry (1970) recognized the importance of positive student-faculty relationships. He formulated the Cognitive Development Theory, which includes the need for students to have instructors that are more supportive and encouraging toward them in order to increase in student achievement. As a part of his Persistence Theory, Tinto (1993) suggested that when instructors and students interact in positive ways in the classroom, as well as outside the classroom, important links are made between the social and academic aspects of college life. Members of an institution’s faculty can be very positive links to student success in how they instruct and support their students (Pascarella & Terenzini, 2005). By improving the relationships between students and faculty, there is evidence that students in STEM fields are more likely to complete a degree program. A correlation has also been discovered between student grade point average and the students’ feelings toward their instructors. As a result, it is suggested that instructors should be accessible to offer student support (Vogt, 2008).
Student attrition among STEM majors may be attributed to many issues. However, instructors may play a role in solving the STEM retention problem. Some college science instructors view student attrition as a consequence of weak students unable to handle the demands of the course. These professors intimidate students entering their classroom by promoting an intensive level of difficulty that is expected to ultimately produce the most outstanding professionals in science and engineering (Micari & Pazos, 2012). This weeding out process appears to be affecting even the STEM students who are considered exceptional students. Statistics are showing that these students are leaving the STEM fields as often as those who are less prepared in science, technology, engineering, and math (Eris et al., 2010; Marra, Rodgers, Shen, & Bogue, 2012; Wagner, Christe, & Fernandez, 2012). When students from underrepresented groups are not expected to perform well in a STEM course, they feel they do not belong there. However, when instructors embrace the belief that these students can grow cognitively, they are not setting them up for failure (Packard, 2016). Studies have suggested that STEM students are more successful when instructors “connect to their students, offering a supportive and warm learning environment” (Christe, 2013, p. 25).

Although research results indicate that interactions between students and faculty members are critical to student success, many faculty members do not grasp the influence they have on their students (Micari & Pazos, 2012). Many of the professors who teach STEM (science, technology, engineering, and math) courses are greatly respected for their work but have a deficit in nurturing meaningful relationships with their students (Kokkelenberg & Sinha, 2010). So much emphasis is being placed on teaching pedagogy, while very little emphasis is being placed on the issue of student involvement (Rodgers & Marra, 2012). There are inadequate connections between the STEM instructors and their students. Many instructors do not recognize that there is a problem at all (Mastascusa, Snyder, & Hoyt, 2011). Due to
this lack of understanding, STEM instructors may be inadvertently adding to the problem of STEM major attrition (Christe, 2013).

Both quantitative and qualitative studies have offered greater understanding of how students perceive positive relationships with instructors and their own success. However, it is the qualitative studies that have revealed the true link between STEM student success and faculty relationships (Suresh, 2006). These students have disclosed how their attitudes about their instructors affect their ability to learn and be successful (Christe, 2013). Suresh (2006) discovered that the engineering students he interviewed felt that their professors were trying to take out the weak students by making the courses excessively difficult. A later study by Hong and Shull (2010) revealed that many students described their professors as callous, humiliating, insulting, and antagonistic, and showed little concern for their learning. Only a few professors were perceived as caring and encouraging. There is an obvious problem remaining in many institutions due to insufficient understanding or lack of support (Christe, 2013).

Institutions are being advised to encourage their faculty members to understand their vital role in retaining students to promote necessary change (Powers, 2004). Discerning how to manage the responsibilities of teaching and research with time needed to aid student success seems to hinder the development of relationships between instructors and STEM students (Christe, 2013). Instructor support may go beyond that of the subjects they teach. Faculty members could have an impact on student retention by supporting achievements and helping students feel integrated with their campus, such as helping them understand their roles as college students (Sternberg, 2013). When STEM students see their instructors as mentors, they are more inclined to persist (Packard, 2005).
Resource Access.

Science, technology, engineering, and math (STEM) courses often require laboratory components. This aspect of STEM education is costly. Although some programs have been offered funds for labs, schools with a lack of resources still exist (Erbes, 2008). College students who were educated in a community that lacks resources (Purnamasari, 2012) may unconsciously adopt a sensitivity construct by comparing themselves to those who have received more equity (Bess & Dee, 2012). They often have fewer opportunities to take higher level courses in high school. There are also not enough teachers trained to teach the more advanced high school STEM courses. Regarding preparedness, a student may enter college with the idea that he or she is not capable of meeting the expectations of a course when no prior knowledge or experience has been gained during her high school years (Purnamasari, 2012). In such cases, this student is likely at risk of failure, changing her major, or dropping out of college. On the other hand, when low-income first-gen students are given opportunities to learn in environments supporting STEM fields, their self-confidence tends to elevate, possibly aiding in setting goals pertaining to STEM careers (Packard, 2016).

In order to incorporate laboratory experiences, funding for supplies is a necessary commodity. Erbes (2008) found that there was a gain in critical connections when The National Science Foundation provided funds to increase student involvement in laboratory settings with a focus on STEM. This type of experience allows undergraduate STEM students to immerse themselves in research design, data collection, and analysis with scientists who share their interests. The results of programs like this have affirmed the benefits to retention of STEM majors (Eagan et al., 2010).

College Student Persistence

Higher education researchers have often debated about the meaning of persistence and how it relates to the retention of college students. In the 1990s, it was recognized that even
though students sometimes moved from one institution to another to satisfy their higher education goals, they were still persisting toward those goals as long as they remained enrolled (Berger, Ramirez, & Lyons, 2012). Therefore, persistence may be viewed as a student’s ability to be successful in earning a degree (Hagadorn, 2012).

The characteristics that allow students to persist in college from one year to the next may vary depending on the individual. The motivation to earn a degree is often a very personal thing, especially for students who are first in their families to venture down the road of higher education. In order for students to remain in college, they must be satisfied with their experience (Davis, 2012). Even though persistence is more associated with a student’s success, the institution may also play a role in this success. Bean’s (1983) research found that there was a correlation between a student’s satisfaction with his institution and persistence. Being content with his college as an organization and recognizing the benefits of his participation in it may have an effect on a student’s persistence.

Previous studies have shown that certain institutional characteristics may be associated with persistence. Institution type, size of the institution, the cost of attendance, and selectivity have all been recognized as having a connection with persistence (Astin, 1993; McClelland, 1990; Smith, 1990). Smaller private institutions that are selective in their student acceptance have a positive impact on degree attainment. Berger (2000) also found that students who feel comfortable with their campus climate possess a greater desire to keep moving forward.

Other aspects of college life may impact persistence, such as where the student lives. Persistence has been linked to students living on campus (Pike & Kuh, 2005). It is suspected that they are more connected to their institutions when they are living on campus, as opposed to an apartment or living at home. On-campus housing allows students to be closer to their classes and student activities. The majority of first-generation college students are not
inclined to live on campus but would rather live at home (Warburton, Bugarin, & Nunez, 2001).

Persisting in college may begin long before setting foot on campus. A student’s high school academic experience may be one of the most crucial elements in completing a degree (Adelman, 1999). According to Astin and Oseguera (2012), a student’s high school grade point average (GPA) is one of the most convincing predictors of college persistence. Not only do students having high GPAs tend to have more confidence, but they also are more inclined to receive scholarships and be accepted by selective institutions. First-generation college students do not typically have a strong GPA while in high school if their aspirations for college are low or nonexistent (Choy, 2001). If they do decide to go to college, most first-gen students choose community colleges (Chen & Carroll, 2005; Choy, 2001). These institutions are more suited for students who have not been well-prepared academically, also providing courses to remediate any academic weaknesses (Byrd & MacDonald, 2005; Choy, 2001; Padron, 1992).

Preparing for college goes far beyond applying for and being accepted by an institution of choice. How a student perceives and anticipates the college experience can have an effect on her ability to persist. Unrealistic expectations about life in college may backfire into confusion and dismay (Davis, 2012). This is especially so for first-gen students. They often do not know how to prepare for college unless they have been given guidance well before they graduate from high school. Having preconceived notions about college that are not realistic may lead to a lack of academic achievement and social integration (Tinto, 1993). Whether first-gen or not, college students must figure out how to manage all the aspects of college life in order to persist (Pascarella, Pierson, Wolniak, & Terenzini, 2004).

College students majoring in STEM fields may attribute their persistence to characteristics other than those previously mentioned. Packard (2016) concluded that three...
specific factors are associated with STEM major persistence. She recognized these factors as the student’s learning capability, interest in his field of study, and his sense of belonging. Each characteristic adds a dimension to the student’s higher education experience that increases the chances for persistence.

How well STEM students perform in their courses may be evidence of their ability to persist in their major. There is, however, a problem when student knowledge is based on multiple-choice tests alone (Stanger-Hall, 2012). Instead of offering special STEM preparation courses to high achievers only, students who lack skills in STEM areas may benefit from the chances to increase their skills (Wilson et al., 2012). This idea follows the conceptualization that people are not born with all abilities, but they are capable of developing abilities with the right guidance, also known as growth mind-set (Dweck, 2006). STEM majors who have confidence that they can learn tasks in their chosen field may affect their intellectual abilities. They must be given opportunities to build their confidence while also building their knowledge base (Lint, Brown, & Hackett, 1994).

STEM majors who are interested in their courses, yet find them challenging, are more likely to persist (Csikszentmihalyi, 2008). When courses contain an enormous amount of information with little application, students tend to lose interest (Crowe, Dirks, & Wenderoth, 2008). “Active learning practices, whether they involve asking provocative questions, engaging in peer debate, or undertaking challenging projects and research, can make a difference in not only engagement but also student comprehension and mastery of the subject matter” (Packard, 2016, p. 12). Student engagement among STEM majors is critical to their persistence. Summer research programs that last for several weeks may provide the link some STEM students need to retain interest and gain much-needed skills (Gibson & Bruno, 2014).

Making connections with other STEM majors while gaining skills may be another very important aspect of persistence for these students. STEM majors who feel like they
belong in their chosen major are more likely to persist. They realize a purpose in acquiring a STEM degree that will enable them to enjoy a career that is intriguing to them (Good, Rattan, & Dweck, 2012). Students who are first-generation or come from low-income families may find it difficult to feel like they do not fit in with the other STEM students who are not required to work and have more time to congregate (Wilson & Wilson, 2013). The absence of one or more of the characteristics associated with STEM persistence may lead to barriers that students cannot overcome without help from others (Packard, 2016).

**College Student Retention**

The term “retention” is often associated with an institution’s ability to move its students through to graduation; but ultimately, it is more about *how* these students get to graduation. Higher education in the United States began with the establishment of Harvard University in 1636; however, more has been discovered about the issue of the lack of student retention in higher education for only about the last forty years (Braxton, Doyle, Hartley, Hirschy, Jones, & McLendon, 2014). In the beginning of higher education in America, there was no concern about retention (Berger & Lyon, 2005). The first study on the subject was conducted in the 1930s, despite the fact that colleges had been in operation for almost 400 years. Retention was not even recognized as a critical issue until the 1970s, when student enrollment became a concern (Berger & Lyon, 2005).

In the decades that followed, more research was carried out due to an expected decline in college students of usual college age; i.e 18-24 (Tinto, 1987). With an increase in student diversity came new issues about student needs (Maldonado, Rhoads, & Buenavista, 2005). Finding what may be offered to these students to ensure their success has become an increasing concern for many institutions (Astin, 1990). This is especially true for first-generation college students. Retaining these students is an issue that has captured the attention of higher education researchers in the past few years, but there has not been enough
institutional action to realize a great deal of change in the number of students graduating from college (Tinto, 2012a).

Students who fit the description of first-generation have more difficulty entering the world of higher education. For those students who do find their way, many do not persist and are not retained by their institutions (Horn & Nuñez 2000; Nuñez & Cuccaro-Alamin 1998; Warburton, Bugarin, and Nuñez 2001). They begin college with special needs mainly due to the lack of tools needed to succeed in such a foreign environment (Engle, Bermeo, & O’Brien, 2006; Forbus, Newhold, & Mehta, 2011). Remaining in college continues to be a challenge for many FGC students. They are much more likely to drop courses that are causing them difficulty than take them again. They also tend to have lower than average grades and are more likely to need remediation (Chen & Carroll, 2005). It has been noted that as little as 10% of the students who take remedial courses persist to earn a college degree (Pulley, 2008). With this in mind, the purpose behind student services needs to change somewhat from what it used to be. Students are no longer planted onto campuses and expected to traverse the grounds alone. Many institutions now realize that in order for their students to keep moving forward, it may be necessary to offer certain groups some assistance (Berger, Ramirez, & Lyons, 2012). It does not mean that they are giving them a higher education without the students’ effort. Instead, it is helping students fit into the world of higher education so they can concentrate on learning (Seidman, 2005). Research continues to show that when first-gen students are provided with support they have a greater opportunity to be retained and earn a degree (Chen & Carroll, 2005).

When college students are retained, both the students and the institutions are achieving valuable goals (Tinto, 2012a). The study of college student retention involves research of those students who have entered into higher education and have reached their goals both academically and personally, even though this area of research is often associated
with the institution’s report card (Seidman, 2005). In reality, “year-to-year retention and degree completion serve as markers for college student success” (Braxton et al., 2014, p.1).

The most critical test of retention occurs within the first year of college because more college students drop out by the end of their freshman year. Those students who do progress to their second year have a greater probability of retention. The retention rate continues to increase as they move from one year to the next (Tinto, 2012a).

More than one type of retention exists. The most commonly researched type is institutional retention, which is the number of students who continue to be enrolled "at the same institution from year to year” (Hagedorn, 2005, p.91). Another type focuses on the retention of students within a particular major or discipline. This is usually monitored by individual institutions but not often done on a broader scale. However, due to shortages of graduates in areas like engineering (especially among women and minorities), there is more interest in retention of particular majors (Chesler, Barabino, Bhatia, & Richards-Kortum, 2010; Daempfle, 2003).

Many theories associated with college student retention have been developed since the 1930s. The majority of them concentrate on combining both the social and academic aspects of college life (Astin, 1985; Tinto, 1987). One of the first examples, in 1937, was proposed by John McNeely. His study of student attrition at many institutions was designed to determine how many college students were dropping out and the factors that led to their departure. This study was actually developed by the United States government during the Great Depression to help colleges and universities understand what needed to be changed to help students prepare for the workforce. McNeely generated two terms associated with student departure: gross mortality and net mortality. Gross mortality refers to students who drop out of college during their predicted four-year degree attainment but return to complete at a later time. On the other hand, net mortality is associated with those students who drop out
of college but never return. In his study of eleven private and fourteen public institutions, McNeely found that the private institutions were less likely to have high rates of gross and net mortality.

McNeely's (1937) study resulted in several discoveries associated with gender, class ranking, student body size, and types of degrees earned. Men returned to college more often than women, even though there were differences noted in the numbers of women and men in the different institutions. Freshmen were more likely to drop out than upperclassmen, and the rate of dropout decreased with each subsequent year. The size of the student body did not have an affect on gross mortality rates; however, more students earned degrees within four years at smaller institutions with fewer students. Students majoring in law experienced less mortality, and those who were in the arts and sciences showed the greatest mortality rates.

As a result of this study, McNeely (1937) attempted to determine which factors played the biggest role in student mortality. His research found a correlation between student mortality and the following factors: student age, distance from home, housing type, and academic achievement. Students who were older were more likely to drop out than the younger students. This is probably due to the extra responsibilities often associated with older students that interfered with their ability to remain in college. Students whose institutions were far from home were more likely to leave. Also, those who were either living at home while in college or in a house with their sorority or fraternity were less likely to drop out than students living in other forms of housing. McNeely discovered that students who were enrolled in courses with nineteen or more hours were less probable to drop out than those who were taking fewer hours. Furthermore, students with a higher grade point average (GPA) stayed in college more often than those with lower GPAs.

Following McNeely, Summerskill (1962) came forward with his insights on college student attrition. He believed that previous college student attrition research was not
producing effective change. Summerskill's ideas focused more on the psychological and sociological aspects of students than others. He recognized certain internal and external factors that motivated students to remain in college. Instead of looking at the institution's productivity and finances, Summerskill believed researchers should consider issues that students face directly; such as personal well-being, family support, social aspects, and financial problems. He was able to influence other researchers to take into consideration the fact that student attrition is multifaceted and should be researched from a more sociological and psychological standpoint.

More than a decade later, Astin (1975) identified several elements that may predict college student retention, labeled as personal and environmental. Personal factors include prior academic achievement, future educational goals, academic preparation, beliefs about college, as well as parental education, student age, and marital status. Two environmental aspects that may have an effect on student retention include where the student resides and job responsibilities. Campus living had a positive effect on students staying in college, as did working on campus part-time. Astin also found a direct correlation between persistence and students with higher grades, better study habits, and a greater drive for earning a degree. He recognized that students who had parents with a degree were more likely to move forward to earn a degree themselves. Furthermore, male students who were married and female students who remained single during college were typically retained, as were students without children.

In 1985, Astin added that student involvement has a positive effect on retention. He emphasized that the amount of involvement was the obligation of the institution as well as the student. The programs and activities offered by an institution may only be as effective as the students who choose to be involved in them. The more involved students are in their institutions, the greater chance they have of being retained to earn a degree.
Continuing his research, Astin (1999) explained that certain behaviors are absolutely necessary for a student to say he is involved. Time is a major component of this theory. According to Astin, when students utilize their time on campus, studying for classes, being involved in college organizations, and connecting with instructors and other students, they are truly involved. At this point Astin is confident that college students are involved. He also emphasized that the quality of time spent closely connected to one's institution is as important as the amount of time involved. Being motivated as a college student is not enough to ensure success. It is, however, these combined aspects of the college experience that enhance learning and individual growth (Astin, 1999).

