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Engagement and STEM Degree Completion: An Analysis of the Relationship Between Time-To-Completion and Engagement and Pre-College Variables

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By

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The dissertation has been examined and approved by the following members of the student's committee.

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Abstract

This quantitative analysis explored measures influencing time to STEM-degree-completion in a correlational, non-experimental analysis of archival data (N = 745). FGCS represent a significant portion of individuals pursuing a post-secondary degree in the United States however, FGCS are less likely to persist to graduation as compared to their continuing-generation peers. FGCS are entering colleges and universities declaring STEM majors yet, are changing their major and or leaving college without a four-year degree (Chen, 2013). FGCS, who identify as female, face additional barriers, whether perceived or actual, in the pursuit of earning a STEM degree. FGCS choose to pursue STEM majors, yet they are less likely to graduate with a STEM degree. A multiple linear regression was performed, and results indicated that time-to-completion was significantly related ($R^2 = .12$, $p < .001$) to ACT score, Pell-eligibility, PSEO credit, learning community participation, and on-campus employment. For students who identified as female, (N = 209) time-to-completion was also significantly related ($R^2 = .26$, $p < .001$) to ACT score, Pell-eligibility, PSEO credit, and on-campus employment. For students who identified as female, (N = 209) time-to-completion was not significantly related ($R^2 = .07$, $p = .18$) to the type of STEM major.

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CHAPTER ONE

INTRODUCTION

The concept of bringing yourself with you wherever you go is often referred to in the fields of counselor education and career counseling. This idea of bringing yourself, with all your successes and scars, is a critical concept in an examination of the experience of first-generation college students' (FGCS) persistence to degree attainment. From a positive psychology perspective, this concept has significant implications for the character strengths and virtues FGCS might bring with them when they arrive on campus (Peterson & Seligman, 2004). Beyond the notebooks, pencils, and laundry, students bring with them ambitions, values, and individual strengths. These invisible qualities are influenced by the sum of their previous experiences (Peterson & Seligman, 2004). FGCS experiences prior to arriving on campus, coupled with their level of engagement in campus social and academic experiences are crucial to an examination of FGCS' persistence to degree attainment.

A bachelor's degree is often a required milestone to access many personal, economic, and social benefits (Abel & Deitz, 2014). As the earnings gap increases between careers that require a bachelor's degree or higher and careers that require a high school diploma continues to grow, completion of a bachelor's degree has direct implications for earning potential, choice of job, and social mobility (Levin, Belfield, Muening, Peter & Rouse, 2007). Kuh and colleagues (2008) estimated that more than 80% of high school graduates would need some form of post-secondary education to be competitive for in-demand careers (Kuh, Kinzie, Cruce, Shoup, & Gonyea, 2008). Ten years later, a recent study from the Center on Education and the Workforce projected that if U.S. graduation rates continued along the same trajectory as previous years, the U.S. would be short nearly five million bachelor's degrees. While there will be plenty of available jobs with projections of upwards of 164 possible positions, 65% of these positions will require a bachelor's degree (Carnevale, Strohl, Ridley, & Gulish, 2018).

According to the National Center for Education Statistics, a U.S. citizen between 25 to 34 years old with a high school education could expect to annually earn $32,610 in 1995 compared to $30,410 in 2014. In contrast, a U.S. citizen between 25 and 34 years old with a bachelor's degree could expect to annually earn $48,740 in 1995 compared to $50,570 in 2014 (Snyder & Dillow, 2012). With 93 out of 100 STEM occupations having wages above the national average coupled with the United States' gap in qualified candidates for STEM employment, colleges must recruit and retain students in STEM majors (Fayer, Lacey, & Watson, 2017).

Access to a bachelor's level education, however, is not the problem. The issue is centered on the fact that a high percentage of U.S. college students are not completing their bachelor's degree (Carnevale et al., 2018). Therefore, colleges are pressed to identify factors that will positively influence students' degree completion (Astin, 1984; Kuh, 2001).

First-Generation College Students

The literature on first-generation college students (FGCS) indicates that FGCS are motivated to attend college, earn a four-year degree, and may experience college differently than their continuing-generation peers (Engle, 2007; Palbusa & Gauvan, 2017). One of the reasons that the FGCS population might experience college differently than continuing-generation students is because many do not have family members to consult with when questions, pertinent to their college-going experience, arise. Continuing-generation students likely have access to family members to consult with about navigating the admissions process, choosing a college major, connecting with faculty and student support staff, finding an internship, networking with professionals in their area of study, and persisting to graduation.

FGCS might have unrealistic expectations about majors due to limited exposure to degree-required careers and likely do not know how to navigate the system to find support to gain opportunities to exposure to different career fields (Bui, 2000). Additionally, the college-going processes might be even more difficult for FGCS, who choose to pursue an academic major in Science, Technology, Engineering, and or Mathematics (STEM) fields (Chen & Carroll, 2005; Olenchak & Herbett, 2002; Thayer, 2000). Furthermore, FGCS, who identify as female, face additional barriers in the pursuit of a four-year STEM degree (Tyson, Lee, Borman, & Hanson, 2007).

The existence of barriers for FGCS and for FGCS, who identify as female in the literature, evokes a need for further inquiry as to what best enables this targeted student population to persist to completion with a four-year degree. Research on college student persistence and degree-completion is not new to the college student development literature. Tinto (1975, 1987, 1993) produced a model of student engagement that is highly acclaimed in academia. He studied what enabled college students to persist to degree attainment and the factors that contributed to students' patterns of stopping out or leaving college altogether. Tierney (1992) offered an essential criticism of Tinto's highly accepted theory of student departure, offering the perspective that Tinto's theory was normed on a homogeneous population of college students. Tinto's theories were primarily normed on White, middle to the upper-middle class, male, continuing-generation college students. Tierney (1992) implored researchers to consider the more contemporary college student demographics and promoted a multicultural perspective. He encouraged researchers to reevaluate student departure and engagement models to consider a more racially, socioeconomically, and gender diverse student population. More recent models of student departure and engagement have since emerged in the literature on student persistence and retention. Because the United States (U.S.) needs to produce more and more skilled employees in the STEM fields to meet the current demands of the labor market, an emphasis on student retention in the STEM fields has gained traction in the higher education literature. Following the call for a holistic reassessment of the previous models of student engagement and departure from multicultural competency perspective (Tierney, 1992), Nora and Rendon (2006), developed the Student Engagement Model (2006), which provides a framework for college's aiming to recruit and retain FGCS in STEM majors. Nora's model considers the previously held assumptions of the dominant culture, such as a parent that can guide their student through academic and social challenges in college. A parent that expects their student to "go away" to college and to create an independent life at graduation. A family of origin with the economic resources to fully or partially finance their student's education. A student with the cultural capital to understand how to read and interpret a syllabus, meet a professor during office hours to ask for assistance on homework or undergraduate research or advocate for themselves by connecting the various supports on their campus (Rendon, Jalomo, & Nora, 2000). Nora's (2006) model of student engagement provides a holistic perspective that captures both the pre-college characteristics and the engagement variables that enable FGCS to persist to degree attainment with a STEM degree.

First-Generation College Students Pre-College Factors

The research on STEM degree completion has emphasized several components that likely contribute to FGCS completion of a four-year STEM degree. The elements that enable FGCS to persist through a myriad of barriers in their college experience fall into two general concepts: pre-college factors and engagement variables. Pre-college variables relevant to the literature on FGCS college students include the family of origin, K-12 educational experiences, socioeconomic status, and academic competencies that FGCS bring with them before they register for this first course as first-year college students. The literature on FGCS often summarizes these pre-college variables as the social and cultural capital that students enter college with. FGCS that enter college from the family of origins with working-class backgrounds bring with them experiences, values, and a work ethic that is unique, and this awareness of being different as a result of being an FGCS emerged as a common theme (Matthys, 2012).

Cultural capital is the aggregate of all the current, actual, and potential resources a person has (Monnier, 2013). College cultural capital refers to knowledge of how to prepare for college, how to matriculate in college, and how to navigate college (McCarron & Inkelas, 2006; McConnell, 2000; Pascarella, Pierson, Wolniak, & Terenzini, 2004). The parents, families, and social network of FGCS often cannot provide FGCS with specific college cultural capital. FGCS may not understand how to navigate the process of college, may perceive less of an importance in leveraging resources, and may feel like an outsider on a campus (McConnell, 2000). Examples of college cultural capital include knowledge of the admissions process, skills needed to communicate with faculty, and education on the process of choosing an academic major and career development expectations such as securing an academic internship (Dumais & Ward, 2010; Raskoff, 2014).

The literature indicates that FGCS are less likely than their continuing-generation peers to possess college cultural capital. College cultural capital includes concepts such as knowledge about college admissions processes, scholarships, and financial aid procedures, and educational requirements (Paulsen & St. John, 2002; Atherton, 2014) and possess less social capital thus receiving less social support from their families regarding college-related issues during the transition period from high school to college relative to continuing-generation students (Engle, 2007; Palbusa & Gauvan, 2017). FGCS may have difficulty navigating the process of deciding how to choose a university to apply to (Paulsen & St. John, 2002), how to navigate the admissions process, and how to navigate the transition from high school to college (Engle, 2007; Palbusa & Gauvan, 2017). The literature shows FGCS are less likely to have received college planning assistance or guidance (Engle et al., 2006). Often FGCS know less about the social environment of a college or university than students whose parents had a bachelor's degree (Bui, 2002) have a sort of "culture shock" when they arrive at a postsecondary institution (Inman & Mayes, 1999) and lack the capital needed to positively influence academic success (Soria & Stebleton, 2012). As a result of this lack of social and cultural capital, some FGCS have difficulty learning the language of college, identifying with the faculty on campus, fitting in with continuing-generation peers (London, 1996), and may feel academically underprepared (Mitchell, 1997). Because FGCS often enter college with limited social and cultural capital, FGCS needs to develop social and cultural connections in college to enable them to navigate the process and policies to graduate.

First-Generation College Students College Engagement

In the last decade, colleges and universities have intensified recruitment and retention efforts to target students beyond what would have been the typical college student historically defined as a White, male, upper or middle class with a college-educated parent. As these recruitment initiatives have gained momentum, diversity recruitment initiatives have expanded the definition of diverse populations beyond racial and ethnic diversity. Diversity recruitment now includes the targeted recruitment of low-income college students as defined by the federal government as students who qualify to receive the Pell grant based on their family's income and estimated financial family contribution to their college education. Diversity recruitment also includes the targeted recruitment of First-Generation College Students (FGCS) as defined by the federal government as neither parent has earned a four-year degree (Snyder, Hoffman, & Geddes, 1999).

FGCS are one of the fastest-growing segments of the American college student population (Kuh et al., 2006). While a college education has a clear connection to employability, FGCS are a group that faces significant challenges in their pursuit of a four-year degree (Engle & Tinto, 2008). Both high school counselors and university faculty and staff place a particular emphasis on assisting students in transitioning from high school into their new academic career as an undergraduate student (Reid & Moore, 2008). The literature on FGCS experiences in the transition into their undergraduate career suggests that FGCS have more need for social supports to be academically successful (Reid & Moore, 2008; Smith, & Zhang, 2010). Often FGCS enter college with less understanding of the processes, systems, paperwork, and expectations of the university and receive less social support from their families regarding college issues during the transition time from high school to college relative to their continuing-generation peers (Engle, 2007). Parents, friends, high school teachers, high school guidance counselors, college professors, college academic advisors, college orientation programs, and first-year seminars all play a role in assisting FGCS successful transition into college (Smith & Zhang, 2010). Furthermore, academic preparation, scholarship, and self-motivation to incorporate effective study habits are also essential components of a successful transition from high school to college for FGCS (Smith & Zhang, 2010). Completing Advanced Placement classes during high school additionally emerged as a decisive contributing factor to easing the transition from high school to college for FGCS (Reid & Moore, 2008).

The literature suggests that FGCS experience much less academic and social engagement on campus than continuing-generation students (Pike & Kuh, 2005). The research indicates that FGCS have similar educational aspirations as continuing-generation students (Lohfink & Paulson, 2005; McCarron & Inkelas, 2006). Additional research suggests that factors such as living on campus and engaging with the campus community may influence educational aspirations for FGCS, which may, in turn, influence persistence and retention (Pike & Kuh, 2005).

FGCS often have financial stress and work full-time while pursuing academics (Choy, 2001). FGCS, as compared to their continuing-generation peers, are more likely to choose a university because of proximity to their family (Saenz, 2007). FGCS often make this decision to maintain their family roles and sometimes take on more family responsibilities while attending college as compared to their continuing-generation peers (Barry, Hudley, Kelly, & Cho, 2009). Because FGCS face competing priorities outside of the classroom, including family and work responsibilities, they often have more difficulty adjusting to college and may inaccurately appear less committed to their student role compared to their continuing-generation peers (Pascarella & Terenzini, 2005). Additionally, because FGCS tend to have more competing priorities outside of the classroom, it is often more challenging to participate in academic and social opportunities on campus (Choy, 2001), which may contribute to lower grades and higher withdrawal rates (Warburton, Burgarin, & Nunez, 2001). The engagement measures capture the multitude of experiences that FGCS experience or do not experience in their college experience. Examples of engagement measures include the relationships they build with peers, faculty, and college personnel, the opportunities they are exposed to or seek out that promote their academic and social integration on campus, and the quantifiable support the college invests in to attract and retain students (Biu, 2002).

STEM Degrees and STEM Occupations

The STEM acronym refers to science, technology, engineering, and mathematics fields of academics and occupations and is defined inconsistently in the literature on STEM majors and STEM fields. While engineering and mathematics consistently make the list of STEM qualifying industrial areas, there is less consistency in the research literature regarding whether to include social scientists, educators, and or healthcare practitioners to the list of STEM qualifying occupations (Beede, Julian, Langdon, McKittrick, Khan, & Doms, 2011). For example, the Economics and Statistics

Administration (ESA) defines STEM occupations by grouping them into four categories: Computer and Mathematics, Engineering and Surveying, Physical and Life Sciences, and STEM Managerial Occupations (Fayer, Lacey, & Watson, 2017). According to this definition of STEM occupations, jobs in the Computer and Mathematics field account for 47% of all STEM employment in the United States (U.S.) followed by 33%, Engineering and Surveying occupations, 12%, Physical and Life Sciences, and 8%, STEM Management jobs (Beede et al., 2011).

The National Science Foundation (2009) approaches the definition of STEM not from the standpoint of STEM occupations but from defining STEM education, further complicating STEM occupations and STEM education definitions in the literature. According to the National Science Foundation, STEM education focuses on how to implement the best practices for teaching science, technology, engineering, and mathematics in K-12 education. STEM education expands the context of STEM from a partial list of topics to teaching models that incorporate real-world problem solving into interrelated subjects where engineering and design are connected. Thus, Art and Social Sciences also meet this definition of STEM (Gonzalez & Kuenzi, 2012).

Defining STEM from a professional or functional standpoint and an educational perspective is complex and lacks consistency in the STEM literature. Adding a layer of complexity is the definition of STEM qualifying academic majors at the bachelor's level, also known as STEM qualifying degree programs. A STEM qualifying degree program or academic major may vary from institution to institution because the qualification is subject to the degree program's assigned Classification of Instructional Program (CIP) code. The U.S. Department of Education's National Center for Education Statistics

(NCES) develops and standardize CIP codes beginning in the 1980s with the latest revision in 2011 (U.S. Department of Education, 2011). The purpose of the creation of these CIP codes was to support more accurate tracking and reporting of fields of student and program completions at the National level.

Additionally, CIP codes have provided the Department of Homeland Security (DHS) with a tool to make considerations and extensions in non-U.S. students' academic pursuits and employment opportunities through the creation of a list of eligible CIP codes for STEM occupational practical training (Demirci, 2016). Students who are not U.S. citizens studying in the U.S. under an F-1 visa may apply for a STEM extension that enables their employer to employ them in qualifying STEM industry areas to mediate the employment gap. the Federal government determines which industry areas qualify for the STEM extension based on the difference in the labor market when occupational areas lack enough U.S. candidates for employment

Engagement and STEM-Degree-Completion

Engagement is a well-established predictor of college student persistence and degree completion (Astin, 1975; 1993; 1999; Chickering & Gamson, 1987; Kuh, 1993, 1995; Pascarella & Terenzini, 1991; Terenzini, Pascarella, & Blimling, 1999). In the past 30 years, the concept of student engagement has evolved to encompass the complex relationships between desired outcomes of earning a bachelor's degree and the investment of time, quality of effort, and campus involvement factors contributing to students' academic and social development during their college experience (Kuh, 2009a).

Since Astin's (1984) contribution to the *Involvement in Learning* report (National Institute of Education, 1984), the construct of student engagement as an influential factor in college outcomes has been widely accepted (Kahu, 2013). In recent literature on student engagement, an emphasis on institutional contribution to student engagement via resources, programs, and institutional climate (Kuh, 2001; Kuh, Schuh, & Whitt, 1991; Kuh, Kinzie, Schuh, & Whitt, 2005). Institutions have been called by organizations such as the Association of American Colleges and Universities (AAC & U) to provide more consistent and widespread use of "High-Impact Educational Practices." Examples of "High-Impact Education Practices" include learning communities, undergraduate research opportunities, first-year seminars, and capstone courses (Peden, Reed, & Wolfe, 2017, p. 7). The AAC & U's LEAP Challenge posits that "High Impact Educational Practices" influence college outcomes and "can help every student get more out of higher education –and be better prepared for work and life" (Peden et al., 2017, p. 3).