Other researchers followed Astin with various ideas about what causes students to leave or remain in college (Morrison & Silverman, 2012); then Tinto (1987) came onto the scene with his theory of individual departure. Tinto proposed that students who were more integrated into their college culture, both academically and socially, were more likely to remain in college. This also meant that students must disconnect from their own culture (family, friends, etc.) and form new connections with their college culture in order to become truly integrated. According to Tinto (1987), transition takes longer for students who leave communities that are very different from that of the college community. For example, if a student’s parents did not attend college, they are less likely to have had conversations about the college culture; helping the student be more prepared for the transition (Tinto, 1987). The concordance between the academic expectations of the institution and the student’s academic abilities is an important component of college student success. If students enter college with a lack of preparedness for the rigor of college courses, they are less likely to persist. The interaction with friends from the institution is also an important part of the informal social integration of college students. Formal integration, on the other hand, is associated with involvement in campus clubs and organizations (Tinto, 1987). With increased student
integration comes an increased potential for retention. According to Seidman (2012), Tinto’s academic and social integration model is the most widely accepted of the retention models.

Tinto is well-known for more than one theory associated with persistence and retention (Braxton et al., 2014), one being his Interactionalist Theory of Student Departure (Tinto, 1993). This theory relates to the ability for college students to persist as a result of their personal and educational background, their higher education goals, and their institutional buy-in. According to Tinto, college students often do not persist when they are not plugged into the academic and social aspects of their institution. He conjectured that students must travel through three stages in order to truly become integrated into the college community: disconnection from the familiar, transition into the college community, and internalization of college life. College students must first set themselves apart from their communities, families, and their former high schools (Tinto, 1987). Alternately, these students will spend more time with fellow students and instructors who value a higher education like they do. This allows them to connect personally with their institutions and identify themselves as a part of their institution (Tinto, 1987). This may be accomplished by living on campus in a dormitory, which allows for more chances of socialization and connection with the institution (Kuh et al., 2010).

Over the course of his career, Tinto has continued to develop his theories based on the research he has done. Several factors have been recognized as possibly having effects on college student retention. A few of these factors are institution type, parental education, income, and student ability (Tinto, 2012a). Combining his ideas about institution type (Tinto, 1993), he considered institutional fit as a retention factor among college students (Tinto, 2012a). This suggests that institutions must offer students ways of creating an emotional investment with their institution in order for them to gain the full college experience, which leads to retention. In other words, if students have institutional buy-in, they are more likely to
stay. When considering college student retention, there is more to the issue than just ensuring that students move from one year to the next. Their success becomes more about the institution’s ability to design effective freshman programs that “foster learning and enable students to develop sufficient momentum (credits earned) to continue on to program and degree completion” (Tinto, 2012a, p.148).

Other researchers have formed their own theories based on those of Tinto (Seidman, 2005; Braxton et al., 2014). One such example is Seidman (2005). Seidman proposed that college students would be more likely to stay in college if the institutions developed programs that included four key components: early identification of at-risk students, early intervention, intensive intervention, and continuous intervention. These programs should address possible academic problems based on high school records and test scores, as well as pre-testing for courses to ensure a student is prepared, or early identification. Seidman recommended that college students receive early intervention, which may involve students while still in high school. Intensive intervention should be offered to students who are struggling in specific areas. These programs should be designed to help students master certain skills that are at a deficit. Students should also be given ample time for mastery, as well. Finally, students should be given the continuous support (intervention) they need to master needed skills until they reach their personal and academic goals (Seidman, 2005).

Another example of revised retention theories based on those of Tinto is that of Braxton, Hirschy, and McClendon (2004). In 1997, Braxton, Sullivan, and Johnson studied Tinto’s Interactionalist Theory (1975) and identified thirteen statements that were separated into either positive or negative directions associated with student persistence. Braxton et al. (1997) used a box score method to test the validity of Tinto’s (1975) Interactionalist Theory. They found that 5 of the 13 propositions in Tinto’s theory were especially applicable to colleges and universities where students reside on campus. A chain reaction of events occur
with these students that increases their likelihood of retention. When students enter college with strong intentions to graduate, their level of social integration increases, as does their commitment to their institution. This process is an important predictor of student persistence (Braxton et al., 1997).

The results of the Braxton et al. (1997) study brought about a revision of Tinto’s 1975 Interactionalist Theory by Braxton, Hirschy, and McClendon (2004). They argued that the credibility of Tinto’s theory is dependent upon its ability to be logically tested; something they called empirical internal consistency. Using factors that lead up to social integration, Braxton et al. (2004) theorized that social integration is dependent upon the institution, as well as the student. The institution’s role includes how committed it is to students’ wellbeing, as well as its integrity. “Institutional integrity manifests itself when a college or university remains true to its espoused mission and goals” (Braxton, Doyle, Hartley, Hirschy, Jones & McLendon, 2014). When students feel that their institution is committed to their success and treats students fairly and respectfully, then social integration is a positive result. College students must also expect they will fit into specific groups within the institution that share similar values and expectations, called communal potential. This includes identifying and interacting with campus groups. Adjusting to college life, what Braxton et al. (2004) called proactive social adjustment, was identified as an important step in becoming socially integrated. Learning how to cope with stressful situations in college is included in this process. When college students have action plans to manage stress, they become more socially integrated (Bray, Braxton, & Sullivan, 1999). Another factor that Braxton et al. (2004) found to have an effect on social integration was dubbed psychosocial engagement. Being a college student requires energy and commitment to involvement in social aspects of college life. There is a direct correlation between student commitment and social integration, which ultimately leads to persistence (Braxton et al., 2014).
Intervention programs and services for college students are not one-size-fits-all. The programs and services needed is dependent on the institution, as well as the needs of the student (Morrison & Silverman, 2012). According to Tinto (1987), higher education institutions should design the programs and services that suit the needs of their students to ensure retention and the attainment of personal and academic goals.

It has been noted that public, four-year, universities have lower retention rates than those distinguished as private, not-for-profit, institutions. Students who are associated with a low socioeconomic background are much less likely to be retained to graduation than if they were from a higher income family (Tinto, 2012a). This is the same case for students whose parents have not earned a college degree. In fact, studies have shown that the low income and FGC students indicate about the same level of retention. First-generation college students have a lower retention rate even if they do not possess a lower income status. However, if these students do possess low-income status, they are about 26% more likely to leave college (Engle & Tinto, 2008). College students take a varying number of courses at any given time due to diverse reasons, such as family or work responsibilities (Webb, 1990). Those who gain fewer than six credits within their first year in college are less likely to be retained than those who are completely immersed in their pursuit of a degree. Consequently, most of these students have come from a low-income family (Tinto, 2012a).

Of all the factors mentioned, student ability seems to have the greatest bearing on retention than any other. This is true across the board, affecting students in both the public and private university settings. Although there is much debate about pre-college characteristics as an indicator of college success, many studies have shown that high school grades and standardized test scores are strong predictors of student retention (Adelman, 2006; Astin, 1993; Astin & Oseguera, 2003, 2005; Astin, Tsui, & Avalos, 1996; Attewell, Heil, & Reisel, 2011; Pascarella, Smart, & Ethington, 1986; Stoeker, Pcarella, & Wolfe, 1988).
Theoretical Framework

There are several reasons why Tinto’s Theory of Individual Departure (1987) was used as the theoretical framework for this investigation instead of other theories. Some retention theories have applicable parts but contain pieces that are not as practical for the purpose of this study. Participants in this study were persisting and being retained despite expected hurdles due to being both first-generation students and STEM majors. Tinto’s theory (1987) underlines the following as predictors of student persistence: pre-college academics, disconnecting from one’s familiar culture, and connecting to one’s college culture through academic and social integration. This theory proposes that students who have the ability to separate themselves from family and friends and integrate themselves more in the college culture are more likely to persist. The college culture includes both academic and social integration, which is critical to persistence, according to Tinto’s (1987) theory. By fully immersing themselves in the college culture, students are able to connect with their new identities as college students.

Students who are strongly connected to family, friends, or community tend to have a more difficult time transitioning into their new college culture, which can lead to drop-out. According to Tinto’s theory (1987), students must follow through the three steps of reaching that cultural change: separation from one’s own culture, transitioning into the new college culture, and becoming integrated in the college culture. This is based on Van Gennep’s Rites of Passage Theory (1960). On the other hand, parents who attended college may share college experiences with their child, helping him gain a better understanding about what is expected as a college student, thus leading to an easier cultural shift. In considering first-generation students, there may be characteristics associated with the student or the institution that are enabling them to stay on their college path, despite the lack of understanding by family about what it means to be a college student.
Although similar, Tinto’s revised Theory of Individual Departure (1993) applied more emphasis on the student’s personal and educational backgrounds as a predictor of persistence. The literature shows that first-gen students are often not academically prepared for college (Stebleton & Soria, 2012). Also, if those students live in areas of low-socioeconomic status, they are less likely to have access to advanced high school courses or do not take them if offered (Pascarella et al., 2004). Although first-gen students are capable of receiving a quality pre-college education, it is not expected that all of the participants are persisting only as a result of their academic background. Also, his 1993 revision included minority groups, such as African-Americans, as having significant needs. Since this study involves STEM majors, the researcher did not expect a large sample of minority students. According to literature, ethnic minorities are much less likely to graduate in STEM fields (Thompson & Bolin, 2011). Therefore, Tinto’s revised theory (1993) did not seem practical for this investigation.

Researchers such as Astin (1975) have developed similar theories on persistence. Astin emphasized that parental education can influence a student’s ability to persist. The students in this study were persisting in spite of their parents’ lack of a higher education. Therefore, Astin’s theory did not fit well with the purpose of this study.

**Summary**

College student attrition rates include those students who transfer between institutions and those who fail to complete a degree or certificate. Several researchers have concluded that there is definitely a problem in keeping students in the science, technology, engineering, or math (STEM) fields (Ehrenberg, 2010). Understanding the reasons for non-completion is a major concern that has been recognized on a federal level (President’s Council of Advisors on Science and Technology, 2012). These students may be at risk upon entering college. This is especially true when the process of finding the institution that fits the needs of the student can be difficult (Kuh et al., 2012).
Many characteristics may be considered as pipelines to college student retention, such as knowing how to find and use institutional resources, how to manage time wisely, and understanding what and how to study (Harrington, 2013). Even the physical campus environment can create a positive effect on a student (Kuh et al., 2010). External conditions can affect a student’s ability to remain in college, but Tinto (1987) does not view these as the most important when compared to institutional involvement.

With growing demands for graduates in science, technology, engineering, and math comes the need to understand the factors that affect the persistence and retention of these students (Purnamasari, 2012). STEM majors who are also first-generation college students face even more obstacles than their non-first-generation peers. There is not enough evidence to conclude the reasons for the success of first-generation college students who are also STEM majors. There is, however, much information about attrition among either group. With considerable background information presented that solidifies the need for awareness of the problems faced by first-gen students today, Stebleton and Soria (2012) suggested that higher education institutions should assist them to ensure academic achievement.

Concern for the lack of college student persistence and retention coincides with the consideration for solutions to such a serious problem in the United States (Hearne et al., 2011). Attrition is especially evident among first-generation college students (McCarron & Inkelas, 2006). What causes first-gen students majoring in STEM fields to persist in college when they have so many deterrents? One or more components may contribute to student persistence and retention. Some examples include intrinsic (personal) motivation (Ward et al., 2012) and extrinsic motivation such as family or peer support, institutional support, and college bridge programs (Prospero & Vohra-Gupta, 2007).

Upon reviewing the research, it is apparent that first-generation college students are at a disadvantage in many areas. It is also apparent that many students who major in science,
technology, engineering, or math (STEM) do not earn their intended degree. In fact, less than 5% of first-gen students in a study performed by Chen and Carroll (2005) were STEM majors. With so many cards stacked against them, successful first-gen students who are also STEM majors possess something to keep them chugging along the track to degree attainment. It is not well-documented whether or not middle-class first-gen students are more likely to survive the college experience. It is suspected that students who attended a high school that gave them valuable tools for doing college-level work are more capable of matriculating through college courses in science, technology, engineering, and math (Choy, 2001).

It is not clear if socioeconomic status plays a role in a student’s involvement in their institution or connection to their college peers. It seems that college students who know where to find help when needed, and who to ask for help, may be more likely to be successful in college. Since first-gen students have parents who cannot share personal experiences to aid them in determining direction, colleges could likely be more aware of these students and their needs (Ward et al., 2012). Studies have proven that college students who are engaged in their institution outside of academics are more likely to be successful (Tinto, 1993). With all the research mentioned about first-generation and STEM major attrition, very little has addressed the factors that promote their persistence and retention. The statistics are proof of a problem; however, little is known about how some first-gen students in STEM fields succeed in earning a degree. There is a great deal of improvement needed in predictors of academic success (Ackerman et al., 2012).

Current studies offer a look at the attitudes that many instructors of STEM courses possess in regards to their role in student achievement. Most of these faculty members do not recognize a problem in how they interact with their students. Many teach and do research, as expected by their institutions, but fail to realize the impact their lack of relationship might have on student success (Mastascusa, Snyder, & Hoyt, 2011). Although there is very little
mentioned about the correlation between first-generation college students and STEM majors, the theories presented about student involvement may be highly applicable to both categories. Not all students are capable of majoring in a STEM field and persisting to graduation because of a deficiency of cognitive abilities (Ackerman et al., 2012). However, if the dropout rate is due to a lack of understanding in how to support these students, then institutional reform may be the critical link between success and failure of first-gen students who are STEM majors (Sternberg, 2013). Although there are many statistics proving there is a problem to consider, there is not enough research that indicates what causes STEM majors to be retained at their prospective institutions. There is a greater understanding now about why students leave their institutions, but we still do not know enough about why students are retained (Tinto, 2012 a).

When a STEM major is coupled with the challenges faced as a first-generation student, the obstacles are compounded. The possible lack of coping skills during times of stress in a student’s classes may have an effect on his or her ability to move forward. In a 1999 research study, Bray, Braxton, and Sullivan revealed that when students prepare for events that cause them stress they are better able to cope and remain on their academic course. However, when students become disengaged due to academic hurdles, they are more likely to change their major (Jex, Bliese, Buzzell, & Primeau, 2001). Many first-gen students (Kuh et al., 2010) and STEM majors are reluctant to communicate with their professors and do not have the confidence to request help concerning the course or the institution (Packard, 2016). When these students have feelings of dread about their major, their commitment often wanes, ultimately leading to departure (Littman & Lunsford, 2009).

The literature reviewed will provide information needed to investigate the characteristics associated with first-generation STEM majors who are persisting and being retained by their institution. The Theory of Individual Departure by Tinto (1987) will be used to provide “an explanation of a phenomenon” (Webb, 2016, p. 92), which is first-generation
STEM major persistence and retention. This theory relates student persistence to pre-college academics, separating from one’s own culture and, finally, becoming academically and socially integrated. Tinto’s Theory of Individual Departure (1987) will be used to help explain the phenomenon of first-gen STEM major persistence and retention.
CHAPTER III
METHODS

This chapter describes the methodology utilized in this study as well as the materials used. The purpose of this study was to determine the characteristics that contribute to the persistence and retention of first-generation (first-gen) college students who are also majoring in science, technology, engineering, or math (STEM). Most studies associated with first-gen students or STEM majors have been quantitative in nature. The purpose of this study, however, was to determine the characteristics associated with first-gen STEM major persistence and retention. It was conducted by interviewing college juniors and seniors attending a four-year regional institution.

Describing human behavior is difficult (Davis, 2010). However, some regard qualitative inquiry as a logical form of testing and discovering human characteristics and behaviors, with no need to justify its uniqueness to quantitative research (Creswell, 2013). The current study was designed to determine what characteristics enable some college students who are first-generation to persist when so many of them are not. This, coupled with the ongoing problem of attrition among science, technology, engineering, and math majors, brings about a true dilemma that can only be understood by those who have experienced college life under those circumstances. This study was conducted qualitatively to understand how individual experiences are explained and the significance of those experiences (Merriam, 2009).

Qualitative research is transparent in design; therefore, the researchers themselves must also be completely open in their ideas when presenting a qualitative study (Creswell,
Researcher bias must be taken into account since human subjects are used in qualitative research (Savin-Baden & Major, 2013). With this in mind, the researcher was careful to not allow personal beliefs about the study to determine the outcome of the study (Birks & Mills, 2011). At the same time, the qualitative research clarified what is trying to be conveyed through interpretations (Denzin & Lincoln, 2011; Merriam, 2009). However, perspectives may be different from those of other researchers.

There are many techniques used in the process of gathering data in qualitative research. In order to accurately represent the individuals participating in a study, the researcher may choose to use a variety of resources, such as “field notes, interviews, conversations, photographs, recordings, and memos to the self” (Denzin & Lincoln, 2011, p. 3). The main purpose of qualitative research is to allow the participants to share their experiences concerning a particular issue and then attempt to interpret those experiences (Creswell, 2013). Each audio-recorded interview lasted approximately one hour in length and took place on the students’ prospective campus. Following each interview, the audio recordings were transcribed, along with any side notes. Each transcription was then coded and patterns in participant answers were analyzed. The goal of the current study was to explain why some first-generation college students who are majoring in science, technology, engineering, or math are persisting and being retained by their institutions. The individuals who can best explain why they experience persistence and retention are the students themselves. Therefore, qualitative research was the most suitable method for gaining understanding about their experiences.

The current study used a purposeful sampling strategy. This type of nonprobability sampling involves choosing participants for their ability to provide the greatest understanding of the phenomenon being studied. They gave the data necessary to help the researcher comprehend the reasons for a phenomenon (Patton, 2002). By choosing the student...
participants based on their experiences, the researcher expected a considerable amount of relevant information to analyze for investigation.

**Research Questions**

The research questions used in the current study were designed to help describe precisely what the study endeavored to determine (Maxwell, 2005). The questions presented were considered for both first-generation students and STEM majors. One overarching question was supported by more precise questions.

Q. How do first-generation college STEM majors persist in spite of the obstacles they face?

Sub-Questions:

1.1 How do you feel your personal beliefs about higher education help with persistence?
   a. How does personal motivation help you persist?
   b. How does the belief that a higher education will satisfy your personal goals help you persist?

1.2. How do you feel your supporting relationships help your persistence?
   a. How do family members help you persist?
   b. How do your friends help you persist?

1.3. How do you feel your high school experiences have helped you persist?
   a. How did academic courses help your persistence?
   b. How did your high school counselors or teachers play a role in your persistence?

1.4. How do you feel your institution contributes to your persistence?
   a. How have faculty members helped in your persistence and retention?
   b. How have institutional resources helped you persist?
c. How has your involvement in the institution helped you persist?

d. How has financial aid helped your persistence?

**Participant Selection**

The sample size needed for qualitative research may depend on several factors and is not the same for all studies. There should be a sufficient amount of participants sharing their stories until the research is clearly repeating ideas or explanations (Merriam, 2009). In other words, no new or different answers are being collected or discovered (Lincoln & Guba, 1985). With this in mind, it was expected that including 30 student participants in the current study would provide the data needed to reach that point of saturation.

The four-year regional institution in which the participants attend offers majors in science, technology, and math, along with applied engineering. It has an average enrollment of just under 7,000 and is located in a rural area that is an attractive choice among many students in the region (Petersons.com, 2016). There are many degree offerings in science, technology, math, and applied engineering at this institution (Petersons.com, 2016).

All participants in the current study qualify as first-generation college students under the definition adopted - neither parent completed a college degree program. These students were declared juniors or seniors majoring in science, technology, engineering, or math (STEM). Participants belonging to various socioeconomic status levels, ethnicities, and gender were desired in order to represent many viewpoints of the phenomenon of college student persistence and retention. Diversity among these students offered broader descriptions and personal stories about persistence and retention that were critical to this study.

Upon receipt of IRB approval, professors at the institution were contacted as a way to solicit participants from their classes for the research study. Two-hundred flyers were also posted around the campus and distributed by professors to advertise the need for participants.
This process began in January 2017, and ended with the last interview in late March of the same year. Fifteen students interested in participating in the study contacted the researcher through e-mail, phone call, or text message. Two of the students were not included in the study because they did not meet the research criteria. Therefore, a total of thirteen students were included in the investigation. The students were given an explanation of the purpose of the research and voluntarily accepted the interview process, which included a face-to-face interview and follow-up e-mail correspondence. They were informed that their identities would remain anonymous, as would the institution to which they are associated.

**Research Design**

Much has been discovered about first-generation college students, as well as majors in science, technology, engineering, and math. However, very little is known about why students belonging to both categories persist and are retained. This study was unique in that it coupled two criteria to help fill the gap in understanding a phenomenon. Collecting data from the personal experiences of students who were both first-generation and STEM majors seemed to be the best fit for understanding what allowed these students to succeed. According to Major, choosing “what” the study is about is a critical step in determining how to proceed with research (Savin-Baden & Major, 2013, p. 37). Distinguishing what is known and unknown about a topic reveals the break in understanding, which is a plausible reason for research (Merriam, 2009).

A pragmatic qualitative research (PQR) approach was utilized in this study. Due to the nature of the study, the PQR approach allowed the researcher to interact with the participants and use their viewpoints on the topics presented during personal interviews to compare to subsequent interviews. Pragmatic qualitative research may utilize various tactics associated with other types of qualitative research to explain a phenomenon, a case, or a narrative. For this reason, it is the most widely used of the qualitative research types.
Savin-Baden and Major (2013) described pragmatism as the explanation of a truth based on its practicality. If a student participant described a factor that truly worked in maintaining retention, then it was a functional element of the student’s success and should be interpreted as such. “Pragmatism is therefore an experience-centered philosophy that emphasizes change” (Savin-Badin & Major, 2013, p. 60). Pragmatic qualitative research is a process that focuses more on finding answers to questions and less about specific methods used to answer those questions. It allows more flexibility for the researcher because data is only collected using methods necessary to draw conclusions and provide meaning (Creswell, 2013). Meaning is something that is built up using pieces of information as well as experiences; an idea Merriam (2009) called “constructionism” (p. 22).

The approach to the current research study was multifaceted in that it involved gathering information from participants, taking into consideration their own viewpoints, while also admitting the viewpoints of the researcher. Since there was no specific theory to be developed as a result of this study, the grounded theory approach was not the best choice. However, the present study used constant analysis of data collected. As the researcher analyzed data, new categories of information developed. The researcher was not bound to any particular conclusion. Furthermore, she drew conclusions throughout the research process, refining them at the end (Charmaz, 2006; Strauss & Corbin, 1998). Although a phenomenon was considered in this study, the participants’ interpretation of their personal experiences were not enough to afford the use of a phenomenological approach to the research (Sandelowski, 2000). Pragmatic qualitative research is a more appropriate method for investigating the details of specific themes when other approaches do not provide a good fit for describing the basis of the research (Savin-Baden & Major, 2013).

The idea behind pragmatic qualitative research has evolved and has been interpreted by researchers as both subjective and objective in nature. Pragmatic qualitative research has
been described as a way of analyzing the interpretations of individuals and making sense of data (Thorne, Kirkham, & MacDonald-Emes, 1997). This type of research engages the ideas that emerge and are repeated throughout the information collected from its participants. These results of the study were a translation of the information by the researcher. It was a process, a reaction to the results of the information gathered (Corbin & Strauss, 2008). One researcher may interpret the information differently from another. Therefore, it may be called a “generic” or “basic” qualitative approach that involves a great deal more describing than categorizing (Merriam, 2009, p. 22).

**Data Collection**

Conducting interviews and observing student participants in their natural surroundings is important when utilizing pragmatic qualitative research (Sandelowski, 2000). Although interviewing individuals is the most widely used method of data collection among qualitative researchers (Savin-Baden & Major, 2013), it is also the most rational in terms of what is being explored. First-generation college STEM majors were interviewed on or near their college campus using sets of questions created by the researcher. The questions used in the initial interview (See Appendix A) were followed by a second set (See Appendix B) designed to bring about a greater understanding of the phenomenon associated with student persistence and retention. A thematic approach was used to analyze the data in this study. Audio recordings were made of the participants as the researcher marked side notes about the setting, as well as about the participants’ expressions and voice inflections. The interviews were then transcribed verbatim while also providing side-notes for further inquiry. Immediately following, the transcriptions were coded and relationships explored that allowed for categorical placement of the information. The transcripts were reread several times to search for relationships between distinguishing terms, experiences, explanations of feelings, and time.
Memoing was used to aid in an understanding of the phenomenon associated with persistence and retention among first-generation college students majoring in STEM fields. According to Lempert (2007), memos are considered data in research, and the process of obtaining them should be a free and spontaneous process (Birks & Mills, 2011). Memos in this research study were taken during and after each interview. Some areas that were considered for memos include the following: assumptions about the research, problems or concerns related to the design of the study or that may influence the quality of the study, decisions about the direction of the study, and categories created from codes. For the purpose of this qualitative study, data was collected and then analyzed for themes. The themes were then divided into sub-themes for further inquiry (Creswell, 2009).

**Data Analysis**

Qualitative data analysis is a process of taking large pieces of information and dissecting them into smaller, more understandable pieces. It involves exploration of information that may lead to answers to the questions the researcher asks her participants. Collecting and analyzing this data was done simultaneously (Merriam, 2009). Overall, “it is data analysis that ties together each aspect of the research project” (Savin-Baden & Major, 2013, p. 435).

Data for this study was analyzed based on the categories that developed from codes, and information was carefully aligned with research questions (Birks & Mills, 2011). Thematic analysis was used in determining the meaning of the data collected. According to Major (Savin-Baden & Major, 2013), thematic analysis is “one of the most complex and compelling approaches to data analysis” (p. 440). It involves going over the data repeatedly before developing codes, followed by themes. These themes are then provided explanations and labels (Braun & Clarke, 2006). Thematic analysis allows the researcher more flexibility
in her task of analyzing data. Thus, data analysis may occur on a more “intuitive level” (Savin-Baden & Major, 2013, p. 440).

The student participants in this study made up the unit of analysis. They have provided their personal accounts of what allows them to overcome perceived obstacles and persist as college students. Feelings about their personal goals, family and friends, high school experiences, and institution were disclosed. Although the entire study is not focused on the institution itself, it does play a role in developing the students’ feelings about higher education, thus contributing to persistence and retention. Once the researcher interviewed the ninth participant, a point of saturation of data was realized. Based on previous studies, institutions that offer support through orientation courses, student programs, and faculty mentoring often have more successful students (Ward et al., 2012).

**Timeline of the Study**

The current study included interviews over the course of one semester involving first-generation college students pursuing degrees in science, technology, engineering, or math (STEM). Solicitation of participants began following IRB approval in January 2017. Interviews began in February 2017, and ended in March of that same year. Memoing was done both during and after each interview. Coding was used following the initial interviews and continued until the research was complete. The timeline was fitting because some of the participants graduated at the end of the spring semester. The quality of the interviews exceeded the quantity, which provided adequate documentation of the characteristics that aid in the persistence and retention of first-generation college students who are also STEM majors.

**Ethical Considerations**

The participants in this study were college students who have completed at least two years of college. It was not expected that these students would have disabilities or require
special assistance. However, a student would not have been excluded from the study if he or she had a disability or required special assistance. In order to remain anonymous, their given names were not used in the written explanations or formal presentation of the results. To ensure that the interpretations of the participant interviews were accurate, the participants were offered an opportunity to review the interpretations as perceived by the researcher. This allowed the participants to trust in the validity of the presentation of their statements.

**Research Positionality**

Having been a first-generation college student majoring in a science field, the researcher admits the possibility for bias. It was expected that the subjects would have similar experiences connecting their drive to be successful and persist to graduation. Most of the research about first-generation college students is associated with students who are of the lower class and/or minorities. Several of the students in this study possess those criteria, while others are in the middle class. The researcher was interested in discovering if characteristics affecting the participants were similar to those that aided in her own degree attainment.

**Validity, Trustworthiness, and Reliability**

Creswell and Miller (2000) explained eight validation strategies that are often used by researchers when doing a qualitative study. The present study concerning persistence and retention of first-generation college students who are also majoring in science, technology, engineering, or math incorporated four of those strategies to ensure validation. Spending time with the participants in conversation allowed the development of trusting relationships with them. Approximately ten minutes were spent casually talking to make them feel more comfortable with me as the researcher and the process of answering personal questions. This strategy also included learning the values upheld by the institution and its students. Lastly,
this strategy encouraged the evaluation of information to be certain of its accuracy (Creswell, 2013).

Admitting to one’s own bias may be difficult, but it is a critical strategy in validation. Regarding this point, the researcher’s ideas or opinions about the subject being studied was an open book. Researcher bias can affect how information is interpreted. “Member checking” is believed to be “the most critical technique for establishing credibility” (Lincoln & Guba, 1985, p. 314). In order to prevent researcher bias, the participants were asked to evaluate the information received from their interviews to verify the accuracy of the interpretation of the information. Following the face-to-face interviews with the participants in this study, they were asked if they would like a copy of the transcript. To ensure validity of this study, some of the initial questions were re-worded if the response was unclear to the researcher. The question sets (Appendices G and H) were designed to specifically target the feelings of the participants as they explained their experiences as first-generation STEM majors. The same questions were asked of each participant, regardless of their class rank, race, or age.

Assumptions, Limitations, and Delimitations

Theories are developed based on how we have interacted with others throughout our lifetime and how we interpret our own personal experiences (Charmaz, 2006). These important factors have an impact on the researchers’ interpretation of data she has collected. According to Creswell (2013), “whether we are aware of it or not, we always bring certain beliefs and philosophical assumptions to our research” (p. 15). With this in mind, how the researcher moves forward in his or her research will depend on these assumptions. Beliefs adopted by researchers are also known as paradigms (Lincoln, Lynham, & Guba, 2011). According to Denzin and Lincoln (2000), paradigms actually direct how research will proceed. How we perceive situations and what we assume has an impact on how we do research. The philosophical assumptions in this study were developed from individual
experiences. Having been a first-generation STEM major, like the participants, the researcher understands that her own experiences provide a lens for understanding unlike another individual. It was assumed that the participants are highly motivated to succeed, are close to their families, and want to earn a STEM degree for the purpose of interest and income.

Creswell (2013) has noted that when qualitative research is being planned, the researcher should recognize the possibility for limitations. One limitation relates to the trustworthiness of the data collected. The caliber of the instrument used in research may be a limitation. Also, the second limitation applies to the quality of the research instrument, while the extrapolation of the data is a possible limitation. Qualitative research design must be carefully considered due to certain limitations. Verifying that the study is valid and reliable is an important step in maintaining ethics (Merriam, 2009). Since qualitative studies are designed to address why things happen, “the criteria for trusting the study are going to be different than if discovery of a law or testing a hypothesis is the study’s objective” (Merriam, 2009, p. 210). Depending on their honesty in answering questions, the participants have an impact on the integrity and reliability of the study (Denzin & Lincoln, 2000). A relatively small sample was used in this study; however, due to the information gathered from students belonging to a unique group (first-gen STEM majors who are persisting and being retained) their participation provided much-needed understanding of their experiences.

The study was delimited by the college students who provided information about their experiences as first-generation students majoring in science, technology, engineering, or math (STEM). They attended college at a regional four-year institution in the Southeastern United States. The participants were interviewed while ranked as juniors or seniors. Freshmen and sophomores were not considered for this study because there was a need for evidence of persistence and retention beyond the first two years. All of the participants had experienced college life and developed their ideas about college at their current institution. Each student
participant offered a unique account as a first-gen student majoring in a STEM field. A larger sample of students and college students from other regions may be necessary to fully understand what characteristics are associated with persistence and retention of first-gen students who are STEM majors. In terms of limitations, human participants were asked personal questions about specific topics concerning persistence, family situations, and institutional factors. These participants were very thorough in their answers, yet they may not have completely disclosed their feelings, resulting in an incomplete story. However, the participants did reveal characteristics that have aided in their persistence and college retention.

Summary

The framework for this study used a qualitative design, which was needed to allow the participants to share their personal accounts of persistence and retention. Tinto’s Theory of Individual Departure (1987) was used to guide the methods of the study. This theory emphasizes personal and academic preparation for college, transitioning into the college culture, as well as academic and social integration. The study provided the development of a deeper understanding of characteristics associated with persistence and retention among first-generation STEM majors. The participants provided details about how they have persisted despite the negative expectations of being first-generation and STEM majors. The results of this study are discussed in chapter four, which reveals the information and descriptions transcribed from the interviews with students.
CHAPTER IV

FINDINGS

Chapter four presents the information gained from interviews with students who are first-generation STEM majors. Each participant was either a junior or senior attending a regional four-year institution and voluntarily shared their experiences. Both males and females from various ethnic backgrounds were included in the study (see Appendix C for participant demographics and background information). Interview questions were designed to investigate the following characteristics affecting first-generation STEM majors: personal beliefs about higher education, external components, high school experiences, and institutional characteristics. Table 1 below provides an overall view of the research questions and themes, along with the sub-themes that emerged as a result of the information gathered from the interviews. Table 2 provides the themes, sub-themes and number of positive or negative responses for each sub-theme.

Table 1: Research Questions, Themes, and Sub-Themes

<table>
<thead>
<tr>
<th>QUESTION 1: How do you feel your personal beliefs about higher education and earning a STEM degree help you persist?</th>
<th>Theme #1: How does personal motivation help you persist?</th>
<th>Sub-Themes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>How does personal motivation help you persist?</td>
<td>A. Interest in Subject</td>
<td>B. Confidence to Succeed</td>
</tr>
<tr>
<td></td>
<td>C. Obtaining a Better Future</td>
<td>D. Open-Mindedness about Career Options</td>
</tr>
<tr>
<td></td>
<td>E. Overcoming Uncertainty</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>QUESTION 2: How do you feel relationships support your persistence?</th>
<th>Theme #2: How does the belief that a higher education will satisfy your personal goals help you persist?</th>
<th>Sub-Themes:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A. Satisfying Job Interests</td>
<td>B. Financial Stability</td>
</tr>
</tbody>
</table>
Theme #1: How do family members help you persist?

Sub-Themes:
A. Verbal Encouragement
B. Financial Support

Theme #2: How do your friends help you persist?