Several "High-Impact Educational Practices" have been well-established in the engagement literature. The positive influence of on-campus living is associated with student persistence and retention in college and a key predictor of students' degree attainment (Blimling, 1989; Pascarella, 1993; Velez, 1985).

Additionally, maintaining part-time employment while in college is currently the norm for many undergraduate students (Pascarella & Terenzini, 2005). With so many college students working part-time jobs, engagement is a matter of debate in the research literature (Astin, 1993; Pike, Kuh, & Massa-McKinley, 2008; Velez, 1985). Velez (1985) studied the academic experiences of students who were high school seniors in 1972 analyzing data from the National Longitudinal Survey of the High School Class of 1982; results indicate that students who held work-study jobs had a 23 percent higher probability of finishing college.

Learning communities have also been studied as a "High-Impact Educational Practice" positively associated as a predictor of students' motivation to engage in both classroom and extra-curricular activities (Pike, Kuh, & McCormick, 2011). Learning community involvement has also been associated with learning outcomes and STEM degree attainment for women (Szelényi, Denson, & Inkelas, 2013). Learning community involvement has been associated with positively influencing academic performance, and holistic engagement in campus culture gains in-class attendance and overall satisfaction with the college experience (Zhao & Kuh, 2004). Learning community participation has also been recognized for influencing first-year students' level of academic effort, integrative and higher-order thinking, diversity experiences, active and collaborative learning, and students' perceptions of a supportive campus environment (Astin, 1993; Pike et al., 2008; Pike et al., 2011; Velez, 1985).

Institutional housing, participating in learning communities, and working part-time on campus are engagement experiences affecting student development and degree completion. Critical to note is that much of this engagement research is grounded in theoretical orientations normed on White, traditional-aged, full-time degree-seeking students. The college student population has diversified, and the construct of engagement, as previously defined, no longer can be broadly applied to students from historically underrepresented populations (Kuh, 2009b).

Nevertheless, the literature suggests that students from historically underserved groups benefit from engagement, and some student populations may benefit more than others from specific engagement experiences (Lopez Turly & Wodtkey, 2010; Pascarella & Terenzini, 2005; Pike et al., 2010). Students from historically underrepresented populations may experience more significant gains in the first-year GPA from Institutional housing (Lopez Turly & Wodtkey, 2010), and first-generation students may experience more substantial benefits from the learning community participation (Pike et al., 2010). To provide a holistic analysis of student engagement for historically underrepresented populations, an examination of engagement and pre-college factors is essential (Astin, 1985; Tinto, 1975; Pace 1982).

Students who enter college with less academic preparation, as indicated by ACT score, may have more difficulty with college-level coursework and passing gatekeeping courses (Greene, Marti, & McClenney, 2008). Kuh and colleagues (2008) reported that pre-college characteristics represented by ACT and SAT scores influenced the first-year GPA and persistence to sophomore year. However, they further stated that when engagement experiences were account for (e.g., living on campus, working on or off campus), the effects of pre-college characteristics diminished considerably (Kuh, Cruce, Shoup, Kinzie, & Gonyea, 2008). Lin, Borden, and Chen (2018) stated that in addition to the influence of student loan type, students that had earned college credit as high school students were more likely to persist. Similarly, Jones (2014) and An (2013) found that dual enrollment participation in high school significantly increased the probability of attaining a bachelor's degree. The results of these studies indicated that when those students arrive on campus, this influences their academic and social experiences, and engagement experiences may serve a mediating effect, particularly for students who come to college with less academic preparation.

First-Generation College Students and STEM-Degree-Completion

Because many FGCS lack familiarity with college-going cultural norms, processes, deadlines, bureaucracies, and academic expectations, FGCS may, in turn, exhibit different major changing patterns (McLean, 2015; Thayer, 2000). Some FGCS choose to stay in majors in which they have no interest to please parents or impress peers (Olenchak & Herbett, 2002). While some FGCS additionally face unique challenges in choosing an academic major because they do not have parental support or guidance (Chen & Carroll, 2005). Additionally, FGCS may have unrealistic expectations about majors due to their limited exposure to college and careers and may not know how to navigate the system to find such support (Bui, 2002). Thus, the research on academic choice for the general population of college students may fall short in its applicability to FGCS, who may not have the same access to the information needed to make a well-informed choice of academic major.

Since 2007, longitudinal data from the Beginning College Survey of Student Engagement and the National Survey of Student Engagement collected and analyzed data from thousands of first-year students regarding their high school educational experiences and their expected experiences during their first year of college (Kuh, 2007). Of these students represented in the data, approximately 18% who declared a STEM major in their first year changed their major to a non-STEM major within their first year of college. Additionally, 29% of all STEM majors were students from non-STEM majors at the beginning of the academic year.

The literature on FGCS retention in STEM majors indicates that opportunities to engage in the academic environment may serve as essential influencers to persistence and degree completion. Engagement opportunities that emerged from the literature as positively related to STEM degree completion for FGCS include engaging in undergraduate research (Doerschuk et al., 2016), interaction with faculty (Espinoza, 2013), and STEM student organizations that promote both academic and social support (Mwaikinda & Aruguete, 2016). Additionally, engaging in extra-curricular activities with faculty and peers and exposes FGCS to peers who may have more college cultural capital and can develop a support network to lean on to assist in navigating the college experience. The research on FGCS persistence and retention in higher education, specifically in STEM majors indicates that FGCS are motivated to attend college and pursue STEM majors, yet, may experience college differently than their continuing-generation peers.

Women and STEM-Degree-Completion

The research indicates that women, in the last decade, have represented about half of the United States workforce, with men representing 52% and women 48% (Beede et al., 2011). However, the United States' Science, Technology, Engineering, and Mathematics (STEM) workforce has been. It continues to be overrepresented by White males (Bentley & Adamson, 2003; George, Neale, Van Horne, & Malcom, 2001; Oakes, 1990; Summers & Hrabowski, 2006).

While more women than men are graduating from college with a bachelor's degree, men continue to earn a higher proportion of degrees in the STEM fields, and women hold a disproportionately low share of bachelor's degrees in engineering and physics (George et al., 2001). Recently, the number of women earning bachelor's degrees in the social sciences and biosciences has increased. Specifically, more women are earning degrees in psychology and medical sciences. Furthermore, like the general population of women in STEM, women who identify as racial/ethnic minorities were also more likely to earn bachelor's degrees in the medical and social sciences and less likely to earn bachelor's degrees in computer sciences and engineering (Beede et al., 2011).

Recently, policies have been implemented to counteract the underrepresentation of women in STEM (Carpenter & Acosta, 2005; Robelen, 2010; Rolison, 2003). During President Obama's administration, the first annual White House Science fair was hosted, signifying the administration's priority to promote STEM education (Robelen, 2010). A reexamination of the Educational Amendments of 1972, commonly referred to as Title IX, emphasizes that no person in the U.S. attending an institutional that is receiving funding from the federal government can be, based on sex, denied the benefits of any education program or activity. Rolison (2003) makes the argument for raising the level of awareness and impact of Title IX beyond the scope of athletic inclusion for men and women in college to educational inclusivity to increase both STEM participation and student performance in the STEM fields (Robelen, 2010). Rolison (2003), using the Title IX argument, encourages the American taxpayer to question if they should support institutions that have athletic equity for both sexes yet, continue to hire White men preferentially for faculty teaching positions in the STEM majors (Rolison, 2003). This argument highlights how inequity in STEM occupations for men and women is systemic and has roots in the educational system itself. However, even with the incorporation of new policies and initiatives, men are much more likely than women to have a STEM job regardless of educational attainment (Beede et al., 2011).

Given the documentation of the challenges FGCS face as they enter college and persist to graduation, the literature has primarily focused on interventions and support structures to strategically increase opportunities for FGCS to gain cultural capital (Reid & Moore, 2008). According to Terenzini, Springer, Yaeger, Pascarella, and Nora (1996), FGCS were found to differ in college experiences from continuing-generation students. FGCS were less likely to engage in extra-curricular activities with faculty and peers, which may further set FGCS behind their continuing-generation peers in developing social and cultural capital (Grier-Reed & Ganuza, 2012; Stieha, 2010).

Statement of the Problem

FGCS represent a significant portion of individuals pursuing a post-secondary degree in the United States (Choy, 2001). FGCS are less likely to persist to graduation as compared to their continuing-generation peers (Choy, Horn, Nunez & Chen, 2000; Paulsen & St. John, 2002; Pascarella & Terenzini, 2005). FGCS are entering colleges and universities declaring STEM majors yet, are changing their major and or leaving college without a four-year degree (Chen, 2013). FGCS, who identify as female, face additional barriers, whether perceived or actual, in the pursuit of earning a STEM degree (Beede et al., 2011). FGCS choose to pursue STEM majors, yet they are less likely to graduate with a STEM degree. Many FGCS do not have the cultural capital to effectively navigate the college cultural norms processes, deadlines, bureaucracies and academic expectations (Thayer, 2000) or social capital such as family and peers with college and career information or professional networks in the STEM industry (Dika & D'Amico, 2016; Espinoza, 2013; Fernandez et al., 2008; Tate, Caperton, Kaiser, Pruitt, White, & Hall, 2015; Trenor, Yu, Waight, Zerda, & Sha, 2008).

Purpose of the Study

The purpose of this study was to explore the relationship between ACT score, PSEO credit completion, Pell-eligibility, learning community participation, institutional housing participation, on-campus employment, gender, type of STEM major, and time-to-completion among first-generation college students graduating with STEM majors.

Research Questions

Following the theoretical perspectives of Tinto (1975), Pace (1982), and Astin (1993) and Nora and Ramirez (2006), pre-college factors and engagement opportunities are reliable indicators of college performance and degree completion. The research on pre-college factors and engagement indicates that who students are when they arrive on campus influences their choice to participate in engagement opportunities, and both pre-college and engagement experiences are strongly related to degree completion.

Certain pre-college factors and engagement experiences may serve a mediating effect, particularly for FGCS students who tend to enter college with less academic preparation than continuing-generation students. Several pre-college factors emerged in the literature that influenced educational outcomes for college students. GPA has been associated with reading, writing, and mathematics placement for students, which has academic repercussions on time-to-completion for college students (Greene et al., 2008). ACT scores have been associated with first-year GPA and persistence to the sophomore year for college students (Kuh et al., 2008) PSEO credit completion has been reported as a predictor of persistence (Jones, 2014; Lin et al., 2018). After a review of the literature on influential pre-college factors, ACT score, PSEO credit completion, gender, and Pell-eligibility status emerged from the research as the variables to explore (London, 1996; Mitchell, 1997).

Research Question One

What is the relationship between ACT score, Pell-eligibility, PSEO credit, learning community, on-campus employment, institutional housing, and time-to-completion for first-time, full-time, degree-seeking, federally defined first-generation college students?

FGCS are a significant segment of the American college student population and face significant challenges in their pursuit of a four-year degree (Engle & Tinto, 2008). The literature indicates that FGCS often enter college with limited social and cultural capital and therefore, FGCS need to develop connections in college to enable them to navigate the process and policies necessary to graduate from college with a bachelor's degree (Engle, 2007; Palbusa & Gauvan, 2017; Paulsen & St. John, 2002; Vargas, 2004). Research question one is designed to explore the relationship between students' pre-college factors and engagement factors and time-to-completion since these have been shown to correlate with degree completion (Astin, 1993; Gellin, 2003; Greene et al., 2008; Jones, 2014; Kuh, 2007; 2009; Kuh et al., 2008; Lin et al., 2018; Lopez Turly & Wodtke, 2010; Pike, 2002; Pike et al., 2008; Pike et al., 2010; Zhao & Kuh, 2004).

Students who are engaged in their college-going experience are more likely to persist in earning their degree (Astin, 1999). The research on engagement has well established that living on campus is related to higher GPAs (Lopez Turly & Wodtke, 2010) and positively influence students' college experiences (Gellin, 2003; Pike, 2002). The research indicates that learning community participation is another factor positively associated with academic performance and engagement (Kuh, 2008; Zhao & Kuh, 2004; Pike et al., 2010). Furthermore, the literature indicates that on-campus employment is positively associated with students' persistence and degree completion (Velez, 1985) and academic performance (Astin, 1993; Pike et al., 2008).

FGCS have similar educational aspirations to continuing-generation students (Lohfink & Paulson, 2005; McCarron & Inkelas, 2006). FGCS, however, experience much less academic and social engagement on campus as compared to their continuing generation peers (Pike & Kuh, 2005). Therefore, engagement variables of living on campus, participation in learning communities, and part-time on-campus employment emerged from the literature as variables likely to influence academic and social engagement during college.

Research Question Two

What is the relationship between ACT score, Pell-eligibility, PSEO credit, learning community, on-campus employment, institutional housing, and time-to-completion for first-time, full-time, degree-seeking, federally defined first-generation college students who identify as female?

The purpose of this question was to explore the relationship between students' pre-college measures further: ACT score, Pell-eligibility, PSEO credit, and campus engagement measures: learning community participation, on-campus employment, and institutional housing participation are related to the time-to-completion with a STEM degree specifically for first time, degree-seeking federally defined, first-generation college student who identified as female. There is currently an emphasis on motivating students toward STEM fields in the K-12 levels. However, there is less attention to increasing academic and career trends in STEM at the post-secondary level (Byars-Winston, 2014). The statistical method chosen to analyze research question two was again a multiple linear regression analysis because research question seeks to explore the relationship or association between numerous independent variables with one dependent variable (Heppner, Wampold, & Kivlighan, 2008).

Research Question Three

What is the relationship between the type of STEM major and time-to-completion for first-time, full-time, degree-seeking, federally defined first-generation college students who identified as female?

The literature has indicated that of the STEM majors where women tend to benchmark in degree completion with men, the biological science tends to be the major where the most common ground is held (National Sciences Foundation, 2011). STEM majors often include competitive grading practices, which result in STEM majors having courses referred to as "gate-keeping" courses to keep some students out of STEM majors (Seymour & Hewitt, 1997). The literature indicates that women tend to react differently than their male counterparts in the perception of competitive academic environments (Hurtado et al., 2007). Where perhaps the male students thrive in the competitive culture, the students who identified as female may perceive this to be more of a "chilly environment" and find themselves on "the other side of the gate" than their male peers (Hurtado et al., 2007, Seymour & Hewitt, 1997).

The purpose of this question was to explore the relationship between the type of STEM major and to time to STEM degree completion for female, first-time, first-generation college students. This question was developed to address a current gap in the research to study relevant interventions aimed at "broadening the participation of all groups in STEM" (Byars-Winston, 2014, p. 341). The statistic method chosen was multiple linear regression because it is consistent with the research design as it explores the relationship or association between numerous independent variables with one dependent variable (Heppner et al., 2008).

Cases for Inclusion

The students in the study were first-time, full-time, degree-seeking, federally defined first-generation undergraduate students who graduated from a comprehensive university in the Midwest between 2008 and 2018 with a STEM degree. The rationale for only including cases that met the assumptions was for two reasons.

First, aside from potentially participating in a PSEO program as a high school student, the first-time population of first-generation college students included in the study had enrolled only at the university under study. Including only these cases allowed for a homogenous sample of students who only experienced college and campus life at the university under study. The rationale for excluding transfer students from the sample population was to control for previous academic and social engagement experiences influencing the academic and social engagement experiences at the university under study. Additionally, because the literature indicates that FGCS tend to be non-traditional in age and often transfer from two-year institutions, a large segment of FGCS who were transfer students were not included in the analysis.

Since the dependent variable for the research questions was time-to-completion as calculated by the date of first enrollment to the date of degree conference, degree-seeking, full-time students were selected. Non-degree-seeking and students who were enrolled at part-time status for much of their academic career were excluded from the data, enabling the data to be controlled for inconsistencies in the length of time-to-completion.

Secondly, the program award data were inconsistent in reporting each of the variables for each student record. Transfer students, non-degree seeking, part-time, and students who stopped out had the most inconsistencies in reporting ACT score or PSEO credit completion status.

Degree-seeking. Degree-seeking was quantified by changing the nominal variable into a dichotomous variable by coding the data in the degree-seeking column as 1 = degree-seeking, 0 = non-degree-seeking.

First-generation college student. The first-generation college student variable was quantified by changing the nominal variable into a dichotomous variable by coding the data in the Federally-defined-First-generation college student as 1 = First-generation college student, 0 = non-first-generation college student.

First-time. First-time was quantified by changing the nominal variable into a dichotomous variable by coding the data in the first-time column as 1 = first-time, 0 = non-first time.

Full-time. Full-time was quantified by changing the nominal variable into a dichotomous variable by coding the data in the full-time column as 1 = full-time, 0 = part-time.