Sub-Themes:
A. Encouragement
B. College Planning & Preparation
C. Academic Competition

QUESTION 3:
How do you feel your high school experiences have helped you persist?

Theme #1: How did academic preparation help your persistence?

Sub-Themes:
A. High School STEM Courses
B. AP & DE Courses
C. ACT Scores

Theme #2: How did your high school counselors or teachers play a role in your persistence?

Sub-Themes:
A. Encouragement
B. Instructions
C. College Planning

QUESTION 4:
How do you feel your institution contributes to your persistence?

Theme #1: How have faculty members helped in your persistence?

Sub-Themes:
A. Attitudes Toward Teaching
B. Accessability
C. Approachability

Theme #2: How have institutional resources helped in your persistence?

Sub-Themes:
A. Campus Environment
B. Housing
C. Classes
D. Tutoring Services

Theme #3: How has your involvement in the institution helped you persist?

Sub-Themes:
A. Campus Organizations
B. Classes

Theme #4: How has financial aid helped your persistence?

Sub-Themes:
A. Scholarships and Grants
B. Campus Jobs

Table 2: Participant Responses

<table>
<thead>
<tr>
<th>THEMES</th>
<th>SUB-THEMES with POSITIVE COMMENTS = #</th>
<th>SUB-THEMES with NEGATIVE COMMENTS = #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal Motivation</td>
<td>Better future = 11</td>
<td>Work for College Expenses = 7</td>
</tr>
<tr>
<td></td>
<td>Helping People = 4</td>
<td>Uncertain About College = 4</td>
</tr>
<tr>
<td></td>
<td>STEM interest = 11</td>
<td>Uncertain about STEM = 11</td>
</tr>
<tr>
<td></td>
<td>Confidence</td>
<td>Personal Goals</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>------------</td>
<td>----------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Job Interests = 13</td>
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<td></td>
<td>Career Options = 6</td>
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<td>Family Support</td>
<td>Financial Support = 8</td>
<td>Do not understand need for time involved = 4</td>
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<tr>
<td></td>
<td></td>
<td>Verbal Encouragement = 13</td>
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<tr>
<td>Friend Support</td>
<td>Verbal Encouragement = 6</td>
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</tr>
<tr>
<td></td>
<td>Academic Competition = 4</td>
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</tr>
<tr>
<td></td>
<td>Planning &amp; Preparation = 4</td>
<td></td>
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<tr>
<td>Academic Preparation</td>
<td>Helpful STEM Courses = 6</td>
<td>STEM Courses Lacking Rigor = 2</td>
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<td>Helpful AP/DE Courses = 5</td>
<td>AP/DE Courses Lacking Rigor = 4</td>
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<td></td>
<td>Satisfying ACT Scores = 8</td>
<td>Lack of AP/DE Courses = 2</td>
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<td>ACT Preparatory Course = 1</td>
<td>Did Not Feel College-Ready = 1</td>
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<tr>
<td></td>
<td>Poor ACT Score = 2</td>
<td></td>
</tr>
<tr>
<td>High School Counselors &amp; Teachers</td>
<td>Encouraging = 9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>College Planning = 9</td>
<td>Not Helpful = 3</td>
</tr>
<tr>
<td>College Faculty</td>
<td>Enjoy Teaching = 12</td>
<td>Intimidating Freshman STEM Courses = 4</td>
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<td></td>
<td>Accessible = 12</td>
<td>Not Accessible = 1</td>
</tr>
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<td></td>
<td>Approachable = 10</td>
<td>Not Approachable = 3</td>
</tr>
<tr>
<td>Institutional Resources</td>
<td>Campus Environment = 6</td>
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Note. The table above lists themes based on participant interviews. Each sub-theme includes the number of participants who provided comments from their personal experiences as either positive that have helped them persist or negative aspects resulting from their personal experiences. There were 13 total participants. Some participants did not provide comments for every sub-theme or were uncertain how to respond.
Question #1: How do you feel your personal beliefs about higher education and earning a STEM degree help you persist?

Two themes emerged from research which addressed research question number one. The themes were personal motivation and personal goals for the future. The interviews also revealed multiple sub-themes, which will be addressed in detail. The sub-themes for personal motivation include the following: obtaining a better future, interest in STEM, confidence to succeed, dealing with uncertainty, and overall confidence. The following sub-themes were revealed for personal goals: satisfying job interests and financial stability.

**Theme 1: Personal Motivation.**

Theme 1 involved the students’ personal motivation to persist in higher education. The participants mentioned several feelings and circumstances that had motivated them or had hindered their motivation. The greatest positive trends were noted in their desire to have a better future and their interests in STEM fields. The most obvious negative trends existed in their uncertainty that they could handle working in a STEM field and that they must work, often many hours, in order to cover the costs of being a college student. Other thoughts were shared that did not show among the majority but were given consideration.

Regardless of personal background, motivation is required to achieve anything. The researcher believes the students in this investigation were very motivated to reach their graduation goal. Of the 13 participants, 10 felt that acquiring a better future than the one their parents experienced was a driving force for their degree achievement. They had seen how difficult life had been for their families as a result of not having a college degree. The participants exhibited an appreciation for the opportunities they had that their parents did not. For example, one participant reported struggling with nursing as her career choice but “definitely” sees being a first-gen student as a motivator to earn a degree. It gave her “more drive to do it; to make a better future.” Others had similar responses, stating that “it’s more
motivational than a reason for going.” Even if these students considered going to college as their own choice, there was consistent evidence that first-gen students wanted to succeed in earning a higher education beyond what their parents pursued.

They were very motivated to earn a STEM degree. Eleven of the 13 students mentioned that their interest in STEM fields motivated them. The majority of participants seemed very passionate about their studies, having a “keen interest in biology and chemistry” or loving “the math part” of computer programming, providing them with a greater level of confidence that they were capable of pursuing their degree of choice. Medical school was the motivation for 3 of the participants. However, some dealt with uncertainty about pursuing a STEM degree. Eleven participants felt that they might not make it through the program and earn a degree. One participant said that she had gone “back and forth” several times between degrees before deciding on nursing. The majority associated these feelings with their lack of pre-college preparation and waiving self-confidence.

Motivation may be due to the student’s love for the subject area he or she is studying or the confidence the student possesses to perform well in learning about that particular subject. However, helping people, as a result of earning a degree in health science or nursing, was also a desire shared by 4 of the 13 participants. These were the students who saw a career in nursing or medicine as a means of bettering the lives of others while also providing a promising future for themselves.

Seven of the 13 participants admitted to having issues with their overall confidence as a college student. They sometimes dealt with doubts but managed to overcome them. Four participants even had doubts about going to college. Managing their time was often difficult for the 7 students who worked to help pay for college expenses. It was frustrating for them because they would have liked to be more involved at their institution. They attributed some of their uncertainty to having to juggle their academic requirements with work
responsibilities. Life was always busy and sometimes complicated. The majority of the participants spent many hours preparing for classes in order to maintain their grades, and good grades were required to uphold their scholarships. Even the most confident students in this study dealt with uncertainty, but overcame it and kept moving forward.

**Theme 2: Personal Goals.**

Theme 2, personal goals, characterized what the student participants were ultimately aiming for in a future career. Three sub-themes developed relating to the participants’ personal goals: financial stability, job interests, and career options. There were no negative comments mentioned concerning their personal goals.

All of the participants stated that income would be an attractive gain as a result of earning a STEM degree. Being “financially stable” was important to them. They felt that a college education was critical in having a career that led to financial security. For example, “Brittany” was convinced that earning a degree would ensure she has a good career. She said, “Nowadays, it’s really hard to get a job if you don’t have a degree.” One student also felt that by bettering her own financial future her parents would benefit as well.

All of the participants also felt that a degree would offer them a job they would enjoy. One participant stated, “I have to have a job that I love.” It was apparent that a drive to succeed was impacted by getting the job that would satisfy interests. Eight participants viewed the opportunity to earn a STEM degree as their avenue to become a medical doctor, physician’s assistant, nurse, or veterinarian. One participant shared that she was motivated to earn her degree in pre-health biology because she had “tried other things” that do not interest her.

Six participants were attracted to specific STEM jobs but were flexible in their career choices. They felt that earning the degree would provide them with options from which they could benefit. One participant understood that even if she became a nurse she may also wish
to be an instructor someday. She felt that earning her nursing degree would give her career options. This was an attractive feature to almost half of the participants. Another example was that of a student who was not sure she would be accepted into medical school but had recently gained an interest in freshwater biology. If medical school does not work out for her, she felt confident that she had career options with a degree in biology.

**Conclusion to Question #1.**

The participants answered question #1 similarly in a few areas. All participants were personally motivated to succeed and had career goals mainly based on their interests. A few understood that their original plan for a career may not work out, and they had other options. Most dealt with uncertainties about their place in higher education but managed to stay on track. Regardless of their final career choice, all participants agreed that they wanted to experience a better future with a college education than their parents had experienced. This included being financially stable, although most said that money was not their main reason for earning a degree.

Personal motivation was apparent among the participants involved in this study; however, many of these students exhibited uncertainty. They would not surrender to doubt, although they had felt it a time or two. Even the most highly motivated students occasionally experienced uncertainty. The difference here was that the students in this study were persisting in spite of all the hardships they had faced to get where they were.

**Question #2: How do you feel relationships support your persistence?**

Two themes emerged from evaluating the research for question #2. The themes involved how relationships supported student persistence. In analyzing the data, six sub-themes were discovered that further illuminated the question about supportive relationships. The sub-themes included verbal encouragement and financial support from family, which
also may include living at home; encouragement; college planning and preparation; and academic competition from friends.

Theme 1: Family Support.

Family support seemed to have a great impact on a first-generation college student’s ability to enter college and persist. Three positive comments were shared by the participants that deal with family support and persistence: verbal encouragement and financial support. All of the participants stated that their parents were very much associated with their ability to persist.

The parents of the participants were offering their support for their child’s pursuit of a college education, despite their own lack of a higher education themselves. All 13 participants received verbal encouragement from their parents, reminding them that they had “the potential to succeed.” Parents were not the only family members who had a direct influence on a first-generation college student to persist. One participant included her older sister as a significant encourager for her persistence. Another felt that her aunt had also been very influential in her pursuit of a college education. However, the majority of participants associated their parents with the greatest amount of encouragement.

Many participants mentioned throughout the interviews that their parents “pushed” them to go to college, but they were also very supportive in other ways. Eight participants were supported financially by their parents. This included payment for tuition, books, food, clothing, and other necessities. Only three of the participants lived at home, but they felt it was necessary in order to keep costs down. Those who did live at home actually enjoyed it but commented that it was often “difficult to concentrate” while studying due to all of the family distractions.

The only negative comment shared about family support was from four participants who felt their parents did not understand why they needed so much time involved in the
institution. For example, one participant’s parents supported her higher education goals, but she explained that being a first-gen student can be difficult at times. She shared that “they don’t understand why it’s taking so long” to complete her studying at the library, especially if it goes beyond a certain time. Another participant was certain his parents were supportive, “but they don’t understand” the amount of time needed to be a successful college student. Finally, two participants shared that they had friends whose parents were engineers. Their friends could talk to their parents about college and know they understood. The participants, however, felt they were at a disadvantage because they could not have the same conversations with their parents.

All the participants received encouragement from family in one way or another. Several obtained financial support from their families. If not directly through monetary aid, it was indirectly through providing a place to live, rent-free. A few of the participants were continuing to live at their parents’ home to save money. Although some had reasoned that staying home was just comfortable, a significant number of participants saw living at home as a means of financial support. Most of the participants had scholarships, but their parents sent money for food, housing, and other necessities not covered by scholarships.

**Theme 2: Support from Friends.**

Friends have the ability to provide encouragement, especially when they have experienced or are experiencing similar situations. They may study together, help find answers, aid in filling out college applications, plan schedules, or even provide a bit of academic competition. All of the sub-themes concerning support from friends were associated with college friends. None of the participants felt that friends from outside the university offered them support. Six of the 13 students interviewed received verbal encouragement from those friends.
When friends take classes together, they not only study together, but they also offer a bit of academic competition. Four participants said that academic competition between friends was something they consider beneficial. Three of the participants had college roommates who were also STEM majors. The participants felt this was an advantage when preparing for classes or when they had questions about topics that their roommates might be able to explain. Problems were more easily solved when they “get more than one head wrapped around” them. Finally, four participants explained that their friends had been instrumental in helping them plan which classes to take. Even something that seemed like an easy task, such as planning a course schedule, was daunting for first-gen students. Two participants had friends who were already enrolled in college to help them apply for admission. One said it was very helpful because he did not receive much guidance while in high school, and another received help with the application process because her parents did not know how to assist her.

Not having parents to help with answering questions about college because they never experienced it themselves can be tricky. In many of these cases, friends offered some direction and helped students learn “how to overcome barriers.” Almost half of the participants felt that friends had helped them persist.

Having good relationships with college friends was a benefit to first-gen students, according to “Taylor.” He had two roommates, who were also high school friends; both were STEM majors. Recalling the “scary” first college STEM course, “Taylor” “got through it” because a few of his friends were with him. He saw a healthy dose of competition as a positive aspect of having friends and roommates taking the same classes together. He said they “help each other out by pushing each other” to excel.

What better way to solve problems than to include a group of knowledge-seeking minds through social media? “Ella” and her college friends did just that when someone
among her nursing peers could not find answers to questions about a class or even something relating to the university. They simply went to Facebook and communicated until the problem as solved. She said that they “are really good at helping each other.” These students were not only persistent but were very resourceful.

**Conclusion to Question #2.**

The participants in this study agreed that family and friends provided support that had an impact on their college persistence. All had received verbal encouragement from their parents, while a few also had received financial support by providing food, housing, or necessities. Although friends were not considered their greatest support, almost half of the participants did view their friends as helpful. They provided encouragement, helped them with planning schedules, and also presented a competitive spirit to the courses they took together. Including themselves in group studies allowed critical social connections. Connecting with people not only createed positive relationships but also built support systems.

**Question #3: How do you feel your high school experiences have helped you persist?**

Two themes emerged from research which addressed research question number three. The themes involved how academic preparation and high school counselors or teachers have helped the participants persist. The roll of academic preparation on student persistence, revealed three sub-themes: feelings about high school STEM courses, advanced placement (AP) or dual enrollment (DE) courses offered, and ACT scores. The themes associated with pre-college preparation received the most negative comments from participants than for any other theme in this study.

**Theme 1: Academic Preparation.**

The participants in this study were asked to describe how they felt in their high school STEM courses. Although their individual answers were diverse, they all had something in
common - an interest in at least one area of science or math. Only 6 of the 13 participants felt that their high school STEM courses were really helpful in understanding the concepts and preparing them for college courses. Two participants mentioned that their high school STEM courses lacked rigor. For example, “Martha” attended a rural high school with about a thousand students in grades seven through twelve. She said she “enjoyed” being in a math or science course, but “it was boring” to her. She explained that she just did not feel challenged.

The majority of the participants attended high schools that offered AP or DE courses. However, not all college-bound students were enrolled in these courses. “Kasia,” for example, was heavily involved in being on the track team. She did not take AP courses because she felt she did not have enough time. She did “enjoy” anatomy class and chemistry, especially performing experiments.

Five of the participants felt that they experienced AP and DE classes in high school that were helpful in preparing them for college and had helped them persist thus far. Luis, for example, felt that his AP courses helped him “form better study habits.” On the other hand, four participants disclosed that their AP and DE courses lacked the rigor they expected in higher level courses. “Mahir” felt that the most noticable problem with his DE courses was that he did not retain many of the concepts by the time he had reached the second course in college because as many as four years had lapsed. It was very difficult for him to backtrack and review the initial course while taking the next.

Two participants explained that even though their AP or DE courses did not help much in preparing them for college, the courses helped them earn college credits while still in high school. Furthermore, two participants attended high schools that did not offer AP or DE courses at all. Despite the negative comments about pre-college preparation, only one student felt that she was not college-ready.
Being accepted into most colleges requires a certain ACT score. The institution at which the participants were enrolled requires a minimum ACT score of 20. A few of the participants felt that the preparation they took while in high school to do well on the ACT helped them realize their higher education dreams. Higher ACT scores can lead to scholarships. This became a reality for 5 of the participants. One said she “really wanted that full ride” to college. Her high ACT score granted her a full tuition scholarship. Another participant was not certain he would be able to go to college until he received his scholarship for his ACT score. The majority of the participants were satisfied with their ACT scores. One student attributed her “good score” to her involvement in an ACT preparatory course while in high school. Only two students felt they were completely dissatisfied with their ACT scores.

**Theme 2: High School Counselors and Teachers.**

Theme 2 emphasized the role of high school counselors and teachers in their students’ preparation for college and persistence once there. The majority of participants in this study mentioned the positive impact that at least one teacher or counselor made on their entry into college and persistence today. Very few felt as though they never received support in high school. A couple of sub-themes emerged as a result of the interviews: encouragement and college planning.

None of the participants in this study felt their high school counselors or teachers had an impact on choosing to go to college or had helped them prepare in some way, ultimately aiding in their persistence. Several students were athletes in high school and were encouraged by their coaches to go to college. Nine participants mentioned the encouragement they received from either a teacher or counselor while in high school. Only 3 students disclosed negative comments about their high school counselors or teachers being no help to them.

There were many examples of how STEM teachers inspired their students. The majority of participants praised their high school teachers or counselors. The application
process is often a daunting experience for first-generation students. In several examples, the
counselors helped the students with not only completing the application but also helped
students keep up with deadlines. One participant shared that he was not considering college at
all until his high school counselor explained that his ACT scores and grades proved that he
had the ability to do well in college. She helped him throughout the rest of his time in high
school to ensure he stayed on the right path.

There were also students who did not feel as if they had any major influence from
teachers or counselors to go to college or major in a STEM field. Testimonials of teachers not
wanting to “be there” and students “not taking the course seriously” were expressed. One
participant “didn’t know where to start” in searching for colleges or scholarships. Instead, she
relied on her friends to help.

**Conclusion to Question #3.**

Participants answered question #3 similarly in the area of high school experiences. A
few shared stories of educators who really impacted their career path. Unfortunately, a few
revealed that they did not receive a great deal of support from high school counselors or
teachers in preparation for college. They lacked challenging courses (even though some were
AP) or did not have access to higher level courses. In some cases, participants were not
encouraged to take advanced classes, which might have better prepared them for college. As
for ACT scores, the majority were happy with their scores personally. Only one participant
who did well on the ACT attributed her performance to a preparatory class in high school.
Several participants also received scholarships due to their ACT scores. Most agreed that the
ACT impacted their decision to go to college, but not necessarily to major in a STEM field.
Overall, the participants felt they could have been more academically prepared for college
while in high school.
Question #4: How do you feel your institution contributes to your persistence?

Four themes emerged from research which addresses research question number four. The themes involved how each of the following had helped student persistence: faculty members, institutional resources, student involvement, and financial aid. Faculty members included sub-themes about their attitudes toward teaching, accessibility, and approachability. Institutional resources included sub-themes in the areas of campus environment, housing, classes, and tutoring services. Student involvement included sub-themes concerning campus organizations and classes. Finally, financial aid included sub-themes about scholarships and grants, as well as campus jobs.

Theme 1: Faculty Members.

When the participants in this study were asked if they felt the faculty members at their institution had an effect on their persistence, the researcher noted words like helpful, easy-going, enthusiastic, welcoming, and approachable. The majority of participants responded positively. In contrast, there were also examples like arrogant, non-supportive, and discouraging. These comments were referenced toward professors teaching freshman STEM courses. Only 4 of the 13 participants felt intimidated by them. In discussing the students’ experiences with their professors, the researcher affirmed that the majority of them were positive.

Attitudes Toward Teaching.

A professor’s knowledge and enthusiasm may play a role in a student’s ability to maintain interest in the course. “Teaching style” may also have a similar impact. Twelve of the participants felt their professors enjoyed teaching. The participants had experienced a better “understanding” of the subjects their professors teach, sometimes by providing “real-life examples.” One participant found herself curious because her instructors were so into the topics he was teaching, which kept her going to class. Sometimes professors had such a
strong influence on students that they decided to major in that subject. Such is the case for one of the participants. She was “good at math,” but she did not know what she wanted to major in until one of her professors sparked her interests in math as a major.

The knowledge a professor exhibits may not be the only aspect of his job that attracts students. It seemed that there as more to the picture than just his understanding of the topics he teaches. When an instructor outwardly displays a genuine love for teaching, his students are more likely to pay attention. It makes the environment more welcoming and interesting. When they seem like they “enjoy their job,” students are captivated. Learning can become contagious. One participant admitted that a STEM professor was so excited about what he taught that the students’s curiosity was piqued. He would like to be as “enthusiastic” as his professor.

**Accessibility.**

When faculty are accessible to students, they have an opportunity to make positive connections with them. Twelve participants agreed that their professors were accessible if they needed to ask a question, as opposed to the one who disagreed. “Some are great about that,” one participant commented. There were a few cases, however, when the professors were not easy to find. This can be frustrating for students, especially for those who are first-generation. An example of this was when a participant’s advisor “would set up a meeting and not show up.” She appeared to be disillusioned by the situation, as if she could not believe that a professor could do such a thing. When asked to describe any STEM instructor who was positive about accessibility to students, “Jakayla” decribed her organic teacher stating, “He’s always in the lab working…I came to him numerous times for help, and he was willing to help.”
**Approachability.**

The transition from high school to college can be difficult, especially for first-gen students. College faculty members have the opportunity to help alleviate some of the uncertainty during this time. For example, one participant shared that her first STEM professor “was very nice and excited to be there…and you could tell he loved what he was doing.” Because “he was easy to talk to,” she felt that “he made the transition easier.” Ten participants felt that their professors are approachable, while only 3 thought otherwise.

Even a friendly gesture can influence the students’ feelings of belonging. The participants provided comments like “she’s so nice,” and “if I see her in the hallway, she’s like, hey!” When students have confidence they can talk to their instructors, they are more likely to “ask teachers for help” when needed. Even the atmosphere the professors present may allow students to feel more comfortable. Some may “crack a little joke” to help alleviate tension, even though “sometimes, they’re not that funny.” Despite her instructor’s lack of funny jokes, she felt so comfortable with the atmosphere he created that she decided to take her second semester of biology with him, as well.

Instructors who are approachable encourage students to ask questions, interject ideas, and be active participants in class. The majority of the STEM professors representing the current institution were “easy to talk to.” Unfortunately, there were cases in which students feel intimidated by a professor’s somewhat abrasive personality. One participant showed disappointment when she commented, “I found out that the ones that teach the intro classes are more caring than the higher level classes, and those that teach the higher level classes are more arrogant.” She went on to say, “One of my teachers I had seems like he doesn’t care if you pass or fail even if you try hard.” She was asked if she ever felt she did not belong in her current major. She replied, “Sometimes…because I have a teacher that if you tell him you don’t understand, then he’ll always come back with you should understand this.” Fortunately,
she was able to follow her comments with a more positive note when she discussed how “helpful and open” her cell biology instructor was. She acknowledged, “He doesn’t want to see any of the students fail.”

**Theme 2: Institutional Resources.**

Theme 2 focused on the institutional resources that were offered at the institution where the participants were enrolled. In analyzing the data from the interviews, several sub-themes have been recognized: campus environment, housing, class size, and tutoring services. The participants provided information about how these resources had supported their persistence.

**Campus Environment.**

The university represented in this study is a four-year regional institution. It is near a farming community and has a very aesthetically pleasing environment with tree-lined walkways and nostalgic brick buildings. All the buildings are easily accessible by foot, although students are allowed to drive on campus. Six of the participants felt that their college campus was welcoming. They enjoyed the location of the campus because it reminded them of their hometown. Five of the participants liked the fact that the university was close to home. The others had mixed feelings about the environment.

A participant was asked to describe the environment at her current institution. She replied, “The environment is okay, but maybe they need to step it up a little bit.” I inquired about what she meant by “step it up.” She expounded, “It just feels like high school. It needs to be updated.” This university was established in the 19th century, even so the newer buildings have been designed to represent the older architecture. One participant began her college studies at another, much larger, institution in an urban setting before transferring. She compared the two institutions. She stated that the first university she attended “felt like a big college.” She felt differently about her current institution in that it was smaller and in a rural
area. Even though she preferred a more urban environment, she agreed that the people were
very welcoming where she attended. Because she had to take some time off from college
before transferring, she was concerned that she would not be able to readjust to the college
environment. However, when she started classes, she confessed that she “didn’t feel as
intimidated.”

The small-town environment associated with the university the participants attend was
attractive to most students who also grew up in a small town. One biology major explained,
“It’s similar to my hometown. The town is small…it’s just the environment. When I came
here, I felt welcome. I just knew I wasn’t ready for a big city yet.” Another participant has
similar feelings about the size of her institution. She explained, “I definitely think that the
university being a small school is really what makes it one of the friendliest campuses, and
they’re always willing to help you.” Many participants agreed that the campus environment is
a positive aspect of the institution.

**Housing.**

There were many dormitories on campus available for students; however, only two of
the participants utilized this resource. However, two students who lived off campus expressed
their desire to live in a dorm but that it was too expensive for them. “Sydney” enjoyed living
on campus. She felt that her on-campus “dormitory/efficiency apartment” as the right choice
for her. She explained, “I can study without distraction.” She has never had a roommate, so
she cannot make the distinction between how it would be with another person around while
preparing for classes. Her dorm’s close proximity to classes is a definite benefit, since she
“can walk everywhere.”

The majority of the students interviewed either lived off campus in an apartment or at
home. “Taylor,” a student who lived off campus in a rental house, explained that his current
living situation affected his preparation for classes in a positive way. Although “being on
campus would be more convenient in just going to classes,” he thought that “being off

campus is more beneficial because you get away from it and just have time to calm down.”

He felt that being away from campus helped keep his “stress level” manageable.

Convenience has been recognized as a benefit to having off-campus housing that is

still close to the university. Such is the case for one participant. She was a very active

participant of the university track team and fortunately for her, the apartment where she

resided happened to be right beside the track. She “hated” her “freshman year living on

campus” because she was placed with someone not on the track team, unlike her teammates.

She also disliked the fact that her dorm was often loud and “distracting.” She described

herself as a “quiet person.” The university campus is surrounded by apartment complexes

and older homes that are rented out to students. “Luis” currently lives in “some apartments

less than a mile away.” Although this is not directly on the campus, it is convenient enough

for him to reach his classes quickly.

One participant who lived off-campus the entire time he has been in college wished he

had lived on campus his first year for “more of the experience.” He would have liked to have

known what it would be like to be completely immersed in campus life. “Besides that,” he

said, “I enjoy living off campus. You get a bigger room…and what I pay in four months, I

would pay in one month on campus. It’s a lot different.”

Three of the participants interviewed for this study did not wish to utilize on-campus

housing or an apartment. Instead, they chose to live at home with their parents. It may not

have been the most convenient for the them in terms of travel, but the convenience was more

financially related. These were the commuter students who were characteristic of the

institution represented. “Ella” thought “there are downsides to living at home.” She had

often thought that it would be beneficial to have a roommate who is a nursing major like

herself. She also felt that if she “lived in town, it would be easier.” Although she did enjoy
living at home, she also delt with distractions. Her tradeoff for living at home was that “it’s cheaper.” The money seemed to be the biggest factor in these students choosing to stay home. Two other participants agreed that one of the reasons for choosing the university they attended was that it was “close to home” and less of a financial burden.

**Class Size.**

Even though the university was small in comparison to a typical research institution, it offered a wide variety of degree programs in STEM fields. Most freshman classes were much larger than the upper-level classes. Three of the participants felt that small class size beyond the freshman year as a positive aspect of attending a regional institution. The majority did not feel that small class size was a major reason for choosing their institution. However, it was the large freshman STEM classes that caused the participants to feel anxious.

Regardless of whether a student was first in his family to go to college or he had been groomed by his parents to prepare him, nothing could take the place of the actual first experience in a college class. It did seem to be more of an eye-opening experience for first-gen students. Most had never been in a large lecture room setting, let alone a class with a group of unknowns. The participants were asked to explain how they felt when they walked into their first college STEM course. Many of their reactions were similar about their freshman courses being rather large. However, as they moved through their degree program, several students mentioned that class size decreased. Three participants feel that small class size is helping them persist.

One participant explained that his first college STEM course was in a “large lecture room,” larger than he had ever seen before. It was a bit “scary” for him initially. He “didn’t know what to expect.” However, he acclimated and became more comfortable. Another participant was so uneasy in her first large freshman class that she considered dropping the course. She soon realized that it did not make sense to drop the course and she eventually
overcame her fear. A participant not fond of interacting with a large group of people shared how her instructor wanted the students to actively discuss topics in a lecture room among a large student group. This was completely out of her comfort zone. Although it was difficult, at first, she realized, “…once you come out of that little bubble, you’re alright.”

Tutoring Services.

Tutoring was a service the university had provided to alleviate the hassle of finding one. These services had been or were being utilized by four of the participants. However, two participants mentioned that tutoring was often difficult to obtain. Tutoring may be the link between passing or failing a class, especially if the student had poor academic preparation for college.

One participant liked to be proactive when it came to getting a tutor. If she expected to be taking a difficult course, she signed up for a tutor before class started. Unfortunately, finding the right tutor was not always foolproof. According to another participant who had “problems with tutor assistance,” many of the students who provided their assistance stopped tutoring because they were not receiving enough payment. Although somewhat irritated about the situation, she was confident that if she could get help from her instructor if a tutor was not available. One participant actually preferred to seek out her professors whenever she needed help in a class. There were times, however, when this was not convenient.

Theme 3: Student Involvement.

Campus Organizations.

Previous research has evaluated how college students get actively involved in their institutions. Involvement may include fraternities or sororities, clubs, dorm activities, and even class participation. Fraternities and sororities are formal organizations usually thriving with activity. There are also clubs that are academically based or focused on community service in which students may be provided with strong institutional connections. The classes
students take may help reinforce their institutional ties, as well. Student athletes connect themselves through their sport. Students may also choose to attend sporting events or concerts with their peers. All of these are examples of what college students might do to help them feel like they belong to a very important establishment while pursuing their higher education goals.

The participants in this study were involved in their institution in varying degrees and in different ways. None of them were members of a fraternity or sorority, but six of the participants were associated with some other campus organization. Most of these were academic or service-oriented clubs or organizations. There was also one participant on the university track team. Sadly, four students had a desire to be involved in organizations or social events but felt they do not have the time.

The majority of the biology majors interviewed were members of the biology honors society. This organization was geared toward attracting students seeking degrees in biology, but they also emphasized good stewardship. One participant involved in this organization shared how the members would meet, then do a community project, like cleaning up a particular street in town, or make “Valentine cards for the senior citizens at the nursing home.” That was not all they did. Professionals from other institutions also were invited to speak with the students about topics like medical school. She particularly enjoyed being able to talk to her instructors on a more casual basis. When asked to describe how being involved in this organization affected her persistence in college, she responded “… it makes me feel good to be a part of something;” however she did not feel it has aided in her persistence. Another student involved in this organization felt that it has “indirectly” aided in his persistence. He elaborated, “Some of the members are my friends, and they are also STEM majors…kind-of like a little competitive thing.” He and his friends enjoy debating topics covered in their meetings.
The National Society of Leadership and Success is another example of an organization in which a few of the study participants are involved. This organization is “one of the largest academic” organizations. According to one member, students who “made the dean’s list or had a 2.5 or above GPA” received an e-mail invitation. She said she was “skeptical, but then saw there would be some benefit” to being involved. She said now that she was in the organization and has evaluated her involvement, she felt “it has positively affected” her. She was learning leadership skills as an “outreach chair” and connecting with others who have set high standards for themselves. Her participation in the National Society of Leadership and Success was also offering her opportunities to associate with students and professionals with similar interests. Another participant involved in the National Society of Leadership and Success agreed that it had been a benefit to her in a different way. She explained that some of the students involved shared her major. They now “study together and get notes” when one of the students is absent from class. The benefits to each student were regarded differently; however, their involvement was accommodating their college persistence.

The majority of students interviewed were not involved in any formal campus organization. Three participants could not participate due to lack of time. One such participant would have liked to be involved but did not see how it is possible. She hoped that might change once she was a senior. Another participant would “love to be,” but she felt that “being an active member of an organization would “take away from” what she was “trying to accomplish.” She also believed that involvement in an organization would cause her to “feel more stress and more overwhelmed.” Regardless, she wished that she could be involved.

When students live away from campus, being involved can be difficult. This was the case for one participant. She also had family responsibilities in addition to preparing for classes. She worked in her parents’ restaurant after classes and helped take care of her
siblings. She wanted to help her family, so she seemed almost torn in her desire to please her family and her wish to be involved in her institution. She admitted, “I’m missing the college experience.” Another student felt similarly but admitted that she was not as concerned about being involved now that she was about to enter her senior year. There was an urgency to complete a degree program for most of these students, yet a desire to belong to something worthwhile outside of preparing for classes.

Classes.

Attending college classes was another way students were involved in their institution, ultimately helping their persistence. All of the participants considered their involvement in their classes a major part of their college persistence. However, there was one class that two participants mentioned as being a complete waste of their time; freshman orientation. However, four students felt that it helped them connect with the university, helped them learn where things are located, and gave them a sense of what was expected of them as college students.

Informal socialization may stem from interactions with fellow students. One student explained that he was not involved in any formal campus organizations, but students in his pre-health courses worked together often. He explained, “I feel like it’s encouraged me to help me know that’s what I want to go into.” When students are encouraged by their class experiences, they are more likely to continue attending. Another participant especially loved the “hands-on labs” in her anatomy and physiology class. A senior biology major felt she was benefiting from assisting one of the ichthyology professors with research. Her work with animals was encouraging to her because she would like to become a veterinarian. In order to be accepted into vet school, she must work a specific number of hours involving research. This had prompted her to “try to do a research assistant job” because she needed “more hours.”
When students are involved in classes that are meaningful to their educational goals, they thrive. Even though one participant said she could have “benefitted from another professor,” her anatomy and physiology course was very useful to her nursing future. Although she referenced on several occasions that her courses were difficult, it was apparent that she enjoyed going to campus; even if it was the only way she could be involved. A senior math major also discussed the difficulty of a few of her courses; but she knew they were going to prepare her for her career. “Stats…I really like stats,” she admitted. “In stats, we did a lot of real-life projects. I really liked that. It helped me understand everything better. Math is super hard as it is.” Aiming to work as an actuary, she was confident that the rigor of her math courses would prepare her for what that job entailed.