STEM major. STEM degree classification was defined by using the most current stem designated degree program list produced by the Department of Homeland security site. STEM qualifying degree program or academic major was determined by the U.S.

Department of Homeland Security's list of STEM-extension qualifying CIP codes. STEM major was quantified by changing the nominal variable into a dichotomous variable by coding the data in the Classification of Instruction Programs column as 1 = STEM-degree, 0 = non-STEM degree.

Type of STEM degree. The STEM six-digit CIP codes were recoded into different variables listing the corresponding two-digit CIP code classifications as categorical as follows: CIP 01 Agricultural Animal and Plant Sciences, CIP 03 Natural Resources and Conservation, CIP 11 Computer Information Sciences, CIP 14 Engineering, CIP15 Engineering Technologies, CIP 26 Biological Sciences CIP 27 Mathematics and Statistics, CIP 30 Multidisciplinary Studies, CIP 40 Physical Sciences, CIP 49 Transportation, CIP 51 Health Professions.

Time-to-completion. Time-to-completion was measured as a continuous variable calculated in years starting from the date of enrollment to the date the degree of program award.

Measures

Pre-college measures

Sex, Pell-eligibility status, composite ACT score, and PSEO credit completion were examined for each of the cases.

Sex. Sex was quantified by changing the nominal variable into a dichotomous variable by coding the data in the Sex column as 1 = female, 0 = male.

ACT score. The ACT score was measured as a continuous variable ranging from 0 to n where n = the composite ACT score.

Pell-eligibility. Pell-eligible was quantified by changing the nominal variable into a dichotomous variable by coding the data in the Pell-eligible column as 1 = Pell-eligible, 0 = non-Pell eligible.

PSEO credit. The PSEO credit variable was measured as a continuous variable ranging from 0 to n where n = the number PSEO credits completed at the university.

Engagement measures

To measure the level of engagement characteristics, learning community participation, on-campus living arrangements, and on-campus employment was examined for each of the cases.

On-campus employment. The on-campus employment variable was measured as a continuous variable ranging from 0 to n where n = the number terms employed on-campus at the university.

Learning community participation. The learning community participation was quantified by changing the nominal variable into a dichotomous variable by coding the data in the Learning community participation column as 1 = Learning community participation, 0 = non-learning community participation.

Institutional housing. Institutional housing was measured as a continuous variable ranging from 0 to n where n = the number terms lived on-campus at the university.

The Rationale for Multiple Regression Study Design

Because the variables included one dependent variable measured at the continuous level and more than one independent variable measured at the continuous or nominal level, multiple regression was selected. Using a multiple regression analysis will determine how much of the variance each independent variable accounts for the level of influence on the dependent variable over and above the mean model (Howell, 2001). Multiple linear regression was chosen for the data analysis because this is the best statistic for studying the relationship between a dependent variable and multiple independent or explanatory variables to "predict, or forecast, the mean value of the dependent variable, given the values of the independent variables" (Gujarati, 1992, p. 188).

Theoretical Perspective

Because the parents, families, and social network of FGCS often cannot provide FGCS with specific social and cultural capital, the lack of this social and cultural capital often permeates the experience earning a bachelor's degree uniquely for FGCS. The lack of cultural and social capital cannot be separated from this group of students because it is often the source of many potential disadvantages. The concept of cultural and social capital applied to FGCS includes noneconomic resources that enable social mobility including access to support to assist with navigating the process of choosing an academic major and moving through their college experience (Perna, 2000; Paulsen & St. John, 2002; Wells, 2008).

Much of the literature on student persistence is grounded in Tinto's (1975, 1987, 1993) model of student departure. Tinto's (1975, 1987, 1993) model of student departure posits that both social and academic experiences are essential to student persistence and degree completion (Rendon, Jalomo, & Nora, 2000). The Tinto's student departure model and subsequent models of student involvement and departure were, however, normed on a homogeneous population of college students who identified primarily as White, male, full-time, traditionally aged students. Therefore, new models of student involvement and engagement have emerged in the literature to include the diverse populations recognized on college campuses in the 1990s and 2000s. Nora (2002, 2003) and Nora and Ramirez (2006) developed one such model. Nora and Ramirez (2006) developed the student engagement model (SEM) to include specifically a Latina/o perspective in the exploration of the related academic and social engagement experiences in higher education. The research on the SEM has primarily focused on STEM degree completion at the community college level.

Crisp and others (2009) studied the choice to pursue a STEM degree for students at a Hispanic Serving community college. The study focused on the studied pre-college, environmental, and engagement factors the influenced students' choice to major in a STEM field. Results indicate that pre-college factors significantly influenced the likelihood of declaring a STEM major. Students' gender identity, ethnicity, SAT math score, and high school percentile emerged as influential pre-college factors relevant to STEM major declaration. The environmental and engagement experiences that were influential in deciding to major in a STEM field for the students in the study were uniquely associated with enrollment in Biology I or higher, and enrollment in Algebra I or higher the first semester of college (Crisp et al., 2009).

Crisp, Taggart, and Nora (2015) studied the factors related to Latina/o students' academic success during their community-college experiences. Like the findings of the previous study, the results of the study indicated that a combination of pre-college factors and engagement factors were related to the academic success for Latina/o students. Gender, ethnic/racial identity, pre-college educational experiences, internal motivation and commitment, academic self-confidence, coping styles, parental education, family socioeconomic status, and belief systems were the factors that influenced academic success for the students in the study. The engagement factors that contributed to academic success were interactions with supportive individuals, the students' perspective of the campus climate/environment, and institutional type/characteristics (Crisp et al., 2015). Considering Latina/o and college students are over-represented as FGCS the student engagement model can serve as conceptual framework to explore that factors the influence FGCS STEM degree persistence and degree completion (Bui, 2002; Engle & Tinto, 2008; Hand & Payne, 2008; Nora & Ramirez, 2006; Terenzini et al., 1996). The results of these initial studies indicate that a combination of pre-college factors and engagement experiences influences historically underrepresented students' skills in college (Crisp et al., 2009; Crisp et al., 2015).

Summary of Introduction

FGCS are motivated to attend college and pursue STEM majors, yet, may experience college differently than their continuing-generation peers (Fernandez et al., 2008; Garriot et al., 2017a; Trenor et al., 2008; Wilson & Kittleson, 2013). Opportunities to engage in the academic environment such as faculty interaction (Espinoza, 2013), undergraduate research (Doerschuk et al., 2016), and STEM student organizations that promote both academic and social support (Mwaikinda & Aruguete, 2016) may serve as essential influencers to STEM degree completion for FGCS. Findings from these studies, coupled with the market data on earning potential and career mobility for STEM majors, indicate an area for further inquiry.

A holistic, critical examination of this topic is necessary to provide appropriate, timely, and essential support for FGCS pursuing STEM degrees. Exploring the pre-college factors and engagement opportunities that enable FGCS to develop social and cultural capital may provide some not yet considered insight as to what types of college experiences are positively related to STEM degree completion for FGCS.

Overview of Remaining Chapters

Chapter two provides a review of the literature on FGCS and their engagement and academic major choice experiences in college. The chapter is divided into three sections, which include: (a) theoretical framework and engagement, (b) FGCS and college engagement, and (c) FGCS and academic major choice. Chapter three describes the methodology, including the research design and the analysis for the present study. The chapter includes the purpose of the study, the description of the students involved in the study, and the statistical analysis procedure for each research question. Chapter four discusses the data, analysis, and results of the investigation. First, data cleaning and variables are presented, followed by a summary of descriptive statistics. The final chapter presents a discussion of the findings for each research question. The next section discusses the implication of the results for the field of Student Affairs. The chapter concludes with a discussion of the limitations of the study and recommendations for future research and practice.

CHAPTER TWO

REVIEW OF THE LITERATURE

The method for identifying the literature was a combination of ERIC searches on relevant terms (e.g., first-generation college, engagement, academic major choice) and the "snowball" method, whereby the researcher identified essential sources and used references within those sources to identify additional literature.

Theoretical Framework

The theoretical framework guiding this study has been informed by the previous research on engagement and college students (Astin, 1975; Astin, 1993; Astin, 1999; Chickering & Gamson, 1987; Kuh, 1993; 1995; Pace, 1982; Pascarella & Terenzini, 1991; Terenzini et al., 1999). Engagement is a predictor of both satisfaction and degree completion (Astin, 1999; Pascarella & Terenzini, 1991). Engagement stems from the concept of student involvement, as defined by Astin (1984, p. 518) as "the amount of physical and psychological energy that the student devotes to the academic experience." Student involvement refers to the subjective and individual cognitive experience of the student (Northy et al., 2018). Engagement refers to and explains the interaction effect of the student's cognitive effort and energy (involvement) with an objective experience (e.g., living in a residential hall, interactions with faculty) to explain the students' level of engagement in college (Northy et al., 2018).

Tinto's (1993) student departure model asserts that the decision to stay at or leave college is a function of both the student's academic and personal background and how well they integrate into the academic and social life of the campus. Much of Tinto's research on student involvement and departure was normed on White male students

(Tierney, 1992). Therefore, new models of student engagement have emerged to explore the relationship between different student characteristics and engagement, academic persistence, and degree completion (Petty, 2014).

Building on the work of Tinto, Nora (2002, 2003), Nora & Ramirez (2006) developed the student engagement model to explore the relationship between academic and social engagement experiences and historically underrepresented students in higher education. Nora's student engagement model examined six major components: (a) pre-college factors, (b) a sense of purpose and institutional allegiance (c) academic and social experiences, (d) cognitive and non-cognitive outcomes, (e) goal determination/institutional allegiance, and (f) persistence.

The current research on the student engagement model has focused on Latina/o students attending community colleges. Crisp, Taggart, and Nora (2015) conducted a systematic review of the literature. They described a comprehensive summary of qualitative and quantitative evidence specific to the factors related to undergraduate Latina/o students' academic success outcomes during college. Findings indicated that each of the six components of the student engagement model contributed to academic success for the Latina/o students in the study. (Crisp et al., 2015). The pre-college factors that influenced academic success for the students in the study were the student's gender identity, ethnic/racial identity, type of parental education, socioeconomic status, types of pre-college educational experiences. The college experiences that influenced academic success for the students in the study were the types of interactions with supportive individuals, perceptions of the campus climate/environment, and lastly, institutional type/characteristics. Additionally, levels of academic self-confidence and internal motivation and commitment, and types of belief systems and coping styles influenced academic success for the student in the study (Crisp et al., 2015).

Additionally, Crisp, Nora, and Taggart (2009) explored the relationship between pre-college, environmental, and college factors that influence students' interest in and decisions to complete a science, technology, engineering, or mathematics (STEM) degree among students attending a Hispanic Serving Institution. Results of the study indicated that student characteristics and pre-college factors such as gender, ethnicity, SAT math score, and high school percentile significantly influenced the likelihood of declaring a STEM major. Educational and social experiences significantly influenced the likelihood of completing a STEM degree and were uniquely associated with enrollment in an entry-level or higher-level college biology course, and enrollment in an entry-level or higher-level college algebra course the first semester of college (Crisp et al., 2009).

In the past 30 years, the concept of student engagement has evolved to encompass the complex relationships between desired outcomes of college and the investment of time, quality of effort, and campus involvement factors contributing to students' academic and social development during their college experience (Kuh, 2009b). In the recent literature on student engagement, a greater emphasis has been placed on how the university contributes to student engagement through resources, programs, and institutional climate (Kuh, 1999; 2001; Kuh et al., 2005). In order to foster student engagement, universities have been to provide more consistent and widespread programs to influence student engagement, such as learning communities, undergraduate research experiences, first-year seminars, and capstone courses.

Pre-college Factors and Engagement of College Students

Student engagement is a concept that promotes individual students' level of involvement in both academic and social experiences during their education. "Student engagement is most often measured by how actively students become involved with their educational processes, as represented in their academic and social behavior" (Nora, Crisp & Matthews, 2011, p. 106). As the college student population has diversified, the construct of student engagement likely is no longer appropriate to broadly apply to the more racially and ethnically diverse population of college students today (Kuh, 2009b).

The literature suggests that students from historically underserved groups may benefit from engagement, and some student populations may benefit more than others from specific engagement experiences (Pascarella & Terenzini, 2005). Following the theoretical perspectives of Tinto (1975), Astin (1985), Pace (1982), and Nora and Ramirez (2006), pre-college factors are reliable indicators of college performance. Greene, Marti, and McClenney (2008) studied the relationships between various pre-college characteristics and student engagement and degree completion. Results of the study revealed that African American students reported being more engaged, yet at the same time demonstrated lower academic outcomes than their White peers. Several pre-college factors emerged in the analysis that positively influenced academic outcomes. GPA was positively associated with having children, delayed entry to college, total credit hours completed before the current semester, reading placement, writing placement, and mathematics placement. Successfully passing a course was positively associated with mathematics placement, having children, delayed entry to college, and total credit hours before the current semester. Gatekeeper course GPA was positively associated with credit hours enrolled in the current semester, mathematics placement, and delayed entry to college. Furthermore, mathematics placement was positively associated with passing gatekeeper courses (Greene, Marti, & McClenney, 2008).

Kuh and colleagues (2008) studied the influence of pre-college characteristics on engagement. They found that pre-college characteristics such as academic achievement represented by ACT score influenced first-year GPA and persistence to sophomore year. However, after engagement experiences were considered (e.g., living on campus, working on or off campus), the effects of pre-college characteristics diminished considerably (Kuh et al., 2008).

Adelman (1999) found that the academic intensity and quality of students' high school curriculum attributed most to their preparation for bachelor's degree attainment over and above test scores, class rank or grade point average. In recent years, there has "been a substantial increase in the availability of college-level courses for secondary students nationwide including advanced placement (AP) and, has been variously called concurrent enrollment, dual enrollment, or dual credit enrollment" (Lin et al., 2018, p. 2). Dual enrollment refers to the offering of college-level courses to high school students, whereby the students have the potential to earn credit toward a post-secondary degree before graduating from high school (Allen & Dadgar, 2012). Lin and colleagues (2018) explored the relationship between financial aid and persistence toward degree completion for students participating in dual enrollment and AP programs at a large, multi-campus, midwestern university. Results of the analysis revealed that students who completed AP courses in high school and who furthermore had higher institutional and private aid were less likely to drop out than non-AP students. Dually enrolled students who received loans were significantly more likely to persist. Additionally, FGCS students were significantly more likely to drop out of college than their continuing-generation peers. Results of this study indicate the intersectionality of pre-college factors, FGCS status, financial need, and participating in AP credits influenced the persistence of students.

Jones (2014) studied the effects of dual enrollment participation and persistence rates of first-year full-time college students attending a research university the fall after high school graduation. The results of the study indicated that dual enrollment participation influenced the GPA of the students. Results of the analysis indicate that students who complete dual enrollment credits before first-year full-time college enrollments tend to earn significantly higher cumulative college GPAs in their first year (Jones, 2014). Also, completing college credit before the first year of college additionally influences higher first-year persistence rates at the end of their first year of full-time college enrollments (Jones, 2014). An's (2013) analysis demonstrated similar findings. Analyzing the data from the National Educational Longitudinal Study of 1988, An (2013) explored the relationship between dual enrollment participation and degree completion for low-income college students. The results of this study indicate that dual enrollment participation significantly increased the probability of attaining a bachelor's degree for students.

The research on pre-college factors and engagement indicates that who students are when they arrive on campus influences their choices to engage, and engagement experience may serve a mediating effect, particularly for students who enter college with less academic preparation. Furthermore, "self-reported levels of engagement may represent an Effort-Outcome Gap, the result of having to put forth more effort in attempting to compensate for a pervasive combination of academic and institutional barriers to educational success" (Greene et al., 2008, p. 529). According to Greene and colleagues, students from traditionally underserved populations are also likely academically "at-risk" (Greene et al., 2008). These students are also likely putting in more effort and energy to achieve educational goals than their peers who face fewer institutional barriers (Greene et al., 2008). Because first-generation students enter college with different pre-college factors, they may perceive that they are working harder to overcome barriers in their college-going experience when comparing themselves to their continuing-generation peers. First-generation students may also make different choices in opportunities to engage than students with fewer risk factors such as continuing-generation students (Kuh et al., 2008). As such, an examination of the engagement experiences of "at-risk" students is necessary.

On-campus Living and Student Engagement

The positive effects of living on campus have been well-established in the literature and include increasing students' sense of belonging, engagement, and openness to diversity (Blimling, 1989; Gellin, 2003; Lopez Turley & Wodtke, 2010; Pascarella, 1993; Pike, 2002; Velez, 1985; Whitt, Edison, Pascarella, Nora, & Terenzini, 1999). Velez (1985) studied the academic experiences of students who were high school seniors in 1972, analyzing data from the National Longitudinal Survey of the High School Class of 1982; results indicate that where a student lives has a significant impact on the probability of finishing college. Students who lived on campus were 43 percent more likely to finish college than students who lived off-campus (Velez, 1985). Institutional housing is associated with more significant cognitive gains for first-year students

(Blimling, 1989; Pascarella, 1993). Pascarella (1993) found that students who lived on campus demonstrated more significant freshman-year cognitive gains than similar students who commuted to college.