Involvement in courses outside the students’ major has also proven to be very beneficial. Most participants mentioned courses that they felt have helped them in many areas of being a college student. For example, one participant felt she was “horrible at writing” until she took her English course. Another participant praised her speech class because she did not consider herself “a really good audience speaker.” She now felt differently because the class helped her to “not be so shy.”

The freshman orientation course at the participants’ institution is designed to help students transition from high school to college. Four of the participants felt that this class was beneficial to them. One participant explained that the class “helped with basic things in college like Blackboard and how to properly e-mail your professor; just the ins and outs of life on campus.” He saw the benefits in participating in it. Another student took the course online. She did not necessarily want to take the class but admitted that “it helped with time management type skills.”

Not all of the comments about the freshman orientation class were positive. Two participants actually believed it was a complete waste of their time. This was mainly due to
the way the course was presented. One participant explained that the instructor “wasn’t a fan of the class.” The only positive aspect of the course was discussing “test strategies.” Another participant said he “hated that class.”

**Theme 4: Financial Aid**

*Scholarships and Grants.*

Finding ways to fund college expenses can be difficult for many students. The case is especially so for first-generation college students. Some of these students were associated with a low socioeconomic background, which made the idea of college impossible without assistance from other sources. One participant felt that not having had financial assistance from her family in the beginning was one of the most difficult aspects of being a first-generation student. Due to her “humble upbringing,” her parents did not have the money to help her with college expenses. Most of the participants in this study belonged to working-class families who had their basic needs met but sometimes struggled financially. Their parents, not having the experience themselves, often did not know how to help their children seek out college funding. Twelve of the participants received scholarships or grants to help them pay for college.

When the participants were asked why they chose this particular institution to get their education, most mentioned the receipt of scholarships. One participant admitted that she chose her institution mainly because “it was fully paid for.” Since her scholarship only covered tuition, she felt extremely fortunate to have assistance from her family for other necessities such as food, clothing, and textbooks. She would have liked to work, but she did not think she could manage a job and her course load.

Being first-generation college students, several of the participants did not know how to find scholarships. One participant felt that he was not well-informed about his options because his parents could not guide him. Fortunately, he received a scholarship for his high
ACT score, but his parents assisted him with any outstanding expenses. Another student was expecting to go to a community college until he received a scholarship to his current institution. He also received federal financial aid, but it was not enough to cover all of his expenses, so he had to get a job with long work hours. This had been difficult for him because he had “less time to study.”

One participant received a track scholarship which was one of the attractive features of attending her institution. College was not her original goal. She had actually planned to go “into the military.” She explained that her mother encouraged her to go to college since she “got the scholarship.” This financial aid paid for her “tuition, books, and a meal plan.” She also received a Pell Grant and a leadership scholarship for her first year. To help pay the excess expenses, she worked through her sophomore year. She recognized that she would need “more time to study” organic chemistry, so she felt it best not to work anymore.

How the students would ultimately pay for college was an issue for all the participants. If they did not get a scholarship or grant, the participants had to get help from family or get a job. The majority relied on many financial sources to cover the costs of earning a higher education.

**Campus Jobs.**

The participants in this study attended a university that offered job opportunities on campus. However, only four of them took advantage of this opportunity. They benefited by being allowed to study while on the job. One participant’s occupation included calling alumni to solicit donations for institutional programs. She said she spends “a lot of time working to make good grades” so being able to study while actually being paid to do a job was an advantage. Doing well academically was a requirement for keeping her scholarship. The scholarship money seemed like a lot but she knew that “money goes fast.” Another participant loved her job at the library. When not doing her duties, she was studying. Without
financial assistance through her job and scholarships, she would not have been able to attend college. Other examples of campus jobs shared by the participants included assisting the instructors, working in academic offices, and the on-campus security office.

Financial assistance was not the only benefit these students gained from having on-campus jobs. They also help them be more connected to the campus and may be more knowledgeable about the campus layout. For example, if help was needed with something concerning her institution, one participant felt certain she “could find a person” to help her, and all because she learned her way around campus due to her job.

**Conclusion to Question #4.**

Question #4 revealed more themes and sub-themes than the other questions included in the investigation. The participant responses to the questions about how the institution helps persistence were varied. First of all, the faculty members’ attitudes toward teaching, accessibility, and approachability were deemed mostly positive. However, there were a few negative comments about individual professors showing a lack of interest in their students. All students found that their current institution was a good fit for them, mainly due to the smaller size of the institution and the small-town feel in which the participants were most accustomed. Most did not like the dormitories because they were too expensive or too loud and chose to live off campus.

The participants were both academically and socially involved in their institution. They felt that attending and preparing for classes was the most important aspect of college. A few participants had negative experiences in classes because they did not feel they were prepared academically. Four participants shared comments about the intimidation they felt in their first STEM course. They also had a difficult time transitioning from high school to college because they did not know much about what to expect. Some felt that their freshman orientation class helped with this somewhat, as did tutoring services. More than half of the
participants were not involved in any campus organizations due to time constraints. Those who were said it was mainly for academic purposes and not social, although interacting with other students is a form of informal socialization. They felt that being involved in their institution academically was more important, yet some revealed that they wished they had more time for social interactions.

Financial assistance may come in many forms, but the majority of participants interviewed would not be able to attend college had it not been for scholarships or grants. Although they received some help from family, most of the participants worked either on or off campus to supplement the cost of attending college. Those who did work on campus found that it was a very rewarding situation in that they could study for classes while on the job. In most cases, the participants relied on many forms of financial assistance in order to remain in college.

**Summary**

This investigation sought to understand the characteristics associated with persistence and retention among first-generation STEM majors. The participants represented both male and female genders, along with a variety of ethnic and socioeconomic backgrounds. They provided their personal experiences in dealing with their own beliefs about higher education and how earning a degree may help them reach their future goals. They painted very colorful pictures about their families, friends, and high school experiences. Finally, the participants shared how they have managed to persist and be retained by their current institution despite some of the hurdles they have faced. Their views on the university’s faculty and resources were explained, along with how their involvement in the institution and financial aid has helped them to keep moving forward.
CHAPTER V

CONCLUSIONS

This study focused on a unique group of college students, first-generation STEM majors. The fact that they were first in their families to persist in college is not unique, but being first-gen and STEM majors who are persisting is distinct. The title first-generation college student may be defined in several ways. Some may define them as students whose parents did not attend college at all (Collier & Morgan, 2008). For the purpose of this study, a first-generation college student is one in which neither parent completed a college degree program (Pascarella et al., 2004). Some of their parents may have taken a few college courses, but a short college experience does not provide a great understanding of persistence (Schultz, 2004). First-generation STEM majors are facing multiple obstacles, and many are failing. However, there are some who are persisting and being retained by their institutions.

Although persistence and retention are similar in that they are associated with achievement, one is an individual explanation, while the other is an institutional explanation. A student may not be able to explain why her institution is retaining her, but her persistence is likely correlated in some way to the institution’s efforts. Persistence is how students manage to continue through their college program to graduation (Berger et al., 2012). Retention, on the other hand, is defined by the steps institutions take to keep students enrolled (Braxton et al., 2014).

The investigation revealed several characteristics associated with student persistence and retention among first-gen STEM majors. Information through personal interviews was obtained regarding several factors. Themes and sub-themes were developed that provided a more in-depth look into first-gen STEM major persistence and retention. The following
themes were included in the investigation: personal beliefs about higher education, supportive relationships, high school experiences, and institutional contributions.

Participant stories reflected how first-generation STEM majors may overcome what so much of the past research has discovered as hurdles. An understanding of the characteristics associated with their persistence and retention was gained. This chapter focuses on the conclusion from the study, and a discussion, followed by implications for high schools and higher education institutions, as well as further research based on the findings. Due to the nature of most of the literature, concerning either first-gen students or STEM majors, some inconsistencies are expected.

Discussion

The purpose of this investigation was to determine characteristics that enable first-generation STEM majors to persist and what the institution might be doing to aid in their retention. The findings allowed the researcher to understand these characteristics associated with persistence and retention. Themes were constructed from the literature on first-generation students and STEM majors. Sub-themes developed as a result of the participant interviews. Their answers to questions about their persistence enabled the researcher to draw conclusions about how and why first-gen STEM majors are able to persist despite expected hinderances.

Four themes developed from the literature about first-gen students and STEM majors. Each of the themes were associated with their effect on persistence or retention and included personal beliefs about higher education, supportive relationships, high school experiences, and institutional contributions. The 13 participants represented diverse ethnic backgrounds, including African-American, Asian, Asian-American, Hispanic, Caucasian, and mixed races. Some literature showed that first-gen students were usually from ethnic minorities (Bui, 2002). On the other hand, a few researchers disagreed, saying that most were actually white.
(Stuber, 2011). Still, others saw the first-gen persistence and retention issue as one that is affecting students from multiple backgrounds (Forbus, Newhold, & Mehta, 2011). However, when looking at research concerning STEM majors, African-Americans and Hispanics make up the lowest percentage (Thompson & Bolin, 2011). Five of the 13 participants were from underrepresented races (African-American and Hispanic). This information, when associated with STEM majors, was inconsistent with the ethnic makeup of the participants in this study; however, this study included a small sample. According to Bui (2002), first-gen students are usually older than students entering college straight out of high school, which did not coincide with the findings from the current study. The participants were of traditional age, except for two. Although they each had a different story to tell, most shared common characteristics concerning personal beliefs about higher education, parental influence, and institutional influence. Each area will be evaluated throughout this chapter.

Tinto’s Theory of Individual Departure (1987) was used as the theoretical framework. This investigation supports Tinto’s theory in several ways, but there is one area that slightly deviates from his theory. The characteristics of first-generation STEM majors that reinforce this theory are student goals and commitments, family support, academic and social integration, and institutional support. The circumstances experienced by the participants in the area of pre-college education are varied and do not consistently support Tinto’s theory.

The participants were highly motivated to succeed. The majority attributed their drive to obtaining a better future, their interests in STEM, and acquiring financial stability. Their strong goals and commitments to their institution supported Tinto’s theory as it correlated with their persistence. The participants’ goal commitments were personal, but their institutional commitment was largely a result of the resources their university offers: scholarships, faculty support, and environment.
Support for these first-gen STEM majors was not only exhibited by their institution but also by their families. Even though their parents had not earned a college degree, they affirmed their children’s decision to get a higher education. The participants attributed much of their success to their families standing behind their goals, which also supported Tinto’s Theory of Individual Departure.

The participants were academically integrated in preparing for classes and maintaining good grades. Although in varying degrees, they were also socially integrated by being involved in campus organizations and peer study groups. According to Tinto (1987), “Positive experiences – that is, integrative ones – reinforce persistence through their impact upon heightened intentions and commitments both to the goal of college completion and to the institution in which the person finds him/herself” (p. 113). The participants had more positive than negative experiences to reinforce their decision to remain in college. Their external commitments (mainly work) were important, yet the participants learned to balance this with all other commitments. They found ways to separate themselves from their personal culture and integrate themselves in their institutional culture, even if not completely. Tinto (1987) posited that partial institutional integration may be enough for some students to persist. Therefore, the findings pertaining to student integration supported his theory.

The only characteristic discovered in this investigation that did not uphold Tinto’s Theory of Individual Departure was academic preparation. Student ability, based on pre-college education, was recognized as a predictor of persistence (Tinto, 1987). The participants’ high school academic experiences were varied. Almost 70% of participants took AP or DE classes. However, 45% did not feel they were helpful. Furthermore, 15% of the participants felt that their high school STEM classes were not beneficial. The findings did not support Tinto’s theory entirely because even though several of the participants did not receive the most effective pre-college education, they were still persisting. It was not certain whether
they would persist at a larger research institution given their lack of college preparation. It did appear, however, that there was a correlation between college student persistence and the application of many characteristics, not one specifically.

**Personal Beliefs About Higher Education.**

The perspectives of the participants in this investigation about higher education were similar. Eleven of the 13 participants viewed the opportunity as a way of bettering their future. A significant number of participants (11) desired to have careers they love, but also admitted the idea of a better income was attractive. This was consistent with previous research in that some STEM majors expected to earn more money as a result of their degree (Erbes, 2008). With almost half of the participants belonging to families that were in a lower socioeconomic class, the participants would like to avoid the financial struggle most of their parents have experienced. Although money is a necessity, few disclosed that an increase in income resulting from a college degree, or a STEM degree, was their only reason for attending college or majoring in a STEM field. Prior research has shown that many college students want a degree in order to gain a better financial future (Propsero & Vohra-Gupta, 2007). The love for the subject they are studying or how they might help other people was the overall influence for their drive to succeed.

Tinto’s Theory of Individual Departure (1987) emphasized the need for students to maintain goals and commitments to their institutions in order to continue down their higher education path. The participants in this study possessed a great deal of motivation to reach their goals in spite of personal set-backs. All chose to go to college because they saw themselves enjoying a career that requires a college degree. They seemed to exhibit an urgency to complete their degree and not waste valuable time. These students pushed through each day with the end product in mind. Despite their motivation, however, many have dealt with uncertainty about their chosen major or their ability to complete college. Eleven participants
admitted to having been uncertain about earning a STEM degree, while 4 have had uncertainty about attending college altogether. Wavering self-confidence is typical of first-gen students (Engle, Bermeo, & O’Brien, 2006). Therefore, the findings were consistent with the literature. The majority of participants felt that they knew what they wanted to do career-wise; however, 6 of them understood that their most desired career choice may not materialize. Furthermore, these participants understood that they did have career options with the degree they were earning. There was a correlation between choosing a STEM major and having a parent with a STEM career (Takruri-Rizk, Jenson, & Booth, 2008). None of the participants in this investigation had parents in STEM fields. They associated choosing a STEM major as a result of their intense interest in STEM subjects, thus the findings were inconsistent with the literature, as well. By continuing to remain goal-oriented, the participants were exemplifying what Tinto found to be a characteristic of persistence.

Supportive Relationships.

Tinto’s Theory of Individual Departure (1987) included the impact that parents have on their child’s college education. Parents motivate their children by reminding them they can be successful if they work hard enough. They also emphasize the need for a higher education to provide a career that earns an income that is usually higher than without an education. However, parents who did not go to college cannot provide their children with the type of support associated with college life (McCarron & Inkelas, 2006) such as the application process and course responsibilities (Bourdieu, 1973). Financial freedom seemed to be what the parents of the participants were hoping their children will obtain. Grandparents, aunts, uncles, and siblings could also be influential in a student’s decision to go to college and persist. Support from family came in various forms: verbal encouragement, providing living space, and financial assistance. All of the participants said their parents were very supportive.
of their pursuit of a college degree through verbal encouragement, and they were one of the main reasons for going to college.

Parents of the participants were viewed as supportive, but they often did not understand why their children spent so much time on campus or preparing for classes. Four of the participants stated that their parents had this mindset, which was especially true of parents who did not attend college. They did not always comprehend the need for their child to be involved in their institution (Murphy & Hicks, 2006; Shultz, 2004), which was consistent with the findings. Although only four participants mentioned this about their parents, the other parents may not understand their child’s need for preparation time or integration, but did not voice their thoughts. There were, however, no references in the literature that expanded on parent understanding of time needed on campus for STEM majors alone.

Financial support from family had helped 8 of the participants. Although they did not pay for everything, these parents were supplying necessities, like food and clothing, which was helping the participants persist in college. Most participants did not have family responsibilities outside the typical household chores, but 7 had jobs because their parents could not pay for all of the extra costs. This was somewhat consistent with the literature on first-gen students. Previous research found that first-gen students lacked academic engagement because of family responsibilities and work (Kuh, 2008). Tinto’s Theory of Individual Departure (1987) explained that the external commitments some students have may take away from their ability to become integrated in their institution both academically and socially. The participants in the current study did not allow their work responsibilities to interfere with their academics. However, work did frequently prevent them from being as involved in campus activities as they would have liked. Three of the participants lived at home with their parents. Although they agreed that this situation saved them money, they often wished they could have been more involved on campus.
Aside from family, 6 participants viewed their friends as encouraging but did not consider them to be a reason for going to college. Friends from high school did not influence the participants as did those associated with their campus. Some had friends they became acquainted with in classes and share the same major. They participated in study groups with friends and got help from them when they had a question about a class or the institution. They aided with planning their schedules and preparing for classes. Four participants also felt that having friends in the same major allowed for academic competition. It encouraged them to do their best. The participants did not feel, however, that they spent much time in social situations. According to Tinto (1987), social integration was a significant part of student retention and may include study groups. Therefore, even if the participants did not consider study group time as social, it still qualified as such. The participants may not have been as socially involved as their more traditional peers, but their social integration was proving to be enough to aid in their persistence and retention.

**High School Experiences.**

First-generation students are often not prepared for challenging college courses (Jehangir, 2010) because they do not have advanced courses in high school, especially in STEM fields (Choy, 2001). On the other hand, when first-gen students are given meaningful STEM experiences, they are more confident to major in a STEM field (Packard, 2016). This was somewhat consistent with the findings concerning STEM majors. Six of the participants felt that they had helpful STEM courses in high school, while 2 disagreed with the rigor in their high school STEM courses. Nine of the participants in this study took AP or DE courses in high school, but only 5 found them helpful. The other 4 felt they were mostly a waste of time due to the lack of rigor. Therefore, just calling courses AP or DE did not mean that the experience was going to be significant.
The participants who did not believe they entered college well-prepared academically were still driven to earn a degree. Even though they all bore the title *first-generation college student* and had similar college experiences, their personal experiences were diverse. Two attended high schools that did not offer advanced courses. Furthermore, those who had AP courses in their schools did not consistently utilize them. The participants were not always encouraged by counselors to take them or they did not understand the need. This was consistent with the research of Pascarella et al. (2004).