Blimling (1989) completed a meta-analysis of 21 studies published between 1966 and 1987 and concluded that students who lived in residence halls had an advantage in academic performance over commuter students. This original analysis, however, lacked controls for pre-college differences in academic performance. In a further analysis of the ten studies, when academic achievement was controlled for, the findings indicated that there was no statistical difference in academic performance for commuter and residential students (Terenzini et al., 1999). Lopez and associates (2010) also explored the impact of living in residence halls on student populations at different institutions. Analyzing a sample of first-year students from the National Postsecondary Student Aid Study (NPSAS), results indicate that for most students in most institutions, living in a residential hall did not have a significant effect on first-year academic performance. However, for specific student populations and institutional types, living on campus did have a significant impact. For example, Black students who lived on campus had significantly higher GPAs than similar students at the same institution who lived off-campus with family. Furthermore, for students attending liberal arts institutions, residential students demonstrated higher GPAs than their peers at the same institution who lived off-campus with family (Lopez Turley & Wodtke, 2010). These findings suggest that some students may benefit from living in residential halls more than others.

Living in residential halls may positively influence other factors of students' experiences in college, aside from GPA. For example, Pike (2002) explored the influence of on and off-campus living arrangements on students' openness to diversity by analyzing the data from 502 first-time college students at a Midwest research university. Results from the study indicate that living on campus was directly associated with higher levels of openness to diversity. Gellin (2003) conducted a meta-analysis of eight studies from 1991 to 2000 to determine if student involvement influenced critical thinking. Results of the analysis indicate that students who lived on campus, who were involved in clubs and organizations, and who had frequent interactions with peers reported higher levels of critical thinking than students who were not involved in the same experiences. The results of these studies support Pascarella's (1993) finding that Institutional housing influences students in the area of critical thinking.

Living in the residence halls provides students with more opportunities to interact with peers, which, in turn, positively influences student's development in college (Velez, 1985). Whitt and colleagues' (1999) studied the impact of peer interactions and student success in college. The results of the study indicate that peer interaction that was centered on course-related issues positively impacted self-reported gains in thinking and writing skills, understanding of science, and academic preparation for a career. Peer interactions focusing on non-course related issues had significant and positive effects on self-reported gains in understanding the arts and humanities and understanding self and others (Whitt et al., 1999).

Recognizing the positive implications for living on campus, many universities have attempted to broaden the scope of residential hall activities to promote scholarship as well as social involvement, such as the development of residential and non-residential learning communities (Lopez Turley & Wodtke, 2010).

Learning Communities and Engagement

Learning communities have been studied as a predictor of students' motivation to engage in both classroom and extra-curricular activities (Kuh, 2008). While there are varying definitions and forms of learning communities, learning communities have some form of commonality, which includes a cohort of students engaging in everyday intellectual activities through the form of taking two or more classes together (Brower & Dettinger, 1998). Zhao and Kuh (2004) studied the relationship of learning community participation and engagement of 80,479 first year and senior students from 364 four-year colleges and universities who completed the NSSE survey in the spring of 2002. Results indicate that participating in a learning community was positively associated with academic performance and engagement, as well as gains in college attendance and overall satisfaction with the college-going experience. Furthermore, the results of the study indicate that when students enter college with low SAT and ACT scores, participating in a learning community provides critical mediating effects for students entering college with less academic preparation (Zhao & Kuh, 2004).

Pike and others (2010) studied the relationship between learning community participation and student engagement both inside and outside of the classroom by analyzing the data from the 2004 NSSE, which included 39,546 first-year students and 37,041 senior students attending 277 colleges and universities. Results indicate that for first-year students, learning community participation is positively related to academic effort, integrative and higher-order thinking, first-year students' diversity experiences, active and collaborative learning, and students' perceptions of a supportive campus environment. Results of the study also revealed that living in residence halls was also positively related to first-year students' diversity experiences, active and collaborative learning, and students' perceptions of a supportive campus environment (Pike et al., 2010). Additionally, the researchers performed multiple regression analyses to identify if any student characteristics accounted for the variability of predictors of student engagement. Results of the further analyses indicated that differing student characteristics further influenced engagement. Results indicated that students who identified as female who were members of a racial/ethnic minority group positively related to their academic effort (Pike et al., 2010).

Additionally, the results indicated that students who were members of a racial/ethnic minority group and were Art or Science majors were positively associated with their integrative and higher-order thinking for first-year students (Pike et al., 2010). First-year students' diversity experiences were also positively related to membership of a minority group, living in a residence hall, and majoring in the Arts and Sciences. Active and collaborative learning for first-year students was also positively associated with living in a residence hall and majoring in the arts and sciences. The first-generation status was negatively related to active and collaborative learning, student-faculty interaction for first-year students, and negatively related to seniors' higher-order thinking, diversity experiences, and seniors' interactions with faculty (Pike et al., 2010). The results of these studies indicate that learning community involvement positively influences engagement and educational outcomes for students.

Employment and Engagement of College Students

Working while in college is currently the norm for many undergraduate students (Pascarella & Terenzini, 2005). With so many college students working, employment, and engagement is a matter of debate in the research literature (Astin, 1993; Pike, Kuh, & Massa-McKinley, 2008; Velez, 1985). Utilizing the data from the National Longitudinal Survey of the Class of 1982, Velez (1985) studied the academic experiences of students who were high school seniors in 1972. For the participants in the study, those who held a work-study job had an increased probability of 23 percent in finishing college. Astin (1993) reported that full-time off-campus employment was negatively related to GPA, overall satisfaction with college, and working part-time on campus positively influenced grades. Pike, Kuh, and Massa-McKinley (2008) found that the number of hours first-year students work influences students' engagement and academic achievement. Students who worked more than 20 hours per work had substantially lower grades than students who did not work. Students' work experiences were significantly related to their levels of engagement in educationally purposeful activities. Furthermore, working 20 hours or less on or off-campus was positively related to engagement measures (Pike et al., 2008).

Additional studies reported the perceived benefits of employment during college (Curtis, 2007; Mantheir & Gilmore, 2005). Manthei and Gilmore (2005) studied the effect of paid employment on undergraduate students' academic and personal lives. For the participants in the study, 81 percent held at least one job during the academic year for an average of 14 hours per week. Students who worked reported spending their earnings typically on essential living expenses and reported that working often left less time than desired for studying, social activities, and recreation. However, the results also indicated that students were spending, on average, 25.9 hours per week on academics. Therefore, many students had extra time to work in paid employment either out of necessity or choice. If given a choice, 43 percent of students said they would choose to continue to work even if they had enough money to cover all their expenses. Reasons these students provided included benefiting from the experience and responsibility employment provided, to achieve a balanced lifestyle, expanding their social network, and enjoyment gained from the work they did (Manthei & Gilmore, 2005).

Curtis' (2007) study revealed similar results. Of the 336 undergraduates who completed questionnaires about their perceptions on the effects of working in college on academics, more students perceived that there were benefits to working than perceived disadvantages. While most students appeared to consider paid work was not damaging to earning their degree, over 25 percent of employed students considered that they were missing out on university life as a result of working (Curtis, 2007). Consistent with previous research, students who worked on-campus typically benefitted more than their peers who worked off-campus (Astin, 1993; Pascarella & Terenzini, 2005).

The results of these studies suggest that many college students work both on-campus and office campuses during college, sometimes out of interest and sometimes out of financial necessity. The number of hours students work while enrolled in college may be a critical factor in students' academic success. Furthermore, working on campus and off-campus may influence students' opportunities to engage with the campus community and may provide a new support network for students.

First-Generation College Students

Despite increasing college recruitment efforts for FGCS, the research suggests that students whose parents have not earned a four-year college degree are less likely to attend and succeed in college (Choy, Horn, Nunez & Chen, 2000; Pascarella & Terenzini, 2005; Paulsen & St. John, 2002). Approximately 27% of FGCS enroll in college compared to 71 percent of students whose parents have a college degree (Choy et al., 2000).

While there is an increase in the number of FGCS enrolling in college, there is concern about the extent to which they achieve degree completion (Pascarella & Terenzini, 2005). Results of Chen and Carroll's (2005) study on FGCS' degree completion in higher education showed that even controlling for similar education preparation, enrollment characteristics, and undergraduate majors, FGCS are more likely to drop out of college. While FGCS are aspiring to complete a bachelor's degree, only half of the students in the study were successful in achieving this goal (McCarron et al., 2006). As such, recent literature has covered the topic of FGCS' educational aspirations (Lohfink & Paulson, 2005; McCarron et al., 2006).

Gibbons and Borders (2010) studied the differences in educational and career aspirations of prospective 272 middle school and high school FGCS and prospective continuing-generation students. The results of the study indicated that prospective FGCS had lower degree attainment aspirations. In contrast, prospective continuing-generation students aspired to graduate from a four-year university or to continue to graduate school. Prospective FGCS also reported perceiving significantly more barriers to going to college than did prospective continuing-generation students, and the researchers found a significant negative relationship between perceived barriers and college-going self-efficacy for prospective FGCS. FGCS and prospective continuing-generation students additionally differed in their career aspirations, and while nearly all prospective FGCS reported planning on attending college, they also reported perceiving lower positive career outcomes as a result of attended college.

Kantamneni, McCain, Shada, Hellwege, and Tate (2018) examined how parental support and perceived barriers influenced academic expectations and career outcomes for prospective FGCS. The students were 142 (62 male and 80 female) high school students participating in a college preparatory program serving low-income students in two midwestern cities who self-reported first-generation student status. Results of the analysis found parental support and perceived barriers predicted career outcome expectations, self-efficacy, and student engagement for prospective FGCS. Furthermore, the results of the study indicated that support from mothers predicted career outcome expectations and school engagement. In contrast, support from fathers and perceptions of barriers predicted higher career outcome expectations and academic self-efficacy. Pike and Kuh (2005) studied the differences in educational aspirations between FGCS and continuing-generation students. Results from the study demonstrate that FGCS had lower educational aspirations than continuing-generation students.

Similarly, Lohfink and Paulson (2005) examined the relationship between FGCS educational aspirations, persistence, and retention in college. The study showed that FGCS, who expected to complete more than a bachelor's degree, was 7.3 percent more likely to persist than those who planned to complete a bachelor's degree or less (Lohfink & Paulson, 2005). McCarron and Inkelas (2006) explored the educational aspirations and attainment of FGCS. Utilizing longitudinal data from the National Educational Longitudinal Study, a nationally representative sample of 1,879 students were studied to explore the difference in educational attainment for FGCS by gender, race/ethnic, and socioeconomic status. Results of the study showed that of the FGCS who had aspired in 1990 as high school sophomores to complete some form of postsecondary degree, 62.1

percent did not attain their aspirations by 2000, eight years after high school graduation. Of the FGCS sample, 29 percent achieved a bachelor's degree by 2000, whereas 40.2 percent had aspired to as high school sophomores in 1990.

Furthermore, when socioeconomic status was considered, more FGCS fell into the lowest income quartile, and 76.6 percent attained less than a bachelor's degree. Regardless of socioeconomic status, 69.1 percent of FGCS earned less than a bachelor's degree (McCarron et al., 2006). Raque-Bogdan and Lucas (2016) also explored differences in educational and career aspirations of 2,106 incoming FGCS and continuing-generation students. While the study revealed that FGCS and continuing-generation students reported similar levels of educational aspirations, the FGCS reported significantly lower levels of college self-efficacy and college outcome expectations for career aspirations than their continuing-generation peers. Additionally, fewer FGCS reported that their parents expected them to complete a master's degree and perceived more educational and career barriers than continuing-generation students. These results could be impacted by FGCS experiencing their college-going experience in more isolation than the continuing-generation students who may be selecting a major and career path in conversation with their parents (Raque-Bogdan & Lucas, 2016).

The results of these studies affirm that experiences in middle school, high school, and parental support likely influence FGCS persistence, retention, and academic experiences in college. The results of these studies also indicate the FGCS and continuing-generation may enter college with similar educational aspirations; however, FGCS perceive more barriers and view the outcome of graduating from college differently than their continuing-generation peers.

Engagement and First-Generation College Students

First-generation students represent a significant proportion of individuals pursuing a post-secondary degree in the United States (Choy, 2001). Within the population of FGCS, there are many within-group differences. FGCS are more likely to be female, be of non-traditional college age, financially independent from their families, and hold an off-campus job (Choy, 2001; Nunez & Cuccaro-Alamin, 1998).

Ethnic minority college students tend to be overrepresented as FGCS (Bui, 2002; Engle & Tinto, 2008; Hand & Payne, 2008; Terenzini et al., 1996). Significant numbers of FGCS identify as African American or Hispanic and predominantly speak a language other than English at home with their families (Bui, 2002). Inkelas and McCarron (2006) explored the between-group differences of ethnic minority FGCS' who graduated with four-year degrees. Results of the study indicated that 42% of Asian-American FGCS graduated with a bachelor's degree as compared to 31% of first-generation White students and 21% African American FGCS. Hispanic FGCS had the lowest college completion rate percentage, with only 19% graduating with a degree (Inkelas & McCarron, 2006). Also, FGCS are overrepresented as members of ethnic and racial minority groups and as low-income college students (Terenzini et al., 1996; Engle & Tinto, 2008; Hand & Payne, 2008). Utilizing longitudinal data from the National Educational Longitudinal Study, a nationally representative sample of 1,879 of college students were studied. An analysis of the student demographics in the sample showed that FGCS "constituted a larger percentage of the lowest socioeconomic status quartile, 38% as compared to 27.6%" of continuing-generation students (McCarron et al., 2006, p. 538).

Considering the FGCS population is representative of multiple racial, ethnic, and socioeconomic identities, it is crucial to examine the research on the differences in FGCS and continuing-generation students' experiences in transitioning into higher education (Horn & Nunez, 2000; Vargas, 2004). While FGCS are aspiring to complete a bachelor's degree, the literature suggests that only 50% are successful in achieving this goal (McCarron et al., 2006). Even though FGCS have similar educational aspirations as continuing-generation students, the research suggests that factors such as living on campus and engaging with the campus community may influence educational aspirations for specifically for FGCS, which may, in turn, influence persistence and retention (Pike & Kuh, 2005).

Many FGCS enter college with less of an understanding of the processes, systems, paperwork, and expectations of higher education and receive less social support from their families regarding college issues during the transition time from high school to college relative to continuing-generation students (Engle, 2007). FGCS may have difficulty navigating the process of deciding how to choose a university to apply to (Paulsen & St. John, 2002) how to navigate the admissions process and finally how to navigate the transition from high school to college (Engle, 2007; Palbusa & Gauvan, 2017). As a result, colleges and universities across the United States have implemented initiatives to support FGCS engagement experiences in college. Examples of initiatives include peer-to-peer mentoring programs, cohort style college experiences to foster unity among FGCS, residence halls that provide special FGCS focused programming, and student groups and academic courses solely for FGCS to foster a sense of community (Pascarella & Terenzini, 1991).

Stephens, Townsend, Hamedani, Destin, and Manzo (2015) explored the impacts of one such program created to provide an opportunity for FGCS to share their college experiences with both their FGCS and continuing-generation peers. The researchers created the "Difference-Education Framework," a program to provide a platform for FGCS to share their personal stories and open a dialogue between FGCS and continuing-generation students. Results of the study indicated that both the FGCS and continuing-generation students benefited from the opportunity to hear about the college experiences of FGCS from the FGCS in their own words and reported improvement in psychosocial outcomes such as improvement in responding to college stress and quality of life. For the FGCS students from low-income backgrounds, speaking about their experiences as FGCS in college may have further equipped the students to experience their working-class backgrounds as a strength and served to aid them in persisting during stressful situations in college (Stephens et al., 2015).

Swecker, Fifolt, and Searby (2013) explored the relationship between engaging in faculty-lead advising sessions and retention of FGCS at a public research university in the southeast. Results of the study suggested that for every meeting with an advisor, the odds of student retention increased by 13%. The researchers' findings supported the hypothesis that advising appointments may be an institutional mechanism that consistently connects the student to the university in a meaningful way and can influence the likelihood of persistence to degree attainment (Swecker et al., 2013).

In addition to individual college and university efforts, federally funded programs such as TRIO programs have been developed to provide engagement opportunities FGCS during their college experience. Rodriguez (2003) investigated factors that influenced

FGCS in completing their bachelor's degree. The results of the study indicated that identifying early with an FGCS identity influenced some FGCS in persisting to graduation. The students reported that being identified as FGCS enabled them to be positively "singled out" by TRIO programs, mentors, teachers, or coaches in their childhood academic experiences. Furthermore, students reported that identifying as FGCS and receiving support from TRIO programs and school personnel helped them to develop an aptitude for risk-taking, which intern enabled them to participate in programs they considered to be atypical of their family members. FGCS referenced that participating in these experiences positively impacted their decisions to move away from home and pursue a college education (Rodriguez, 2003).