The majority of the participants felt satisfied with their ACT scores. Only one participant attributed her high score to an ACT preparatory class. According to Thompson and Bolin (2011), ACT scores are a likely predictor of STEM major persistence. Unfortunately, not all of the participants in the current study viewed their ACT scores as desirable. However, they scored high enough to be admitted into their current institution and were still persisting.

High school counselors (Barry, Hudley, Cho, & Kelly, 2008) and teachers can have a big impact on a first-gen student’s decision to go to college (Ward et al., 2012). Nine participants in this study shared that their counselors were sometimes helpful with college planning, but in some areas there could have been more college preparation. Several mentioned that they could have benefited from more assistance with finding and applying for scholarships. Others who were less inclined to ask for help from counselors or teachers just got help from friends in those areas. Although there was some evidence that teachers had an impact on these students in choosing to go to college, there did not seem to be an overwhelming influence from them nor a great deal of assistance offered to them. Nine participants felt that they had at least one teacher who encouraged them to either go to college or major in STEM. First-gen students are not as likely to persist when they have not received substantial support while in high school (Bryan, Moore-Thomas, Day-Vines, & Holcomb-
McCoy, 2010). According to Tinto (1987), students who are more prepared academically before arriving on campus are more likely to persist. The findings were somewhat consistent with the literature. The participants may have received a little support in high school from counselors and teachers, but they had not allowed any lack of support to affect their persistence.

**Institutional Contributions.**

Once students leave high school and enter into higher education, the culture changes. First-gen students often do not know how to adapt to this new culture (Oldfield, 2007). However, when students are satisfied with their institution, their retention is more probable (Tinto, 1987). The fact that the participants were being retained was a testament to the institution. Faculty, institutional resources, involvement in the institution, and financial aid all played a role in student retention. According to the responses in this investigation, the university represented seemed to meet the needs of most of the participants. According to Byrd and MacDonald (2005), smaller institutions like the one represented in this study are typically more suitable for first-generation students. The institution associated with this investigation was not considered a research institution, but the participants felt that they had been offered valuable research opportunities that would aid in their understanding of their field of study.

The campus environment associated with the participants’ institution was viewed as mostly positive. According to Packard (2016), students who are first-generation increase their chances of persisting when they feel a sense of belonging at their institution. All of the participants agreed that the size of their university was suitable for them. This was consistent with research concerning the success rate of first-gen students at smaller institutions (Byrd & MacDonald, 2005). Six of the participants felt that their institution had a welcoming environment. The majority of faculty were welcoming and approachable, as well. Ten
participants agreed that their professors seemed to enjoy teaching. Ten participants also believed their professors were approachable, meaning that they felt comfortable talking to them or asking questions. Furthermore, eleven participants felt they were easily accessible and seemed to care about their students’ success in their classes. Only 3 participants felt that their professors were not approachable, and only one believed they were not accessible. The faculty were knowledgeable about the subjects they teach, challenging their students, yet offering help when the need arose. Many professors seemed to try to make their students comfortable. According to Pascarella and Terenzini (2005), instructor support for students is as important to their persistence and retention as their ability to instruct them. Four participants shared negative comments about the professors having arrogant attitudes, some in the freshman courses while others were noted in the more advanced courses. The participants stated that freshman classes were rather large in size but were much smaller as students move through their degree programs. In spite of a few negative experiences, the participants believed their professors enjoy what they did at the institution. Therefore, the literature was mostly consistent with the findings from this study.

Institutional resources such as housing, tutoring, and freshman orientation courses were available to aid in student persistence and retention. These resources were available to all, yet they were not utilized by all of the participants. Of the three mentioned, the freshman orientation course was the only resource that every student must take upon entering the institution as a freshman.

The choice concerning where to live while in college was varied among the participants in this study. Most students did not live on campus because it was too expensive (mentioned by 2 participants) or they preferred to live off campus. Previous research has shown that students who do not live on campus have a difficult time connecting with their college culture, thus decreasing their chances for success (Pascarella et al., 2004). Only 3 of
the participants lived at home with their parents because it was familiar and saved them money. Some even commented that the dormitories were too loud, making the environment unsuitable for studying. However, those who did live in the dorms (2 participants) seemed to enjoy being there. For those 11 participants living off campus, their situation did not seem to hinder their persistence or retention.

Tutoring was another resource offered by the institution but was only used by four of the participants. Fortunately, they seemed to benefit from it. This was consistent with the literature in that first-gen students often perform better while being tutored (Padron, 1992). Consequently, two participants experienced issues with the institution not having enough tutors, so they sought help elsewhere. The majority of participants were not afraid to ask questions for fear of being judged as incompetent or search for help when necessary. According to Jenkins, Miyazaki, and Janosik (2009), first-gen students are not usually confident enough to ask for help when needed. This may not be characteristic of first-gen students, but the participants in this study exhibited a kind of tenacity to do whatever it takes to succeed, which also included finding resources.

Based on prior research, students who are heavily involved in their institution are more likely to persist and be retained (Tinto, 1987, 1993). The participants in this study did not consider institutional involvement to be the most important aspect of their educational experience. However, attending classes is considered involvement (Tinto, 1987, 1993); so these students were very much involved. All of the participants felt that their classes were preparing them for their goal to earn a STEM degree. There was one class, however, that not all participants agreed upon as being helpful - freshman orientation. This course was a requirement when the participants began college unless they transferred from another institution. Four participants felt that the course was somewhat helpful, while 2 felt that it
was completely unhelpful. Most who responded believed that some changes to the course might benefit first-gen students more.

The participants in this study were more concerned with preparing for classes than socializing, although many confessed to feeling that they were “missing out” on campus activities. Because so many of the participants must work (7), they did not often have extra time for campus organizations. Six participants were associated with academic organizations, clubs, or sports, which did allow some social interactions. Although the students enjoyed their connection with their organizations, their primary purpose for involvement was retaining scholarships or gaining valuable job skills. They tried to ignore that they would like to be more involved socially because they needed to stay focused on finishing their degree. According to Kuh (2008), it is atypical for first-gen students to involve themselves in academic groups. However, the majority of students in the current study did participate in study groups and academic organizations associated with their majors. Therefore, the findings were not consistent with the literature about first-generation students.

The participants came from low to middle socioeconomic families and represented a variety of ethnic backgrounds. Five of them belonged to ethnic groups considered underrepresented in STEM fields (African-American and Hispanic), according to Thompson and Bolin (2011). Finances were an issue for all of them. The majority had been awarded scholarships or federal financial aid, which was rated as one of the most important aspects in their ability to attend college. Due to the institution’s assistance with financial aid, they were experiencing what their parents did not or were not able to experience themselves. According to Whalen and Shelley (2010), STEM major retention is impacted by the amount of financial aid received. Three of the participants had campus jobs that allowed them to study while working, which was supported by literature as having a positive effect on retention (Whalen & Shelley, 2010). Jehangir (2010) found that most first-gen students work to pay their own
tuition and do not receive financial assistance from family. Very few of the participants were relying on assistance from family for tuition but received some help for other expenses. Scholarships were allowing 12 of the participants to attend college. Those who were receiving scholarships were also experiencing a form of institutional support (Pascarella & Terenzini, 2005). It was very important for those students to maintain the grades necessary to keep their scholarships while working and attending classes. Their academic integration, which was extremely important for persistence (Tinto, 1987, 1993), was also directly affecting their ability to keep scholarships, which also led to retention.

**Implications**

This study revealed that college students who were first in their families to attend college or persist in higher education often lacked valuable information about how to prepare for college. With this in mind, there were actions that education professionals should take to help these students successfully traverse college life. When parents do not have knowledge of what is needed to prepare for college, teachers (Ward et al., 2012) and counselors (Barry, Hudley, Cho, & Kelly, 2008) may guide their children. Even before a student enters high school, he should already have a plan for his future education (Whalen & Shelley, 2010). High school should then aid the student in setting goals for his future education. Once in college, first-generation students need to stay connected to their institutions (Tinto, 1987). This may be accomplished through various strategies. The following are recommendations for high schools and institutions of higher education for aiding first-generation STEM majors in their pursuit of a college degree. In addition, recommendations are offered for future research concerning first-generation STEM majors.

**Implications for Practice Among High School Teachers and Counselors.**

Based on the results of this study, three recommendations are offered with first-generation students who might also be interested in STEM fields. These recommendations
focus on recruiting students for STEM fields, helping them plan ahead, and providing guidance along the way. The students in this study have received encouragement from many different people, but many of them lacked the guidance they could have benefited from while in high school. These students are highly motivated; however, other first-gen students may require more support to enter higher education and be successful.

First of all, college planning should begin early in a student’s education, even before high school. Although not every child aspires to be a college graduate, those who have the desire and the drive to succeed in higher education should be given opportunities to gain experiences in high school that will groom them for college courses. This is especially so for students belonging to underrepresented ethnicities in STEM fields. With so few minority students in STEM fields today, students who show interest in STEM fields should be encouraged to investigate STEM careers as options. With early intervention, the students’ high school should include AP and DE courses in their 4-year plan, which are intended to be more challenging than general education classes. With increased rigor, high school students are expected to acquire the tools needed to transition more fluidly into higher education. Counselors should find out who the first-generation students are in their schools and encourage them to take the more advanced classes, as well as help them find tutors when weaknesses are discovered. High school counselors should also help first-generation students find the right college for their interests, aid them in the college application process, and assist them in finding financial aid. Counselors and teachers should encourage parents to be included in the college planning process, as well. With support from both counselors and teachers, the transition from high school to college may be substantially less stressful and confusing for first-generation students.

Secondly, students who have hands-on laboratory experiences early in their education are more comfortable with the setting and develop valuable problem-solving skills. High
school teachers should help them gain these experiences by implementing more laboratory practice. In areas where funding is limited for STEM classes, teachers should seek out grants to buy supplies or receive training. They should also help students with deficits in STEM subjects by offering tutoring or developing peer tutoring programs. Students who have confidence in understanding STEM subjects are more likely to consider earning degrees in these areas. With a need to increase diversity in STEM fields, students of all ethnic backgrounds should be given opportunities to develop interests in these fields. Furthermore, positive experiences in STEM classes will likely inspire students to further investigate their interests that could lead to a STEM-related career.

Lastly, as suggested by Whalen and Shelley (2010), first-generation students may benefit from programs that help them make the transition from high school to college. Even though the participants in this investigation are persisting, other students who are not quite as confident about the change are more likely to manage it if they are given support beforehand. If schools develop a culture that embraces higher education as an attainable goal, there will be a shift in the student mindset that they can achieve their goals given hard work. This includes incorporating colleges and universities in the plan. High schools should arrange visits from higher education faculty to not only talk with students about the college experience, but work with them in the classroom or laboratory. These experiences will allow first-gen students who are considering STEM majors to gain confidence in working with college faculty in solving problems and realize deficits in understanding concepts in order to better prepare for the rigor of college courses. Students who lack the confidence necessary to persist may gain it as they are exposed to the expectations of college academics while still in high school.
Implications for Practice Among Higher Education Professionals.

According to participant feedback during this study, three recommendations for higher education professionals (faculty and policymakers) are offered. These recommendations are associated with supporting students who are first-generation STEM majors. Students who belong to this unique group will benefit from institutional support more than their more traditional counterparts. Recommendations are offered in the areas of on-campus housing, increasing opportunities for integration, and faculty training.

Participants in this study discussed the cost of on-campus housing being too expensive. Due to the high cost, some students are unable to live on campus. If students are to truly become integrated in their institutions, they should offer more affordable housing; especially the first year. Allowing first-generation students to reside on campus is expecteded to increase their likelihood of persistence. Requiring that students reside on campus as freshmen will help first-generation students integrate themselves in the college culture more quickly. They will be close to classes and campus activities, including those offered by the dormitory, that will allow them to get involved more often. This will help increase the students’ institutional commitment, ultimately aiding in persistence and retention.

Integrating potentially at-risk students is aided by programs and opportunities for potential first-gen STEM majors to get connected with each other in order to establish stronger ties to the institutional culture. High school students also need to be made aware of what it costs to attend college and how to fund it. Getting first-gen students comfortable with the idea of going to college should include communicating with higher education professionals. This may include summer laboratory experiences or programs that allow high school teachers and college professors to collaborate in the classroom. Summer laboratory experiences allow students to polish skills needed to be successful in STEM courses and develop positive relationships with other students and faculty. Helping these students develop
a sense of belonging in what may be considered a foreign world, will encourage them to persist. Considering the comments made by participants about the lack of rigor in their high school AP and DE courses, teacher collaboration with college professors has the potential to remedy this problem. With better teacher training, high school students will get the level of instruction they need. Bringing college STEM instructors into the high school classrooms and laboratories will provide a model for high school teachers as well as encourage opportunities for students to interact with an expert in his field. Involving the instructor’s own college students may also lead to valuable discussions about college preparation and expectations. Financial aid professionals from local institutions should also visit high schools to discuss the students’ options in paying for college. This is especially necessary for first-generation students.

Finally, higher education institutions should offer more training for STEM faculty to understand how to connect in a more positive way with their students, especially those who are first in their families to go to college. College faculty have so many responsibilities that they often do not know how or attempt to create positive student-faculty relationships. According to Kokkelenberg and Sinha (2010), many STEM instructors lack this ability. Institutions with a high dropout rate among STEM majors should consider forming faculty mentoring programs to help encourage STEM major involvement (Griffin, Perez, Holmes, & Mayo, 2010). Tinto’s Theory of Individual Departure (1987) recognizes faculty/student interactions as having an impact on retention. According to this theory, college students who have positive relationships with faculty have a greater chance of being retained. First-generation students enter college with a lack of understanding about how to navigate. Faculty members have the ability to be positive mentors for these students, especially those who lack STEM skills, to guide them toward the courses or tutoring they may need to increase their chances of success.
Implications for Future Research.

In reviewing the data, two recommendations are offered for studies including first-generation STEM majors. There is very little literature involving this unique group of students. There is a great deal, however, that includes either first-generation students or STEM majors. The two factors together seem to be associated with characteristics that are similar to each group, yet with a few unexpected components. The recommendations offered deal with family support among first-gen STEM majors and four-year research institutions.

First of all, personal motivation was found to be a major characteristic of persistence among first-gen STEM majors. All of the participants in the study received support from their families in one form or another; verbal encouragement or financial help. Therefore, quantitative studies should be conducted at other institutions to determine if first-gen STEM majors are persisting even without family support. If they are, qualitative studies should be conducted to determine what is keeping them in college. Tinto’s revised Theory of Individual Departure (1993) could be used as a theoretical framework at institutions with large numbers of minorities (African-American or Hispanic) to explain their persistence. This theory focuses more on the ability (or inability) of students to disconnect from their culture (external commitment) and connect with the college culture as a predictor of retention. Other investigations should be performed to determine if African-American first-generation STEM students are persisting more at HBCUs, which may be more similar to their personal culture.

Secondly, a broader understanding of first-gen STEM major persistence and retention may be gained with a larger sample in a different setting. The current study included a small number of students who have spent most, if not all, of their time in higher education at a regional four-year institution. The second recommendation is for quantitative studies, with more participants, to be conducted to determine if first-gen STEM majors are persisting and being retained by larger research institutions. If they are remaining, then how is this possible?
Longitudinal qualitative studies of first-generation STEM majors (beginning during their freshman year) would likely illuminate the characteristics these students possess personally and academically that allow them to persist. By analyzing the results of such studies, institutions are likely to find ways to better support first-generation STEM majors, leading to increased retention.

**Summary**

This qualitative investigation contributes to scholarly literature on persistence and retentions of first-generation STEM majors. The participants in this study were unique in that they belonged to two groups often associated with lack of persistence and retention. The results from this study provided a greater understanding of the characteristics associated with persistence and retention among first-gen STEM majors in relation to Tinto’s Theory of Individual Departure (1987). This theory emphasizes academic preparation for college, goal and institutional commitment, and academic and social integration in order to associate with the college culture. This study showed that first-gen STEM major persistence and retention was the result of many characteristics. Every example is unique, yet there is a culmination of characteristics associated with most of the students interviewed that has allowed them to succeed.

College students majoring in STEM are more likely to be Asian, than white, with even fewer represented by African-Americans and Hispanics. Almost half of the participants in this investigation were from groups that were underrepresented in STEM fields; i.e. African-American and Hispanic. Several were also from low socioeconomic backgrounds. First-gen students are showing an interest in STEM fields and should be recognized as a unique group that may offer the diversity desired in STEM fields. These individuals may also possess the very talent needed in STEM jobs but are possibly overlooked due to their lack of understanding of what is necessary to be successful in higher education. First-generation
college students must overcome situations their non-first generation peers do not experience. However, their drive to succeed, along with support from their families and institutions, allows them to keep moving forward.