Once enrolled, FGCS may still face barriers to persistence and retention. FGCS may meet unique challenges after they start their college education, which may contribute to lower college retention and graduation rates (Barry et al., 2009; Choy, 2001; Pascarella & Terenzini, 2005; Rodriguez, 2003). Rodriguez (2003) study examined factors that were pivotal in helping FGCS persist to degree completion. After enrollment, the study revealed that factors that enabled FGCS to graduate were inspirational teaching, promoting a sense of belonging, activism, and risk-taking, and aiding students in taking academic plans (Rodriguez, 2003). Pike and Kuh (2005) studied the differences in college engagement and intellection development between FGCS and continuing-generation college students. The study examined the students' academic and social engagement and found that both factors served as predictors of educational aspirations beyond a bachelor's degree. FGCS, as compared to their continuing-generation peers, reported significantly lower levels of academic and social engagement and reported less favorable perceptions of the college environment. Additionally, for students in the study, living on campus had a direct, positive effect on learning and intellectual development, which is relevant considering the previous studies on FGCS enrollment patterns indicates FGCS often do not live on campus (Pike & Kuh, 2005).

FGCS often have financial stress and work full-time while pursuing academics (Choy, 2001), and FGCS may choose a university-based on proximity to family of origin (Saenz, 2007). Saenz studied the enrollment patterns of FGCS and found that almost 50% of FGCS decide to attend a college or university within 50 miles of their home (Saenz, 2007). The results of the study indicated that FGCS might select a university that allows them to continue to live at home and work while going to school. Saenz (2007) concluded that this combination of working while in school and not living on campus might lead to less study time and lower grades and likely result in limited participation in extra-curricular activities in college (Saenz, 2007).

Many FGCS are faced with competing priorities outside of the classroom, including family and work responsibilities, and, once enrolled, may experience more difficulty adjusting to college and, as a result, may inaccurately appear less committed to their student role (Pascarella & Terenzini, 2005). When Barry (2009) studied the work patterns of FGCS in college, results indicated that FGCS are likely to work more hours a week as compared to continuing-generation students (Barry et al., 2009). FGCS also tended to maintain active family roles and have demanding family responsibilities while attending college (Barry et al., 2009).

Pike, Kuh, and Massa-McKinley (2008) also studied the relationship between working on and off-campus in college and students' background characteristics to explore who works in college and how much they work. Results of the analysis indicated that FGCS status was positively related to working 20 hours or less on campus and at the same time, positively related to working more than 20 hours a week on or off-campus. Martinez, Bilges, Shabazz, Miller, and Morote (2012) studied the relationship between resiliency and university engagement and working on and off-campus in a sample of 42 low-income FGCS. The results of the study indicated that working while in college positively influenced resiliency; however, no significant relationship between intuitional engagement and employment. Results indicated more excellent resiliency among students employed off-campus than among students employed in on-campus work-study positions (Martinez et al., 2012).

Choy (2001) also studied the influence of finances and FGCS' college experiences. Results of the study indicated that FGCS have significant financial worries, many FGCS work full-time to contribute financially to their family in addition to paying for their college expenses such as tuition, books, transportation (Choy, 2001). Because FGCS tends to work full-time, it is often more challenging to participate in academic and social opportunities on campus (Choy, 2001). In turn, because many FGCS have less time to participate in campus activities, this may result in lower grades and higher withdrawal rates (Warburton, Burgarin, Nunez, & Carroll, 2001). Warburten (2001) studied FGCS experiences adjusting to college. Results of the study indicated that FGCS tended to be less involved in campus activities often as a result of the need to work full-time (Warburten, 2001) and were less likely to live on campus. Pike and Kuh (2005) additionally studied the different experiences of FGCS and continuing-generation students as they transitioned to college. The study demonstrated that FGCS reported much less academic and social engagement on campus than continuing-generation students (Pike & Kuh, 2005).

In addition to low-income status influencing FGCS engagement in college, the literature additionally suggests that FGCS who also identify as students of color may have different experiences in engaging with campus culture than their continuing generation peers (Jack, 2016; Parks-Yancy, 2012; Storlie, Mostade & Duenys, 2015). Parks-Yancy (2012) studied low-income, African American FGCS experiences in college. The study explored how the students obtained social capital resources in college to set and achieve career goals. For the students in the study, many reported knowing little about career opportunities available to college graduates. The knowledge about careers that they possessed was related to the current jobs they held as college students. Results indicated that 88 percent of the students had plans to stay in their current position after graduation and "work their way up" the company hierarchy. These results seemed striking in that the students did not need a degree to obtain their current occupation. An additional theme from the study was very few of the students took advantage of career resources such as faculty interactions, appointments at the career center, or internship experiences. Reasons for not taking advantage of career resources varied and included not having enough time, the perceived value of the support, and not exploring career options because they had already decided to stay at their current position. Furthermore, the study found that social capital played a significant role in students' college experiences. Students who engaged with faculty and staff reported an increased level in knowledge of career opportunities and options (Parks-Yancy, 2012).

Storlie, Mostade, and Duenys (2015) studied FGCS Latina students' college experiences at a primarily Caucasian university. Two graduate and eight undergraduate Latina FGCS participated in the study. Two overarching themes were generated to explain how students understood how their values and life-role salience impacted their individual career development: "fitting in and redefining career development pathways" (Storlie et al., 2015, p. 309). All ten students referenced the desire "give back" to others in their community to make the most of their unique and perceived privileged opportunity to attend college. Participants reflected on their FGCS experience within a Latino family and how this created influenced a sense of disruption in their sense of belonging in both their family system and academic life. Six of the ten students discussed the struggles of having to navigate their career paths in an unfamiliar system as "unsettling and created a sense of separating from their family units" (Storlie et al., 2015, p. 309). Students also reported feelings of isolation after becoming college students and communicated the struggle of disconnection with both their family culture and their campus culture. Further adding to the feelings of discord between family and campus were the expressed feelings of navigating cultural ties to traditional life roles in their Latino families with the more individualized Caucasian environment of campus and career roles.

Jack (2016) additionally studied the differing engagement experiences of black and Latino FGCS and continuing-generation students. Semi-structured, in-depth interviews were analyzed for themes revealing a distinct difference between FGCS and continuing-generation students' engagement experiences with faculty. In addition to having fewer engagement experiences with faculty, FGCS reported actively withdrawing from faculty interactions even as they perceived their continuing-generation peers reaping benefits from forging relationships with faculty. The FGCS students reported feeling as though they were lagging-behind their continuing-generation peers in learning the norms and expectations of engaging with faculty. Continuing-generation students referred to experiences of engaging with faculty about personal and social matters; however, the FGCS students reported feeling uneasy with the expected style of engagement with faculty. The FGCS students referenced that the expectation to "build relationships" with faculty made them feel uncomfortable as they expected faculty and student interactions to center solely on to be limited to discussing academic material (Jack, 2016, p. 9).

The results of these studies highlight the complexity of academic and career development experiences for FGCS. The experiences of isolation from both family and the academic environment further demonstrate the unique within-group differences of the larger FGCS population.

First-Generation College Students and Support Systems

Many factors influence college students' persistence and retention (Hand & Payne, 2008). Hand and Payne found that for the FGCS students in their study, working full-time was one of many influences on the students' persistence with their college degree. Other factors that contributed to FGCS persistence and retention included: home culture and family, internal locus of control, relationships and emotional support, and communication of information (Hand & Payne, 2008).

Because many FGCS enter college without a parent to guide them through the processes of admissions, academic rigor, and social adjustment they may find it difficult to process their experience and integrate into the campus environment (Hsiao, 1992; London, 1996; Mitchell, 1997; Palbusa & Gauvan, 2017; Warburton et al., 2001).

Mitchell (1997) studied the differences in academic and personal adjustment to college for FGCS and continuing-generation students. The results indicate the FGCS, as compared to their continuing-generation peers, experience distinct challenges in both academic adjustments and social adjustment. Some may receive less familial support or may experience alienation from their family of origin (London, 1996), and others may feel academically underprepared (Mitchell, 1997). Others may break with family traditions intentionally or indirectly as a result of the college-going experience (Hsiao, 1992). London expresses: "first-generation students live on the margin of two cultures, having to renegotiate relationships at college and home to manage the tension between the two" (Thayer, 2000, p. 5).

Perna and Titus (2005) assert, "parental involvement is a form of social capital that promotes college enrollment by conveying norms and standards" (p. 507). For the students, parent-student discussions about education-related issues influenced a higher likelihood of enrolling in postsecondary education. Furthermore, regarding social capital, students who attended high schools in which many parents contacted the school about academic matters were more likely to enroll in a four-year college. The results of the study affirm the influence of social capital on high school students' college enrollment decisions (Perna & Titus, 2005).

For some FGCS, completing a bachelor's degree can mean navigating complex family relationships regarding the economic and social benefits of attaining a bachelor's degree (Hsiao, 1992; London, 1996; Mitchell, 1997). London (1996) studied FGCS as they integrated into the college experience. Students of the study reported an uncomfortable separation from their culture of origin because the educational environment did not mirror a familiar environment consistent with their previous experiences. FGCS reported having difficulty learning the language of college, identifying with the faculty on campus, and fitting in with continuing-generation peers (London, 1996). Garriott, Hudyma, Keene, and Santiago (2015) examined Lent's (2004) social-cognitive model or normative well-being of 414 FGCS and continuing-generation college students. Results indicated differences in FGCS and continuing-generation students' interaction between academic satisfaction, intrinsic motivation for attending college, and life satisfaction.

Soria and Stebleton (2012) studied the ways FGCS engage with faculty and experiences in classroom discussions. The study examined academic engagement as measured by the frequency of faculty engagement and patterns of participating in class. Results of the study indicated that FGCS' involvement in college differs from continuing-generation students, and FGCS had less frequent interaction with faculty, were less likely to contribute to class discussions, and were less likely to ask questions in class. The results of this study draw attention to the reality that FGCS experiences and engage in their academic experience in college in a different way than continuing-generation students. Because FGCS are engaging less with faculty, they are likely not able to benefit from the social capital of leveraging their faculty as sources of career information. As such, likely, their academic experiences and career development experiences may also differ. The lack of capital cannot be separated from this group of students because it is often the source of many potential disadvantages for college students.

Palbusa and Gauvan (2017) investigated the role of communication between college students and parents during the transition year from high school to college. The study explored the parent-student communication on the experience of going to college during the students' first academic year. While results from the study show no difference in frequency of discussion with parents about college between FGCS and continuing-generation students, the continuing-generation students perceived conversations with their parents about college to be more helpful and of higher quality than FGCS.

For continuing-generation students, Garriott (2015) asserted that attending college is more of a socialized experience. Thus, inherent motivation and satisfaction may lead to high levels of life satisfaction. Whereas for FGCS, attending college is less of a socialized experience and additionally can present the students with personal costs such as distancing themselves psychologically from family and friends and navigating that feeling of being an imposter on a college campus (Davis, 2012). Because of these factors, even for FGCS, intrinsic motivation and academic satisfaction may not lead to high levels of life satisfaction, explaining the difference in the findings for these two groups of students (Garriott et al., 2015).

First-Generation College Students and Academic Major Choice

Selecting a college major is undoubtedly one of the most important career decisions that a college student must make (Goodson, 1978). There are a variety of factors that influence a students' choice of major (Beggs, Bantham, & Taylor, 2008). Academic major choice can be influenced by an interest in a subject area (Adams, Pryor, & Adams, 1994), having access to individuals with experience in a specific major or field of study (Leppel, Williams, & Waldauer, 2001). College or department's communications and promotional materials such as the information communicated to students about academic majors, as found on college websites, in department brochures, and academic catalogs also influence students' decisions to pursue specific academic majors (West, Newell, & Titus, 2001). Lastly, introductory courses and timing of introductory courses (Mauldin, Crain, & Mounce, 2000) or perceived earning potential of college major serves as influential factors in students' academic major decision-making process (Montmarquette, Cannings, & Mahseredjian, 2002).

Galotti (1999) studied how college students choose a major. College students were surveyed first in their first year and again one year later about their major choice. Results of the study indicated that career information, faculty, and degree requirements were the most significant contributing factors to students' choice of academic major. Results of the study indicate that for the participants, students successfully choose a major after collecting information such as what job prospects for graduates with a specific degree were, who the faculty in the department were, and what degree requirements were necessary to complete specific majors. Additionally, these students had the benefit of many available resources, including parental involvement and guidance counselors, to consult within making their choice. The results of these studies demonstrate the importance of evaluating the complex factors that influence students' choice of academic major.

FGCS face additional barriers to choosing and changing their academic major as they may have unrealistic expectations about majors due to their limited exposure to college and careers. The literature shows that FGCS may not know how to navigate the system to find such support (Bui, 2002). Thus, the research on academic choice for the general population of college students may fall short in applying to FGCS, who may not have the same access to the information needed to make a well-informed choice of academic major. Recent literature indicates that FGCS status may influence academic major choice (Bowen, Kurzweil, Tobin, & Pichler, 2005; Goyette & Mullen, 2006; Leppel, 2001; Montmarquette et al., 2002). Goyette and Mullen (2006) explored parents' level of education on academic major choice behavior. Results of the study indicated that parents' education is associated with enrollment in arts and sciences versus vocational majors, the study, however, did not explore differences for continuing generation and first-generation students' choice in majoring in either the arts or the sciences.

Chen and Carroll (2005), in their "Postsecondary Education Analysis Report," examined what FGCS study in college. They analyzed the data from the Postsecondary Education Transcript Study and the National Education Longitudinal Study of 1998 (NELS, 1998) to explore the academic major and course-taking patterns of FGCS and compare their postsecondary experiences with continuing-generation students. The results of the study demonstrated that FGCS might struggle to choose a major, maybe because they do not have parental support or guidance. Results showed that FGCS who majored in education and the social sciences were more likely to persist than students majoring in business. FGCS who majored in health sciences, human/protective fields, or other majors were even less likely to persist to graduate with their degree (Chen & Carroll, 2005).

Montmarquette and colleagues (2002) also studied the factors that influenced the major choice for FGCS using longitudinal data from the National Longitudinal Survey of Youth. Results of the study showed that FGCS and continuing-generation college students both considered income potential as an influential factor in choosing an academic major. The results of the study suggested that liberal arts majors such as humanities, arts, and social sciences may be passed over by both FGCS and continuing generation-college students because of perceived lower-earning potential (Montmarquette et al., 2002).

McLean (2015) also studied how major changing patterns impact FGCS and continuing-generation college students' self-efficacy. The study examined the survey responses of 719 students, 229 identified as FGCS, seven were unsure of their generation status, and 483 identified as continuing-generation students. Results of the quantitative analysis revealed a difference in academic major changing patterns between FGCS and continuing-generation students; 90 % of the FGCS students reported changing their major at least once. The FGCS who did not change their major had a significantly higher GPA than FGCS, who had changed their major at least one time. The gatekeeper courses likely influenced these results, and the FGCS may have changed their major after experiencing academic difficulty in coursework required for their first declared major. An additional conclusion was that FGCS, who did not change their major, reported a higher level of confidence in their ability to decide what they valued most in a career than did FGCS who changed their major at least once.

Olenchak and Herbert (2002) reported that FGCS are more likely to feel guilty when they do not pursue the goals that their parents want them to in college because their parents have sacrificed so much for them to be able to attend college. Individually, they may not participate in career exploration and are thus more likely to select college majors early and stay enrolled in unsuitable majors. Because many FGCS have less information on navigating campus resources, they likely do not have the necessary capital to explore college majors and career opportunities related to different majors. Results of the study indicated FGCS might stay enrolled in majors in which they have no interest to please parents and or to impress peers (Olenchak & Herbett, 2002).

First-Generation College Students and STEM Majors

FGCS are less likely to declare majors in science, technology, engineering, and mathematics (STEM) (Chen, 2005). An examination of FGCS experiences in declaring a STEM major and persistence in STEM degree attainment is essential as STEM majors tend to have more employability and earning potential than that of majors in the liberal arts, education, and the humanities (Wolniak, 2016).

Wolniak (2016) examined data from the Beginning Postsecondary Students Longitudinal Study to explore the factors of college students' likelihood of completing a STEM degree within six years of beginning college. STEM graduates were more likely to report foreign citizen status, having English as a second language, and having at least one parent with a bachelor's degree. Students who completed a STEM degree within six years also reported, on average, significantly higher household incomes, $83,083 vs. $69,712, than the full sample of college enrollees (Wolniak, 2016).

Bowen, Kurzweil, Tobin, and Pichler (2005) studied FGCS and continuing-generation students at highly selective universities. The results revealed that FGCS were more likely to major in the Social Sciences, Humanities, and Business and are underrepresented in the Natural and Hard Sciences (Bowen et al., 2005). Leppel (2001) examined the effects of socioeconomic status and parental occupation on a choice of college major. Data from the NCES survey were analyzed to see if parents' occupation or parents' income level were predictive of students' choice of major. The results of the study showed that that parents' occupations influenced students' choice of major. Students whose fathers held professional or executive occupations were more likely to choose a major in engineering and the sciences.

Montmarquette and colleagues (2002) also explored FGCS status and socioeconomic status. Results of the study demonstrated that FGCS, supported by an educational loan, were more likely to choose liberal arts majors over majors in business and science (Montmarquette et al., 2002). However, Crisp, Nora, and Taggart (2009) found that FGCS status was neither a positive nor a negative predictor of choosing a STEM major. Results of the study indicated that gender (male), ethnicity (Hispanic/Latina(o), Asian), higher math SAT score, and high school class rank were all influential factors in predicting the likelihood of enrolling in a STEM major.

FGCS with STEM majors may have different experiences than their continuing-generation peers in choosing a STEM major and persisting to graduation with a STEM major (Fernandez, Trenor, Zerda, & Cortez, 2008; Garriot et al., 2017; Trenor, Yu, Waight, & Zerda, 2008; Wilson & Kittleson, 2013). Trenor and colleagues (2008) studied the experiences of FGCS in STEM majors. Results of the qualitative analysis indicated that FGCS described their choice of engineering a coincidence or something they "fell into" as a result of a guidance counselor or teacher noting their aptitude for math and science (Trenor et al., 2008, p. 5). Students referenced an awareness of their parents' struggles as a result of a lack of higher education and engineering as an appealing major because of the prospect of making a decent salary and the potential to raise their socioeconomic status. Furthermore, social capital emerged as a theme for FGCS students. Additionally, the results of the study indicated that FGCS had less social capital in the form of peers with engineering-related information or professional networks before entering college. As a result, the students turned to the internet for information and formed peer groups at the university, which contributed to decisions to persist in the field (Trenor et al., 2008).

In addition to peer support, FGCS interactions with faculty in their STEM major may also serve as an influential predictor of persisting and graduating with a STEM degree (Espinoza, 2013). Espinoza (2013) studied eight FGCS Latino students majoring in engineering, utilizing a qualitative analysis. Results indicated that the students perceived they had less social capital than their continuing-generation peers; the students referenced knowing less about the engineering field than their continuing-generation peers. The study further explored the factors that influenced the students in persisting to graduation while navigating feeling different from their continuing-generation peers. The study found that faculty relationships were an essential factor in the students' persistence to graduation. Having access to faculty played an essential role in the students' feelings of validation in pursuing engineering. Additionally, students referenced their families positively influenced goal setting and motivation. For the students, the motivation to pursue and persist with a STEM major was influenced by wanting to do well both for themselves and for their families, which, in turn, enhanced students' desire to perform well academically and persist to graduation.

Fernandez, Trenor, Zerda, and Cortez (2008) studied the institutional and personal barriers FGCS encountered in pursuing a STEM major. Results of the qualitative analysis revealed that for the eight students pursuing majors in engineering, social capital was a predominate theme. The students referenced a lack of understanding of the admissions process, few, if any, role models and lack of parental knowledge as barriers to persisting with their degree in addition to other personal barriers such as financial concerns, challenging engineering curriculum, and balancing college and personal commitments (Fernandez et al., 2008).

FGCS may experience support from their family as they pursue their STEM major and at the same time, may experience tension with family as a result of their college-going experience (Wilson & Kittleson, 2013). Wilson and Kittleson (2013) studied the influence of family support on FGCS pursuing STEM majors. Results from the qualitative analysis indicated that for the students, family support served as an influential factor in first, choosing their major and second, persisting in their STEM major. Additionally, students reported a feeling of "tension between their own academic goals and the expectations their families had for their personal lives" (Wilson & Kittleson, 2013, p. 815). To persist, the students' reported needing to prioritize expectations of their undergraduate STEM programs over the expectations of their home culture. Adding to the tension, the students' reported feeling like they were not able to "remain friends with people from home" and could not rely on those friends as social support (p. 815).

Garriot and colleagues (2017) examined the relationship between parental support and self-efficacy of FGCS engineering majors. The results of the study showed that parental support was a significant predictor of engineering-related verbal persuasion and vicarious learning. These findings suggest that family may serve as an essential influence for FGCS in choosing and persisting in STEM majors, and FGCS may differ from their continuing-generation peers in navigating the expectations of the major with obligations to their family.

Results of Tate, Caperton, Kaiser, Pruitt, White, and Hall's (2015) qualitative study of 15 FGCS also indicated that family appeared to influence academic major and career decisions. One participant shared that her family demonstrated support for her college degree and professional career. At the same time, she also reported feeling like her parents' lacked knowledge about how to navigate college and the career development process (Tate et al., 2015). Students also discussed perceived barriers to entering the world of work after college and the financial struggles of their parents as an influence on their career development. Another important theme was the lack of a professional or career network. One participant expressed his frustration with a faculty member, assuming he had access to a professional network when he asked questions about how to get an internship (Tate et al., 2015). Students' felt that they had to work harder than continuing-generation students at achieving their career goals because they did not have access to a professional network. Students' also perceived themselves as more persistent, self-reliant, responsible, adaptable, motivated to succeed, and appreciative as compared to what they perceived as their "entitled" continuing-generation peers (Tate et al., 2015). Furthermore, it could also be constructed as a strength for FGCS to engage in navigating their college and career development process autonomously.

Career development happens long before a student enrolls in college and selects a major (Zunker, 2012). However, many FGCS may not have had exposure to the myriad of career opportunities a four-year degree can provide (Chen, 2005). As the previous sections have outlined, FGCS may face barriers that could impact their engagement experiences and influence the amount of information they must make an academic major choice and career decisions. Some of the barriers included limited access to role-models, financial stress associated with college cost, tendency to have parents with limited information about education and college, family pressure to enter the workforce after high school, and under-preparedness for college coursework (Chen, 2005; Choy, 2001; Engle & O'Brien, 2007; Horn & Nunez, 2000; Sickles, 2004). These barriers likely differently shape the academic major choice and career development experiences of FGCS.

In recent years programs have been developed on college campuses, and assessments have been analyzed to recruit and retain specific populations of college students to STEM majors (Doerschuk, Bahrim, Daniel, Kruger, Mann, & Martin, 2016; Mwaikinda & Aruguete, 2016). STAIRSTEP is a program that recruits first-generation, low-income college students to self-select into a two-year program. Once enrolled with the program, the students participate in specific engagement and retention programming to connect them with faculty and undergraduate research in STEM majors (Doerschuk et al., 2016). Researchers analyzed the data from a self-assessment questionnaire and the Learning Outcomes Questionnaire. Both assessments were tested to establish the validity and reliability of the instruments. Students completed the questionnaires when they entered the program, each spring semester, and when they graduated. From 2009 to 2014, a total of 96 undergraduates completed the program, and of the students, 89.58% remained in their STEM major. Cumulative statistics further indicated that since the inception of the program, students made higher grades (3.3 vs. 2.71 GPA) and lower drop rates (1.81 vs. 10.25 %) in their major courses than cohorts of students from prior years (Doerschuk et al., 2016).

Similarly, Mwaikinda and Aruguete (2016) studied the effectiveness of the STEM Alliance program designed to support students in STEM majors. Utilizing a quasi-experimental design, the researchers tested the efficacy of a STEM Alliance student organization to evaluate if FGCS showed a significant benefit after attending STEM Alliance events compared to their continuing-generation peers. The STEM Alliance student group was created to increase both academic and social support for STEM students at a Historically Black University. Data was collected from the 141 students at the end of the one-year program. Using a Chi-Square test of independence, researchers analyzed the data to examine whether FGCS attended STEM Alliance sessions at the same rate as continuing-generation peers suggesting the relationship between the two variables was not significant (Mwaikinda & Aruguete, 2016). The FGCS reported feeling significantly less motivated than their continuing-generation peers. Participation in the STEM Alliance appeared to influence continuing-generation students' personal contact with faculty more than it did for FGCS (Mwaikinda & Aruguete, 2016). The results of these studies suggest that programming to retain students in STEM majors may be influential for both continuing-generation and FGCS, and FGCS may further benefit from more targeted programming to connect them with faculty.

Grier-Reed and Ganuza (2012) studied the effectiveness of a constructivist career course implementing activities focused on cultural capital. Through the development of the course structure, the researchers proposed such cultural capital development experiences as a visit to the career center, resume, and cover letter assignments, and delivering an oral presentation. Furthermore, the researchers proposed four "constructivist tools of narrative (telling one's own story), action (exploring identity, beliefs, and values), construction (constructing identity across contexts), and interpretation (using personal information to guide career direction" (p. 464). Students were 36 TRIO students at one comprehensive Midwestern university enrolled in the semester-long constructivist career course, which met weekly for two hours. The racial/ethnic composition of the same was 28% Asian American, 25% African American, 20% European American, 17% Latino/American, and the remaining 10% identified as mixed-race or other. Analysis of the students' responses to the Career Decision Self-Efficacy Scale-Short Form (CDSE-SF) revealed significant differences in pretest/posttest scores on CDSE-FG subscales (Grier-Reed & Ganuza, 2012). The focus on developing an identity, cultural capital, and supportive relationships with peers corresponded with significant improvements in students' confidence in career decision self-efficacy.

These studies explored the influence of family on FGCS college major choice, career aspirations, and persistence in college. Themes from these studies provide a direction for future research to continue exploring the unique academic experiences of FGCS in STEM majors and suggest the importance of engagement experiences and opportunities develop social capital via faculty interactions and a professional network (Grier-Reed & Ganuza 2012; Stieha, 2010).

Women in STEM

In 2010 the American Association of University Women (AAUW) released a report by Hill, Corbett, and St. Rose, which referenced both social and environmental factors contribute to the gender gap in science and engineering. The report indicates that the foundation for earning a STEM degree is laid early in women's educational careers. Women who experienced teaching styles that created a "growth mindset" environment in middle school were more likely to continue to study math in the future. That is, the girls who were told by teachers that they had the potential for intellectual growth and believed in this potential were more likely to continue with mathematics studies. The authors posit that this belief may serve as a mediating factor for the stereotype that boys are better than girls at math, and further explored that this negative stereotype can indeed measurably lower girl's test performance. Martin-Dunlop and Johnson (2014) reference Hill and colleague's report in justification for furthering the inquiry about women's pursuit of STEM careers and how the literature has primarily focused on White women's college experiences. Martin-Dunlop and Johnson explored the intersection of race, gender, and bias on women's experience in STEM graduate programs. Results of their qualitative study indicated that for the three students, positive experiences with professors in their undergraduate program were influential. However, only one participant conveyed positive experiences with teachers at the elementary level. This participant furthermore referenced her experience in a Gifted and Talented program as well as a black female engineering professor who served as a mentor as new experiences the positively contributed to her pursuit and completion of a STEM undergraduate major. Each of the students mentioned negative experiences with college professors and middle school teachers. Another participant referenced that only one professor at her undergraduate major supported her and, as a result, felt like a "sore thumb sticking out" (p. 4). Also, to support teachers and professors, two students had positive experiences with others during their STEM education. One participant shared that the engineering department secretary would check-in and make sure she went to all her courses. Another participant shared that two additional influential contributors to her earning a STEM undergraduate degree were a 1-week mini-medial school experience instilled a love of biology in her and earning a scholarship to cover the cost of her textbooks. Two students additionally referenced spirituality and church support as playing a significant decisive role in their life as well.

Jolly, Campbell, and Perlman (2004) conducted a review of the literature in quantitative disciplines that focused on STEM education and student success. Results of the reviewed research and evaluation efforts revealed three broad themes that Jolly et al. categorized as the engagement, capacity, and continuity trilogy. Jolly et al. (2004) noted that each of these three factors must be present for student success and engagement, capacity and continuity are interdependent. Jolly et al. (2004) provides different examples of engagement: cognitive engagement, emotional engagement, and vocational engagement. Emotional engagement can be explained as the feeling that one's social worth will improve as a result of participating in an academic, social, or extracurricular activity or the experience of finding the content itself exciting and intellectually satisfying (Jolly et al., 2004). Cognitive engagement is explained by one's interest in mastering a topic or concept, which thus leads to more advanced concepts (Jolly et al., 2004). Lastly, vocational engagement is explained by one's interest in an activity that is connected to their career goal and is also perceived to be rewarding (Jolly et al., 2004). Capacity is an extension of self-efficacy (Liu, Hsieh, Cho, & Schallert, 2006; Roue, 2007).

Lastly, continuity is the combination of the resources, activities, encouragement, and support offered by all individuals within a school district to create pathways or continuity for students to remain in the STEM pipeline (Jolly et al., 2004). Weber (2012) conducted an analysis of Jolly et al. (2004) engagement, capacity, and continuity trilogy and gender and student grade-level in a study of 556 middle school and high school students. The sample included one hundred and twenty female middle school students and 48 female high school students and 183 male middle schools, and 205 male high school students. A series of two-way factorial analyses of variance was conducted to examine if there was a relationship between gender and level of interest in engaging in technology and engineering-related activities and work. Results showed that males and females indicated similar levels of interest in engaging in technology and engineering-related activities and work. Results also indicated that males reported a higher level of perceived personal capacity than females. Additionally, both males and females indicated an interest in utilizing resources or continuing to participate in activities related to STEM (Weber, 2012).

Chapter Summary

After a review of the literature on degree completion, engagement emerged as a critical, influential factor that served as a predictor of both satisfaction and degree completion (Astin, 1999; Pascarella & Terenzini, 1991). Engagement experiences that are positively influential to students' college experiences, academic performance and persistence include living on campus (Blimling, 1989; Gellin, 2003; Lopez Turly & Wodtke, 2010; Pascarella, 1993; Pike, 2002; Velez; 1985) learning community participation (Brower and Dettinger, 1998; Pike, Kuh & McCormick, 2010; Zhao & Kuh, 2004) and on-campus employment (Astin, 1993; Curtis, 2007; Mantheir & Gilmore, 2005; Pike, et al., 2008). These engagement opportunities provided students with more opportunities to interact with both their peers and with university faculty and staff, which thus added to students' academic experiences and positively influenced their persistence and degree completion. Pre-college characteristics additionally emerged as a theme in the research on persistence and degree completion (Greene, Marti, McClenney, 2008). High School GPA (Greene, et al., 2008), ACT Scores (Kuh et al., 2008), and earning college credits while in high school (An, 2013; Jones, 2013; Lin et al., 2018) each were identified as pre-college factors that influence students' degree completion.

The literature suggests that students from historically underserved groups benefit from engagement, and some student populations may benefit more than others from specific engagement experiences (Pascarella & Terenzini, 2005). FGCS represents a significant proportion of individuals pursuing a post-secondary degree in the United States (Choy, 2001). While the number of FGCS enrolling in college is increasing, there is concern about the extent to which they achieve degree completion (Pascarella & Terenzini, 2005). Once enrolled, FGCS may meet unique challenges after they start their college education, which may contribute to lower college retention and graduation rates (Barry et al., 2009; Choy, 2001; Pascarella & Terenzini, 2005; Rodriguez, 2003). FGCS experience distinct challenges in both academic adjustments and social adjustments once they arrive on campus (Mitchell, 1997). Often FGCS enter college with less knowledge of academic processes and expectations, and many receive less family support with the issues that relate to their college-going process relative to continuing-generation students (Engle, 2007). Because FGCS enter college without a parent to guide them through the processes of admissions, academic rigor, and social adjustment they may find it difficult to integrate to the campus environment and process their experience (Hsiao, 1992; London, 1992, 1996; Mitchell, 1997; Palbusa & Gauvan, 2017; Warburton, Burgarin, Nunez, & Carroll, 2001).

Because FGCS tend to work full-time, it is often more challenging to participate in academic and social opportunities on campus (Choy, 2001). As a result, many FGCS have less time and opportunity to engage on campus with clubs and social organizations, which may influence their academic performance and retention in their major or persistence to a four-year degree (Engle, 2007; Warburton et al., 2001). FGCS tend to have less frequent interaction with faculty, are less likely to contribute to class discussions, and are less likely to ask questions in class (Soria & Stebleton, 2012). Research suggests that engagement factors like frequently communicating with faculty and Institutional housing may influence the educational aspirations for FGCS. Additionally, these engagement experiences likely influence persistence and retention in college (Engle, 2007; Pike & Kuh, 2005).

A students' choice of major is likely to influence their academic success in college and their professional career after graduation. (Olenchak & Herbett, 2002). Therefore, for FGCS choosing a major is often one of the first college experiences that may determine their academic experience and career outcome (McLean, 2015). FGCS may face additional barriers to choosing and changing their academic major because of limited exposure to college majors and careers. Thus, the research on academic choice for the general population of college students may fall short in applying to FGCS, who may not have the same access to the information needed to make a well-informed choice of academic major. FGCS may struggle to choose a major because they do not have parental support or guidance (NELS, 1998). FGCS may choose to stay enrolled in academic majors even if they are disinterested or are experiencing academic difficulties because of a feeling of obligation to their families (Olenchak & Herbett, 2002).

The literature indicates that FGCS tend to graduate with majors in the Social Sciences, Humanities, and Business and are less likely to graduate with majors in the Natural Sciences (Bowen et al., 2005). FGCS are less likely to declare or remain declared in Science, Technology, Engineering, and Mathematics majors (Chen 2005) yet, STEM majors out-earn majors in the Liberal Arts such as Humanities and Education (Wolniak, 2016). Because STEM majors out-earn majors in the Liberal Arts (Wolniak, 2016) some FGCS may be influenced to choose STEM majors because of the prospect of making a decent salary and the potential to raise their socioeconomic status (Espinoza, 2013; Fernandez et al., 2008; Trenor et al., 2008).