The participants in this investigation were motivated to succeed regardless of their personal setbacks. Their pre-college education was varied, with some having advanced classes and while others did not. They were academically integrated in their institution, which is one of the components of Tinto’s Theory of Individual Departure (1987). Although many of the participants lived at home with their parents, they managed to separate home life from college life. However, they often did not have time to be socially integrated at their university. Tinto (1987) saw social integration as an important aspect of student persistence. Even though the participants did not experience a great deal of social integration, they were able to connect with other students in study groups and academic organizations. Their time involved on campus was limited, but they were persisting. The results from studies about first-gen STEM major persistence and retention has the potential to help high schools determine how to better prepare these students and their families for college. Their teachers and counselors should aid in the college application process, as well as offer help in finding financial aid; because parents who did not attend college have no experience to assist their children. Preparation for the goal of going to college for first-gen students should begin even prior to high school. Also, young students who show interest in STEM fields should be provided with opportunities to develop skills through hands-on investigations.

Results from studies of this kind will enable higher education practitioners to examine what programs, classes, or organizations might be implemented to help these students persist and be retained to graduation. With increased awareness and support for first-gen STEM majors, more students from diverse backgrounds will graduate equipped with the skills
associated with highly qualified workers. Graduates have the potential to obtain careers they enjoy and jobs that secure their financial future.

Further research in the area of first-generation STEM major persistence and retention is needed to ascertain what influences them to keep going, despite the many obstacles they may face. If more students from low socioeconomic backgrounds are given the support they need, they are more likely to overcome financial concerns. Also, if more opportunities are offered to underrepresented students to develop STEM skills, they have a greater chance of filling the diversity gap in STEM careers.
REFERENCES


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Hong, B. S., & Shull, P. J. (2010). A retrospective study of the impact faculty dispositions have on undergraduate engineering students. *College Student Journal, 44*(2), 266-278.


national-universities/freshmen-least-most-likely-return


Hello, my name is Lorie Burnett. First of all, I want to thank you for your willingness to be a part of the study I am conducting. I would like to tell you a little bit about the purpose of the study. Previous research has shown that first-generation college students face obstacles in college that sometimes lead to drop-out. Researchers have also shown that students majoring in science, technology, engineering, or math (also known as STEM) struggle as well. With the retention rate of college students who are first-generation and STEM majors being lower than is desired, I would like to find out what characteristics are associated with the persistence and retention of students who are continuing their college studies.

You will be asked a series of questions during this interview that will help me identify what aids the success of first-generation college students who are also STEM majors. This face-to-face interview will last about one hour. For clarification purposes, I may also ask a few follow-up questions through e-mail. You and your institution will remain completely anonymous throughout the study. Before the information you share is submitted, you will be allowed to review the written transcript. Please feel free to ask questions at any time during the study. I look forward to working with you to find out what has helped you succeed in college.

Question Set #1

1. What is your major and class ranking (sophomore, junior, or senior)?
2. What is your age, gender, and ethnicity?
3. Can you tell me a little bit about why you chose a STEM major?
4. Did income, as a result of earning a STEM degree, affect your decision to choose such a major?
5. What caused you to choose your current institution to study in the area mentioned?
6. What are some of the things you do in your major studies at this institution?
7. What are some of the things you have done in your general education courses that have helped prepare you for your future?

8. Have you taken classes at any other institution? Why? Why did you leave?

9. Did either of your parents attend college for any length of time?

10. Did having parents that did not complete a college degree program have any effect on your decision to attend college?

11. Has anyone in your life been instrumental in your decision to go to college?

12. How did this individual impact your decision?

13. What kind of programs did your high school have in place to aid in college preparation?

14. Did you utilize any of these programs? Which one(s)?

15. Do you feel that these programs were effective in helping you prepare for college? Please explain.

16. Do you recall any teachers or counselors you helped you decide your post-secondary education path? Tell me about your discussions with that individual.

17. When you were in high school, how did you feel when in a math or science class? Please explain in as much detail as possible.

18. Was there ever a time when you did not think you would go to college? If so, why?

19. How do you think the ACT exam impacted your decision to go to college?

20. How do you think the ACT exam impacted your decision to major in a STEM field?

21. Describe your experience with the college application process. Was it difficult?

22. Are there programs at your current institution that helped you transition from high school to college? Please explain your experiences. (Example: Freshman Orientation)

23. Have you always been a STEM major? If not, what was your previous major?

24. At any point during your college education, did you consider changing your major? If yes, which major were you considering? Why?

25. Where do you live?

26. Do you have a roommate that is also a STEM major? If so, does he or she encourage you in any way?
27. How do you feel your current living situation affects your preparation for classes?
28. Can you explain how you felt when you walked into your first STEM course?
29. How did the instructor behave?
30. Was the environment welcoming? If yes, in what way?
31. Was the class large or small according to your standards?
32. Did this class aid in your confidence to become a STEM major? If yes, how so?
33. Please describe your instructors’ attitudes toward teaching.
34. Please describe your instructors’ attitudes toward being accessible to students.
35. Do your instructors know you are a first-generation college student? If so, has this changed his or her attitude toward you?
36. Do you ever feel like you do not belong in your current major? Why or why not?
37. Are you involved in any organizations at your institution? Please explain.
38. How has your involvement affected your college success? Please explain.
39. How many hours of classes do you typically take each semester?
40. Do you feel that this is a manageble work load? Please explain.
41. Do you have a job? If so, how many hours do you work each week?
42. Do you have family responsibilities you must consider on a daily basis? (Example: taking care of a child or other family member) Please explain.
43. Have you received scholarships or grants? If so, what does this funding pay? (Example: tuition, housing, books, etc.)
44. Do you receive financial support from your family? If so, in what way? (Example: tuition, housing, food, etc.)
45. At any point in your college education did you consider dropping out? If so, why?
46. What do you feel is the most difficult aspect of being a first-generation college student? Please explain.
47. What do you feel is the most difficult aspect of being a STEM major? Please explain.
48. If you need help with a class or something on campus, do you ask for it? Please explain.
49. Do you know who might assist you with questions about the institution or a class?
50. When do you plan to graduate?
51. Please explain how you intend to accomplish graduation.
52. What are your long-term goals in life?

Thank you (name of the participant), for sharing your answers to my questions today. If you do not mind, I may contact you within the next week if any clarification is needed. Soon, you can expect a request for you to proofread what I have written concerning your interview to make sure it is accurate. I appreciate your time and wish you well in your college education.
APPENDIX B

Question Set #2

Characteristics of persistence and retention among first-generation college students majoring in science, technology, engineering, and math.

Please answer the questions below and send them to lrlasseter@crimson.ua.edu.

Name:

Date:

1. Rate the following attributes as to the impact they had on your decision to attend JSU. Please type a value of 1, 2, or 3 beside each example.  
   1 = no impact; 2 = some impact; 3 = great impact
   a. Location
   b. Low cost of attendance
   c. Scholarship received
   d. Size of campus
   e. Class size
   f. Degree program offered
   g. Faculty / institutional support
   h. Clubs and organizations offered
   i. Friends
   j. Influence by high school teacher or counselor
   k. Housing

2. Do you believe that support from family or friends has played the biggest role in your persistence to earn a college degree? Please explain.

3. Were you expected to go to college by your family and friends?

4. Would you attend college even if you did not receive financial aid? Please explain.

5. Do you feel that your high school really prepared you for college courses? Please explain.

6. Do you receive encouragement from faculty members or advisors at JSU?

7. Do you utilize tutoring services at JSU?

8. Do you believe that JSU is a good fit for first-generation STEM majors? Why or why not?
9. Knowing what you know now, how could the transition from high school to college be improved for students who are first-generation STEM majors?

10. What is your greatest motivation to attend college? (example: self-motivation, motivation from family or friends, motivation to earn more money, motivation to have a career that interests me, etc.)

11. Despite the many students who do not persist to graduate with a degree in science, technology, engineering, or math, what do you think has allowed you to be successful thus far?

Thank you for your time in sharing your experiences. I will also share the results of my study as soon as I have completed the dissertation process.
## APPENDIX C

### Participant Demographics and Background Information

<table>
<thead>
<tr>
<th>Participant</th>
<th>Age/Sex</th>
<th>Ethnicity</th>
<th>Major</th>
<th>Background Information</th>
</tr>
</thead>
</table>
| “Kasia”       | 21/F    | African-American   | Pre-Health Biology | ~No time for AP courses  
~Involved in leadership organization  
~Lives off campus; did not like dormitory |
| “Tamera”      | 22/F    | African-American   | Pre-Health Biology | ~Parents were her “main push” to go to college  
~Works on campus  
~Needed tutoring but tutors were in short supply |
| “Jakayla”     | 29/F    | African-American   | Pre-Health Biology | ~Likes institution being close to home  
~High school lacked resources; no AP courses  
~No time for campus involvement |
| “Sasha”       | 23/F    | Mixed              | Pre-Health Biology | ~Parents’ hard work impacted decision to go to college  
~Works on campus  
~Needed tutoring but tutors were in short supply |
| “Mei-Lien”    | 22/F    | Asian              | Pre-Health Biology | ~Works many hours in parents’ restaurant  
~Frustrating college application process  
~Parents don’t understand time needed to prepare for classes |
| “Brittany”    | 27/F    | White              | Math               | ~Impacted by professor to major in math  
~Initially attended a large urban university  
~Worked in a factory before going back to college |
| “Sydney”      | 22/F    | White              | Biology            | ~Plans schedules with friends  
~Enjoys dormitory close to classes  
~Assists professor with research  
~Works on campus |
| “Makenzie”    | 20/F    | White              | Biology            | ~Campus job allows her to interact with other students, faculty, and staff  
~Has excellent professors  
~Twin sister provides academic competition |
| “Martha”      | 21/F    | White              | Nursing            | ~Being first-gen is a motivator to earn a degree  
~Counselor helped with application process  
~Lives at home |
| “Ella”        | 19/F    | White              | Nursing            | ~Friends work out problems through social media  
~No time for involvement in campus organizations  
~Chose institution due to closeness to home and scholarship |
| “Luis”        | 20/M    | Hispanic           | Biology            | ~Had doubts about his major; changed 3 times  
~Friends study together and are encouraging  
~Works long hours to cover other costs  
~AP courses were beneficial; helped form better study habits |
| “Mahir”       | 22/M    | Asian-American     | Chemistry          | ~Never considered college until his high school counselor encouraged him  
~AP/DE courses lacked rigor  
~No study skills learned in high school |
| “Taylor”      | 22/M    | White              | Chemistry          | ~STEM major roommates is advantage  
~Living on campus would be more convenient, but enjoys being away from stress  
~Working with classmates has helped confidence in his major |
APPENDIX D

Diagram:

Characteristics Associated with Persistence and Retention Among First-Generation STEM Majors

Characteristics Associated with Persistence & Retention Among First-Generation STEM Majors

Social:
Interaction with other students; study groups

Institutional:
Faculty support; services

Intellectual:
Pre-college preparation; counseling

Familial:
Parental support
APPENDIX E

IRB Approval

February 3, 2017

Lorie Burnett
Department of Higher Ed. Admin.
College of Education
Box 87023

Re: IRB#: 17-OR-048 "Characteristics of Persistence and Retention among First-Generation College Students Majoring in Science, Technology, Engineering, or Math"

Dear Ms. Burnett:

The University of Alabama Institutional Review Board has granted approval for your proposed research.

Your application has been given expedited approval according to 45 CFR part 46. Approval has been given under expedited review category 7 as outlined below:

(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies

Your application will expire on February 1, 2018. If your research will continue beyond this date, complete the relevant portions of the IRB Renewal Application. If you wish to modify the application, complete the Modification of an Approved Protocol Form. Changes in this study cannot be initiated without IRB approval, except when necessary to eliminate apparent immediate hazards to participants. When the study closes, complete the appropriate portions of the IRB Request for Study Closure Form.

Please use reproductions of the IRB approved stamped consent form to provide to your participants.

Should you need to submit any further correspondence regarding this proposal, please include the above application number.

Good luck with your research.

Sincerely,

Stuart Usdan, PhD
Chair, Non-Medical Institutional Review Board

358 Rock Administration Building | Box 070127 | Tuscaloosa, AL 35487-0127
205-348-8461 | Fax 205-348-7189 | Toll Free 1-877-820-3066
APPENDIX F

Informed Consent

UNIVERSITY OF ALABAMA
Individual’s Consent to be in a Research Study

You are being asked to be in a research study. This study is called “Characteristics of Persistence and Retention Among First-Generation College Students Majoring in Science, Technology, Engineering, or Math”. This study is being done by Mrs. Lorie Lasseter Burnett. She is a doctoral student pursuing a degree in Higher Education Administration at the University of Alabama.

The study is being financially supported by the researcher. Mrs. Burnett is covering the costs of advertising, travel, postage, and gift cards for participants.

What is this study about?
Previous studies have shown that first-generation college students experience difficulties persisting in college and being retained by their institutions. It has also been noted that students majoring in science, technology, engineering, or math (STEM) are also at a disadvantage in their ability to succeed. Despite the many possible obstacles associated with first-generation college STEM majors, some do persist and earn a degree. This study is seeking to understand the characteristics that enable students who are first in their families and STEM majors to persist in college and be retained by their institution. Specifically, the investigator would like to know how these characteristics affect the students’ ability to remain in college and move on to degree completion, despite the many expected hurdles. You will be asked about your reasons for attending college, family background (including income level), and who or what you feel has helped you be a successful college student.

Why is this study important—What good will the results do?
The findings will help high school counselors and teachers, as well as higher education practitioners, understand the issues that first-generation college STEM majors face, as well as the characteristics that aid in persistence and retention. This will help them better prepare students like yourself for college and support them while enrolled in college to increase the number of graduates that belong to this unique group.

Why have I been asked to take part in this study?
You responded to an ad posted at your college campus. You revealed that you are a first-generation college student majoring in science, technology, engineering, or math. You gave the researcher your contact information.

How many other people will be in this study?
The investigator hopes to interview 30 students from Jacksonville State University within the next 4 months.

What will I be asked to do in this study?
If you agree to be in this study, Mrs. Burnett will interview you in a private office on campus or at the Houston Cole Library. You may also choose a different location for your convenience. The interviewer would like to digitally record the interview to be sure that all your words are captured accurately. However, if you do not want to be recorded, simply tell the interviewer, who will then take handwritten notes.

**How much time will I spend being in this study?**
The interview should last about 45-60 minutes, depending on how much information about your experiences you choose to share.

**Will being in this study cost me anything?**
The only cost to you from this study is your time.

**Will I be compensated for being in this study?**
In appreciation of your time, you will receive a $10 gift card to a local store when the interview is completed.

**What are the risks (problems or dangers) from being in this study?**
The risk to you is expected to be no more than what you might experience in an everyday situation. Should you become distressed during this study, you may discontinue your participation. You can control this possibility by not being in the study, by refusing to answer a particular question, or by not telling the researcher things you find to be distressing. Mrs. Burnett can also recommend a counselor to you if you seem to be upset or depressed. Seeing the counselor would be at your own expense.

**What are the benefits of being in this study?**
There are no direct benefits to you unless you find it pleasant or helpful to describe your experiences as a first-generation STEM major. You may also feel good about knowing that by sharing your story you have helped future students; possibly aiding their success.

**How will my privacy be protected?**
You are free to decide where Mrs. Burnett will visit you so you can talk without being overheard.
Mrs. Burnett will visit you in the privacy of your home or in another place that is convenient for you.

**How will my confidentiality be protected?**
The only place where your name appears in connection with this study is on this informed consent. The consent forms will be kept in a locked file drawer in Mrs. Burnett’s home, which may only be accessed by her alone. When the interview is recorded, Mrs. Burnett will not use your name, so no one will know who you are on the recording. Once the interview is complete, Mrs. Burnett will listen to the recording and type the results. When the interviews have been typed, the recording will be destroyed. This should occur within one month of the interview. You may also refuse to be audiotaped, in which case the interviewer will take handwritten notes.
Mrs. Burnett will be using this information in her dissertation, but participants will be identified only as "students from a four-year regional institution in Alabama" or be given alternate names. No one will be able to recognize you.

**What are the alternatives to being in this study?**
The only alternative is not to participate.

**What are my rights as a participant?**
Being in this study is totally voluntary. It is your free choice. You may choose not to be in it at all. If you start the study, you can stop at any time. However, if you stop the interview, you will not receive the gift card. Not participating or stopping participation will have no effect on your relationships with the University of Alabama.

The University of Alabama Institutional Review Board is a committee that looks out for the ethical treatment of people in research studies. They may review the study records if they wish. This is to be sure that people in research studies are being treated fairly and that the study is being carried out as planned.

**Who do I call if I have questions or problems?**
If you have questions about this study right now, please ask them. If you have questions later on, please call Mrs. Lorie L. Burnett at (256) 282-0304. If you have questions or complaints about your rights as a research participant, call Ms. Tanta Myles, the Research Compliance Officer of the University at 205-348-8461 or toll-free at 1-877-820-3066.

You may also ask questions, make a suggestion, or file complaints and concerns through the IRB Outreach Website at [http://osp.ua.edu/site/PRCO_Welcome.html](http://osp.ua.edu/site/PRCO_Welcome.html). After you participate, you are encouraged to complete the survey for research participants that is online there, or you may ask Dr. Johann for a copy of it. You may also e-mail us at participantoutreach@bama.ua.edu.

I have read this consent form. I have had a chance to ask questions.

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**Signature of Research Participant**  
Date

**Signature of Investigator**  
Date