While FGCS may choose to pursue a STEM major they may be less likely to graduate with a STEM because many FGCS do not have the cultural capital in the form of family and peers with college and career information or professional networks in the STEM industry (Espinoza, 2013; Fernandez et al., 2008; Tate et al., 2015; Trenor et al., 2008). The literature on FGCS retention in STEM majors indicates that opportunities to engage in the academic environment influence persistence. Engagement opportunities such as student-faculty interactions (Espinoza, 2013), participating in undergraduate research (Doerschuk et al., 2016), and membership in STEM student organizations that promote both academic and social support (Mwaikinda & Aruguete, 2016) are all practical engagement experiences. Engaging in extra-curricular activities with faculty and peers, additionally, likely exposes FGCS to students who may have more college cultural capital and thus a support network to lean on to assist in navigating the college experience. The research on FGCS persistence in higher education and persistence, specifically in STEM majors, indicates that FGCS are motivated to attend college and pursue STEM majors yet, may experience college differently than their continuing-generation peers.

In conclusion, the literature on FGCS college experiences and persistence indicates that FGCS are interested and motivated to enroll in college and persist with a STEM degree. Several pre-college factors and engagement experiences serve as potential predictors of degree completion for this population.

CHAPTER THREE

METHODOLOGY

The research on FGCS persistence in higher education, specifically in STEM fields, indicates that FGCS are both motivated to attend college and to pursue STEM majors, and experience college differently than their continuing-generation peers (Fernandez et al., 2008; Garriot et al., 2017; Trenor et al., 2008; Wilson & Kittleson, 2013). The results of the research on FGCS retention in STEM fields emphasize the importance of opportunities for students to engage academically and socially on-campus (Doerschuk et al., 2016; Espinoza, 2013). Furthermore, opportunities to engage with peers further provides opportunities to receive both academic and social support and may serve as essential influencers of persistence to graduation with a STEM major (Mwaikinda & Aruguete, 2016). Findings from these studies, coupled with the market data on earning potential and career mobility in STEM careers, indicate this is an area for further inquiry.

The university under study provided an ideal setting to study the factors that influence FGCS STEM degree completion. The university is a competitive four-year university with a mission for promoting effective undergraduate teaching, scholarship, and research in service to the state, the region, and the global community (university website, retrieved November 2018). At the time of analysis, the university offered over 130 undergraduate major programs, including six engineering and engineering technology programs accredited by the Accreditation Board for Engineering and Technology (ABET). The ABET accreditation led to increased project-based learning initiatives across STEM-designated programs at the university.

Restatement of Study Purpose

The purpose of this study was to explore the relationship between the influence of pre-college measures and academic and social engagement measures on the time it takes first-time, full-time, degree-seeking, federally defined first-generation college students to graduate with a STEM degree. The variables that emerged from the literature on FGCS and degree completion included in this study are as follows: ACT score, PSEO credit, Pell-eligibility, learning community, institutional housing, on-campus employment, and the type of STEM major, identity as female or male, a time-to-completion.

Statement of Purpose for Research Questions

Statement of Purpose for Research Question One

What is the relationship between ACT score, Pell-eligibility, PSEO credit, learning community, on-campus employment, institutional housing, and time-to-completion for first-time, full-time, degree-seeking, federally defined first-generation college students?

The purpose of this question was to determine the relationship between students' time-to-completion was influenced by pre-college measures: ACT score, Pell-eligibility, PSEO credit, and campus engagement measures: learning community, institutional housing participation, and on-campus employment. The students in the study were all first-time, full-time, degree-seeking, federally defined FGCS who had graduated from the university under study between 2008 and 2018 with a STEM major. Multiple linear regression analysis is the best statistical analysis for each research question because each question explores the relationship between multiple independent variables and one continuous dependent variable, time-to-degree completion. Additionally, multiple linear regression consistent with the analysis used in previous studies on student engagement and persistence (Pike et al., 2010; Pike et al., 2011; Woosley & Shepler, 2011). Furthermore, multiple linear regression is a statistic common in social psychological research (Barron & Kenny, 1986).

Research question one model. Time-to-completion = $\beta 0 + \beta 1$Pell-eligibility + $\beta 2$ Act Score + $\beta 3$ PSEO credit + $\beta 4$ learning community + $\beta 5$ institutional housing + $\beta 6$ on-campus employment + δ.

Statement of Purpose for Research Question Two

What is the relationship between ACT score, PSEO credit, Pell-eligibility, learning community, institutional housing, on-campus employment, and time-to-completion for first-time, full-time, degree-seeking, federally defined first-generation college students who identify as female?

The purpose of this research question was to analyze the relationship engagement and pre-college variables for the subset of students who identify as female. While there is relatively equal gender representation in the U.S. workforce with men representing 52% of the workforce and women representing 48% of the workforce, women's representation in the STEM fields has remained stagnant over the last 20 years (Beede et al., 2011). STEM majors and STEM fields have been male-dominated for decades. While improvements and policies have been implemented to improve women's persistence in STEM fields, it is apparent that colleges and universities have a role to play in influencing women's persistence and STEM degree completion. Multiple linear regression was the statistic best suited for analysis because the question seeks to explore the relationship between one continuous depending variable and multiple independent or predictor variables (Heppner et al., 2008).

Research question two model. Time-to-completion for students who identify as female = $\beta 0 + \beta 1$ Pell-eligibility + $\beta 2$ Act Score + $\beta 3$ PSEO credit + $\beta 4$ learning community + $\beta 5$ institutional housing + $\beta 6$ on-campus employment + δ.

Statement of Purpose for Research Question Three

What is the relationship between the type of STEM major and time-to-completion for first-time, full-time, degree-seeking, federally defined first-generation college students who identify as female?

Based on the research, this purpose of this research question was to analyze further the relationship between the type of STEM major on time-to-completion for female, first-generation college students graduating with STEM majors. While women currently represent 25% of the American STEM workforce, few women are represented in the engineering and computer science industries (Hughes, 2014). Beede and colleagues (2011) reported that in the U.S., women hold a disproportionately lower share of bachelor's degrees in engineering and physics. The National Science Foundation's Women, Minorities, and Persons with Disabilities in Science and Engineering (2011) report that women hold a disproportionally lower share of bachelor's degrees in Engineering and Computer Sciences (National Science Foundation, 2011). Again, the statistical method chosen was multiple linear regression because it is consistent with the descriptive correlation research design as it explores the relationship or association between multiple independent variables with one dependent variable (Heppner et al., 2008).

Research question three model. Time-to- completion for students who identified as female = β0 + β1type of stem degree + δ.

Participants

In order to determine the number of cases necessary for the analysis, the number of necessary cases was calculated following Green's (1991) equation. Because research question two had the highest number of independent variables, N > 104 + 7 was used as the equation for determining the sample size. This equation is the standard in which the analyses can meet the assumption standards to consider a medium-sized relationship (VanVoorhis & Morgan, 2007). To move forward to the analysis, at least 111 cases were needed to perform the regression analyses.

All data was obtained from the Office of Institutional Research, which collects this data based on students' college application and enrollment records. In order to allow for a homogenous sample of students with a similar academic experience, it was decided only to include students who had only enrolled at the university under study as first-time study. Furthermore, the university under study did not consistently collect pre-college data on all transfer and non-degree seeking students. Therefore, recorded ACT score and PSEO credit completion records for these student populations were incompletely and inconsistently reported in the program award data. Also, the university did not consistently collect data on PSEO credit completion when the PSEO credits were earned at a different college or university. Therefore, only PSEO credit completion from the university understudy was collected and reported. In order to allow for a homogenous sample and because of the inconsistencies in the data, only first-time, full-time, degree-seeking students are included in the study as transfer students and students who stopped out had too many missing variables to be included in the analysis.

The final sample was comprised of 745 first-time, full-time, degree-seeking, federally defined first-generation college students who graduated with a STEM degree between 2008 and 2018.

The majority of the students identified as White 87.4% (*n* = 643) followed by 4.3% (*n* = 32) as Black or African American, 3.3% (*n* = 24) as Asian, 2.9% (*n* = 21) as Hispanic of any race, 2% (*n* = 15) as two or more races and .1% (*n* = 1) as American Indian or Alaska Native. Most of the students, 71.9% (*n* = 536) identified as male as compared to 28.1% (*n* = 209) students who identified as female.

Of the students , 91.8% (*n* = 684) of the students fell into the 21-24-age-category followed by the 5.8% (*n* = 43) in the 25-34-age-category, 2.1% (*n* = 16) in the 19-20-age-category, and 0.3% (*n* = 2) in the 35-44-age-category. Tables 1 and 2 provide the racial/ethnicity identities of the sample in comparison to the entire population of first-time, full-time, degree-seeking first-generation students who graduated from the university between 2008-2019.

Most of the students 64.4% (*n* = 480) were non-Pell-eligible as compared to 35.6% (*n* = 265) of the students who were Pell Eligible.

Most of the students did not participate in a learning community, 89% (*n* = 663), as compared to 11% (*n* = 82), who participated in a learning community.

Most of the students lived on campus for two terms 38.1% (*n* = 284) followed by 31.8% (*n* = 237) who never lived on campus, 10.1% (*n* = 75) lived on campus for one term, 10.1% (*n* = 75) lived on campus for four terms, 4.2% (*n* = 31) lived on campus for

3 terms, 2.3% (*n* = 17) lived on campus for five terms, 1.5% (*n* = 11) lived on campus for six terms, and 2% (*n* = 15) students lived on campus for seven or more terms.

Many of the students 52.7% (*n* = 393) students worked on campus for at least one term as compared to 47.2% (*n* = 352) students who never worked on campus.

The mean composite ACT score for the students was 23 (*n* = 105), most of the students had a 21-23 ACT score, 36.6% (*n* = 333), followed by 28.7% (*n* = 214) students with 24-26 ACT score, 13.6% (*n* = 101) students with 18- 20 ACT score, 12.1% (*n* = 90) students with 27- 29 ACT score, 5.1% (*n* = 38) students with 13-17, ACT score, and the lowest category was represented by 3.8% (*n* = 29) 30-36 ACT scores.

Many of the students do not complete PSEO credits at the university 93.7% (*n* = 698) as compared to 6.3% (*n* = 47) students who completed at least one PSEO credit at the university.

Of the 745 students, the majority 30.5% (*n* = 227) graduated with a major in CIP 26 Biological Sciences, followed by 18.3% (*n* = 136) in CIP 14 Engineering, 18.3% (*n* = 136) in CIP15 Engineering Technologies, 10.1% (*n* = 75) in CIP 11 Computer Information Sciences, 6% (*n* = 45) in CIP 40 Physical Sciences, 5.6% (*n* = 42) in CIP 49 Transportation, 3.9% (*n* = 29) in CIP 27 Mathematics and Statistics, 3.5% (*n* = 26) in CIP 03 Natural Resources and Conservation, 2.6% (*n* = 19) in CIP 51 Health Professions, 1.1% (*n* = 8) in CIP 30 Multidisciplinary Studies, and lastly .3% (*n* = 2) majoring in CIP 01 Agricultural Animal and Plant Sciences.

Data Collection and Cleaning

Once the study received IRB approval, the Office of Institutional Research was contacted to request the final data file of students who had received an undergraduate

STEM degree from the university between 2008 and 2018. All data were the property of the university under study and were stored on a secure server. Data was delivered in the form of an electronic spreadsheet file. The variables were listed in columns, and the cases or individual student records were listed in rows. To protect student privacy and anonymity, the Office of Institutional Research removed the student's unique identification number from the data set and replaced this number with a randomized case number. The undergraduate degree completion records data contained 24,902 undergraduate degree completion records or cases.

Transfer students and non-degree seeking students were removed from the data set, first leaving 14,349 cases. Cases that indicated that the student did not identify as a federally defined, first-generation college student were excluded from the data leaving 6,431 cases. A new variable was created to identify only the cases where the students graduated with a STEM degree. This variable was created by recoding the Classification of Instruction Programs (CIP) variable into a new variable. Cases, where the student had graduated with one of the following CIP identifiers, were coded as Yes (1) graduating with a STEM major, and all other cases were coded as No (0) did not graduate with a STEM major.

Each of the STEM six-digit CIP codes was recoded into different variables listing the corresponding two-digit CIP code classifications as follows: 01, 03, 11, 14, 15, 26, 27, 30, 40, 49, and 51. This variable was also labeled with each of the CIP code's two-digit code title: CIP 01 Agricultural Animal and Plant Sciences, CIP 03 Natural Resources and Conservation, CIP 11 Computer Information Sciences, CIP 14 Engineering, CIP15 Engineering Technologies, CIP 26 Biological Sciences CIP 27

Mathematics and Statistics, CIP 30 Multidisciplinary Studies, CIP 40 Physical Sciences, CIP 49 Transportation, CIP 51 Health Professions.

The data set included duplicate case numbers in multiple rows because each row represented a program award from the university. In other words, if the student graduated from the university with multiple majors, each case was coded with the same student case number in multiple rows of the data. A new variable was created for those students who graduated with multiple majors. In each of the cases where the student earned at least one STEM major, the STEM major was listed as the first major, and the second and or third major was coded as STEM or non-STEM major. New variables were created for the multiple majors, and the subsequent rows containing duplicate case numbers were removed, leaving 5,868 cases. Only cases where the first major was coded as STEM majors were selected, which resulted in a total of 745 cases. These cases represented all the first time, full-time, degree-seeking, federally defined first-generation college students who graduated with a STEM degree from the university between 2008 and 2018 (n = 745).

Data Analysis

Multiple linear regression was chosen as the statistic best suited for each of the research questions. Because the variables that emerged from the literature review included one dependent variable (time-to-completion) and multiple predictor variables, a multiple regression analysis was selected. The multiple regression statistic is used to explain the relationship between the dependent and independent variables, and furthermore will identify the strength of the relationship between the variables (Cohen & Lea, 2004). Modeling the dependent variable as examination of linear relationship is consistent with the literature in the social sciences on college student development (Astin, 1993; Pascarella & Terenzini, 2005; Tinto 1993).

The Office of Institutional Research provided the graduation records for students who graduated from the university between 2008 and 2018. Students (N= 745) included in the analysis represented first-time, full-time, degree-seeking, federally defined first-generation college undergraduate students.

The regression was run to test for normal distribution of residuals. The observation of histogram and normal probability plots of the residuals indicated that the residuals were normally distributed. The assumption of normally distributed residuals was accepted by the Kolmogorov-Smirnov test of normality for Pell-eligibility $Z = 0.41$, $p < .001$, Act Score $Z = .09$, $p < .001$, PSEO credit $Z = .52$, $p < .001$, learning community participation $Z = .53$, $p < .001$, + on-campus living status $Z = .24$, $p < .001$, on-campus employment status $Z = .24$, $p < .001$, gender $Z = .45$, $p < .001$, and $Z = .24$, $p < .001$, for the type of STEM degree. Pooling the STEM majors together required homogeneity of variance in the dependent variables and similar means and standard deviations of the independent variables. After it was determined these requirements were met in the data, the analyses was conducted.

Since the review of the literature did not provide clear indications about which variables might explain more or less of the relationship between time to degree completion, standard multiple regression was chosen as the statistic over hierarchical and stepwise methods (Heppner et al., 2008). All independent variables were simultaneously entered into the analysis. In order to be able to run inferential statistics, the errors in prediction or the residuals need to be normally distributed (Howell, 2002). To determine if the data met the assumption for normality of the residuals, a histogram with the superimposed normal curve and a P-P Plot where checked, as was the Normal Q-Q Plot of the studentized residuals. After checking the histogram, it was determined that the standardized residuals appeared to be approximately normally distributed. The P-P plot was checked, and it was determined that the residuals were mostly aligned along the diagonal line.

The data was screened for errors, including out of range values and duplicate cases by reviewing SPSS descriptive statistics and frequencies (Tabachnik & Fidell, 2007). In order to test that the data met the assumptions necessary for multiple regression analysis, the histograms, Standardized Residual plots, and partial plots from the multiple regression SPSS outputs were screened for normality, linearity, homoscedasticity, and independence of residuals (Draper & Smith, 1998; Kutner, Nachtsheim, Neter, & Li, 2005). A linear relationship between the dependent variable and each of the independent variables was tested in two parts. First, by plotting a scatter plot of the studentized residuals against the unstandardized predicted values and next by using partial regression plots between each independent variable. The residuals formed a horizontal band. Therefore, the relationship between the dependent variable and independent variables was likely to be linear (Draper & Smith, 1998; Kutner et al., 2005).

Homoscedasticity of residuals was checked using the previous scatter plot, where the student residuals were plotted against the unstandardized predicted values. After examining the scatter plot, the residuals were evenly and consistently spread. Therefore, the data demonstrated homoscedasticity (Draper & Smith, 1998; Kutner et al., 2005).

Multicollinearity was assessed to determine if two or more independent variables were highly correlated with each other. A thorough inspection of the correlation coefficients and Tolerance/VIF values. Each variable had a tolerance value greater than 0.1, so it was determined that the data met the assumption indicating that the assumption of multicollinearity was not supported.

The third assumption of multiple linear regression is designed to test for the first-order autocorrelation, meaning that adjacent observations, more specifically their errors, are correlated and, therefore, not independent. The fourth assumption of multiple linear regression is designed to test for the independence of observations typically calculated utilizing the Durbin-Watson test. Because of the study design, analyzing unique student records, it was highly unlikely that the observations were in any way related, therefore it was determined the Durbin-Watson test was not appropriate for the analysis (Wan, Zou, & Banerjee, 2005).

The final assumption for a multiple linear regression requires any significant outliers or unusual points are detected and removed. A new variable was created, calculating the percentage of system missing variables for each case. Cases listed in the casewise diagnostics were removed from the analysis as it was determined these were outliers. In each of these cases, the student's time-to-completion was equal to or greater 10.29 years. Leverage points were checked to determine where any cases exhibited high leverage. The Lev_1 variable was checked to identify any values between 0.2 and 0.5, which are considered risky and or values of 0.5 and above, which are considered dangerous (Huber, 2011). The most significant value in the Lev_1 variable was 0.13. Therefore, it was determined no further cases needed to be excluded based on their leverage value. Influential points were checked for using a measure of include knowns as Cook's Distance. After examining the data in the COO_1 variable, the most significant value was 0.12. Therefore, there were no values above one (Cook & Weisberg, 1982), so it was determined that there were no cases that would be considered highly influential points. Following data cleaning and the creation of variables for analysis, linear regression analyses were conducted to answer the three research questions. Once it was determined that the assumptions were met, the multiple linear regression analyses were conducted.

Chapter Summary

In this study, an analysis of archival data was performed to explore the relationship between pre-college measures: ACT score, PSEO credit, Pell-eligibility and campus engagement measures: learning community, institutional housing, on-campus employment are related to the time-to-completion with a STEM degree for first-generation college students graduating with STEM majors.

Based on the research questions, a multiple linear regression was used to analyze the data because it was the statistic best suited to explore the relationship between multiple predictor or independent variables and one continuous dependent variable (Heppner et al., 2008).

Additionally, of the lack of research on women in STEM fields, the study further examined the data to determine if the model provided further explanation for the factors which influence time-to-completion for students who identify as female adding the type of STEM degree earned. The results of the analysis are discussed in the following chapter.

CHAPTER FOUR

FINDINGS

Chapter four discusses the data, analysis, and results of the study. First, a summary of descriptive statistics is presented. Next, the extent to which the data met the assumptions for linear regression and the results of the analysis for research questions one, two, and three are described.

Research Question One Findings

The first research question of this study explored the relationship between first-generation college students' pre-college factors and college engagement factors and the time it takes a student to earn their degree with a STEM major.

Research question one. What is the relationship between ACT score, Pell-eligibility, PSEO credit, learning community, on-campus employment, institutional housing, and time-to-completion for first-time, full-time, degree-seeking, federally defined first-generation college students?

Confidence intervals at the 95% level and case-wise diagnostics (residuals) at three standard deviations were calculated. The observations in a multiple regression must not be related. Influential points were checked Cook's Distance measure of inclusion. After examining the data in the COO_1 variable, the most significant value was .01, (Cook & Weisberg, 1982), so it was determined there were no cases that would be considered highly influential points. Once it was determined that the assumptions were met, the multiple linear regression was conducted.

Students' time-to-completion served as the dependent variable. Multiple linear regression was run to test the hypothesis, which stated that the difference between ACT score, Pell-eligibility, PSEO credit, learning community, on-campus employment, and institutional housing who predict students' time-to-completion. Regression analyses indicated that the model significantly predicted students' time-to-completion F (6,738) = 18.73, $p < .001$, $R^2 = .12$, $R^2_{adjusted} = .12$. Therefore, 12% of the variance in time-to-completion is explained by the equation. Values for the model summary of the multiple linear regression for research question one can be found in Table 4 and Table 5.

The analysis shows that ACT score (Beta = -.13, t(738) = -3.82, $p < .001$), Pell-eligibility (Beta = -.26, t(738) = -7.44, $p < .001$), PSEO credit (Beta = -.11, t(738) = -3.26, $p < .001$), learning community (Beta = .1, t(738) = 2.85, $p < .005$), and on-campus employment (Beta = -.1, t(738) = -2.94, $p < .003$) significantly predicted time-to-completion, however institutional housing (Beta = .01, t(738) = .43, $p = .66$) did not significantly predict time-to-completion.

Students' predicted time-to-completion is equal to 6.08 - .04 (ACT score) - .61 (Pell-eligibility) - .02 (PSEO credit) + .36 (Learning community) - .03 (on-campus employment) + .01 (institutional housing). Time-to-completion decreased .04 years for each unit increase in ACT score, decreased .02 years for each PSEO credit completed, decreased .03 years for each term employed on-campus, increased .36 years if the student participated in a learning community and increased .01 years for each term lived on-campus. Values for the coefficients table for research question one can be found in Table 6.

Research Question Two Findings

The purpose of the research question two was to further inform the research on STEM degree completion for students who identify as female. The question was constructed to explore further the relationship between ACT score, Pell-eligibility, PSEO credit, learning community participation, on-campus employment, institutional housing, and time-to-STEM-degree-completion for the first-time, federally defined, first-generation college students FGCS who identify as female.

Research question two. What is the relationship between ACT score, Pell-eligibility, PSEO credit, learning community, on-campus employment, and institutional housing and time-to-completion for first-time, full-time, degree-seeking, federally defined first-generation college students who identify as female?

The assumptions for linear regression had already been analyzed for the data set of 745 cases of first-time, federally defined, first-generation college students who had completed a STEM degree from the university between 2008 and 2018. Therefore, regression analysis was run for including only the cases of students who identify as female (N = 209) after the cases of students who identified as male (N = 575) were excluded for the second regression.

Multiple linear regression was calculated to examine if there was a relationship between time-to-completion with a STEM degree and ACT score, Pell-eligibility, PSEO credit, learning community participation, on-campus employment, and institutional housing (N= 209). Regression analyses indicated that the model significantly predicted students' time-to-completion $F\ (6,202) = 11.86$, $p < .001$, $R^2 = .26$, $R^2_{adjusted} = .24$. Therefore, 26% of the variance in time-to-completion is explained by the equation. Values for the model summary of the multiple linear regression for research question one is found in Table 7 and Table 8.

The analysis shows that ACT score (Beta = -.3, t(202) = -4.85, $p < .001$), Pell-eligibility (Beta = -.33, t(202) = -5.13, $p < .001$), PSEO credit (Beta = -.19, t(202) = -3.16, $p < .002$), and on-campus employment (Beta = -.13, t(202) = -2.09, $p < .038$) significantly predicted time-to-completion, however learning community (Beta = .11, t(202) = 1.76, $p < .08$) and institutional housing (Beta = -.01, t(202) = -.22, $p = .83$) did not significantly predict time-to-completion.

Students' predicted time-to-completion is equal to 7.13 - .08 (ACT score) - .65 (Pell-eligibility) - .03 (PSEO credit) + .32 (learning community participation) - .04 (on-campus employment) - .01 (institutional housing).

Time to STEM degree completion for females decreased .08 years for each unit increase in ACT score, decreased .03 years for each PSEO credit completed, decreased .04 years for each term employed on-campus, increased .32 years if the student participated in a learning community, and increased .01 years for each term lived in institutional housing. Pell-eligible students who identified as female had a decrease of .65 years to STEM-degree-completion. Values for the coefficients table for research question two is found in Table 9.

Research Question Three Findings

The purpose of research question three was to further explore the relationship between the type of STEM major and time-to-completion, specifically for FGCS, who identify as female.

Research Question Three. What is the relationship between the type of STEM major and time-to-completion for first-time, full-time, degree-seeking, federally defined first-generation college students who identify as female?

Multiple linear regression was conducted to assess whether the type of STEM degree significantly predicted time-to-completion for 209, first-time, full-time, degree-seeking, federally defined first-generation college students who identify as female. The following CIP codes and descriptions were loaded into the regression: CIP 01 Agricultural Animal and Plant Sciences, CIP 03 Natural Resources and Conservation, CIP 11 Computer Information Sciences, CIP 14 Engineering, CIP15 Engineering Technologies, CIP 26 Biological Sciences, CIP 27 Mathematics and Statistics, CIP 30 Multidisciplinary Studies, CIP 40 Physical Sciences, CIP 49 Transportation, CIP 51 Health Professions. Because all the cases included in the analysis were STEM CIP codes, the two-digit CIP 26 Biological Sciences were intentionally removed from the analysis to attend to perfect multicollinearity otherwise referred to as the "dummy variable trap" (Gujarati, 1970). Next, scatter plots were examined for each of the variables to visually test for homoscedasticity (Draper & Smith, 1998; Kutner et al., 2005).

Regression analyses indicated that the model did not predict students' time-to-completion F (10,198) = 1.41, p = .18, R^2 = .07, $R^2_{adjusted}$ = .02. This indicates that there is not a strong relationship between the model and time-to-completion. Values for the model summary of the multiple linear regression for research question one is found in Table 10 and Table 11.

The analysis shows that CIP 01 Agricultural Animal and Plant Sciences (Beta = -.01, t(198) = -.19, p = .85), CIP 03 Natural Resources and Conservation (Beta = .07, t(198) = .96, p = .34), CIP 11 Computer Information Sciences did not significantly predict time-to-completion (Beta = .01, t(198) = .18, p = .34), CIP 14 Engineering (Beta = .08, t(198) = 1.09, p = .28), CIP 27 Mathematics and Statistics (Beta = -.09, t(198) = -

1.36, p = .17), CIP 30 Multidisciplinary Studies (Beta = -.04, t(198) = -.57, p = .57), CIP 40 Physical Sciences (Beta = .1, t(198) = 1.44, p = .15) CIP 49 Transportation (Beta = -.02, t(198) = -.26, p = .79), CIP 51 Health Professions (Beta = .04, t(198) = .58, p = .56) did not significantly predict time-to-completion. However, CIP15 Engineering Technologies (Beta = .19, t(198) = 2.74, p = .01) did significantly predict time-to completion. Values for the coefficients table for research question three can be found in Table 12.

Summary of Findings

Before data analysis, multiple steps were taken to clean the data for the analysis. Prior to running the analysis for the three research questions in the study, assumptions of each test were checked to verify that each test met the required assumptions for multiple linear regression analysis. Three multiple linear regression analyses were performed on the data of the first-time, federally defined first-generation college students who graduated from a single midwestern university with a STEM degree between 2008 and 2018.

Research question one explored the relationship between ACT score, Pell-eligibility, PSEO credit, learning community, on-campus employment, institutional housing, and time-to-completion for 745 first-time, full-time, degree-seeking, federally defined first-generation college students. The results indicated that the model was significant. The six independent variables contribute to 12% of the variance explained by the model. ACT score, Pell-eligibility status, PSEO credits, learning community participation, and on-campus employment were significant predictors of time-to-completion. However, institutional housing did not significantly predict time-to-completion.

Research question two explored the relationship between ACT score, Pell-eligibility, PSEO credit, learning community, on-campus employment, institutional housing, and time-to-completion for a sample of 209 students who identified as female.

The results indicated that the model was significant. The six independent variables contribute to 26% of the variance explained by the model. ACT score, Pell-eligibility status, PSEO credits, and on-campus employment were significant predictors of time-to-completion. However, learning community participation and institutional housing did not significantly predict time-to-completion.

Research question three explored the relationship between the type of STEM degree and time-to-completion for 209 FGCS, who identified as female and graduated from the university between 2008 and 2018. Results of the multiple linear regression analysis indicated no that there is no significant relationship between in FGCS who identified as female's time-to-completion explained by the type of STEM degree that the model did not predict students' time-to-completion. Because the p-value was higher than .05, it was determined that the slope coefficient was not statistically significant, meaning there was likely no linear relationship between the type of STEM major and time-to-completion. A discussion of the findings is provided in the following chapter.

CHAPTER FIVE

DISCUSSION

First-generation college students are one of the fastest-growing segments of the American college student population (Kuh et al., 2006). Unfortunately, they face significant challenges in the pursuit of a four-year degree (Engle & Tinto, 2008). The purpose of this study was to explore the relationship between ACT score, PSEO credit, Pell-eligibility, learning community, institutional housing, on-campus employment, type of STEM major, identifying as female, and time-to-completion among first-generation college students graduating with STEM majors.

Discussion of Results

The results for research question one indicated that measures of engagement such as learning community participation, on-campus employment, and participation institutional housing together with pre-college characteristics such as Pell-eligibility, ACT score, and PSEO credit completion are significantly related to the time it takes a student to earn a STEM undergraduate degree.

In further exploring the measures that significantly related to time-to-completion with a STEM degree, higher ACT scores, more PSEO credits completed at the university, being Pell-eligible, and participating in on-campus employment were all significantly related to time-to-completion with a STEM major for first-time, full-time, degree-seeking federally defined first-generation college students.

While the findings were significant for research question one considering all six variables, this only accounted for 12% of the variance on time-to-completion. Three of the variables weighed in heaviest in influencing time-to-completion, Pell-eligibility (Beta

= -.26, t(738) = -7.44, $p < .001$), followed by ACT score (Beta = -.13, t(738) = -3.82, $p < .001$), and PSEO credit (Beta = -.11, t(738) = -3.26, $p < .001$).Two additional variables had smaller influence on time-to-completion, on-campus employment (Beta = -.1, t(738) = -2.94, $p < .003$) and learning community participation (Beta = .1, t(738) = 2.85, $p < .005$). Institutional housing was not significantly related to time-to-completion.

ACT score, being Pell-eligible, number of PSEO credits completed, and on-campus employment each contributed to less time to STEM degree completion. These findings are consistent with the prior research on FGCS, which has demonstrated that FGCS, who participated in engagement experiences during their time at the university, tend to persist to graduate and degree completion at higher levels. Examples of engagement factors which emerged from the literature that support these findings include studies on the impact living in institutional housing (Lopez Turly & Wodtke, 2010; Pike, 2002; Gellin, 2003), the influence of learning community participation (Kuh et al., 2008; Zhao & Kuh, 2004; Pike, Kuh & McCormick, 2010) and the influence of on-campus employment experiences on persistence and retention (Astin, 1993; Pike et al., 2008; Velez, 1985). While learning community participation contributed to a longer time to degree completion and participating in institutional housing was not significantly related to-time-completion for the students in the study, it should be emphasized that each student included in the study did successfully attain a four-year STEM degree from the university.

Research question two explored the relationship between three measures of pre-college characteristics, and three measures of engagement that emerged from a review of the literature on FGCS persistence and retention. ACT score, Pell-eligibility, PSEO credit, learning community, on-campus employment, institutional housing, and time-to-completion, for a sample of 209 students who identify as female.

Results of research question two revealed that the same engagement measures and pre-college measures were statistically significantly related to time-to-completion for FGCS who graduated with a STEM degree and identified as female. The results indicate that for the students who identified as female, four of the six measures: Pell-eligibility, on-campus employment, ACT score, and PSEO credit were significantly related to time-to-completion with a STEM major. The variables that weighed in heaviest in influencing time-to-completion for the students in the study who identify as female were Pell-eligibility (Beta = -.33, t(202) = -5.13, $p < .001$), ACT score (Beta = -.3, t(202) = -4.85, $p < .001$) and PSEO credit PSEO credit (Beta = -.19, t(202) = -3.16, $p < .002$). The order of variables influencing the students that identify as female was consistent with the full sample. On-campus employment had less influence on time-to-completion (Beta = -.13, t(202) = -2.09, $p < .038$). Neither institutional housing nor learning community participation was significantly related to time-to-completion for the students who identify as female in the sample. Results of research question two indicate that these variables accounted for 26% of the variance for FGCS who identify as female, which represents a greater amount of influence of the variables on time-to-completion. However, it is important to interpret this 26% of explanation of the variance in time-to-completion with caution as the sample only consisted of 209 students.

Consistent with the findings of research question one, participating in institutional housing was not statistically significant in explaining the relationship to time-to-completion. Learning community participation for the students who identify as female was not statistically significantly related to time to STEM degree completion, whereas the learning community measure was significantly related to time-to-completion when the sample included both students who identify as male and female.

These findings indicate that for the students in the study who identify as female, time-to-completion is connected to their pre-college experiences. The findings indicated that for FGCS, who identify as female, being Pell-eligible, higher ACT score, and more PSEO credits completed influences time-to-degree completion. These findings are consistent with the previous literature on FGCS, who identify as female that academic preparation and completion of college academic credit before entering college influence persistence and degree attainment (Reid & Moore, 2008).

Research question three was designed to address a gap in the current literature on FGCS who identify as female and STEM degree completion. Results of research question three indicate that for the students in the study who identify as female, the type of STEM degree was not significantly related to time-to-completion. When coefficients for each of the eleven qualifying two-digit CIP codes were interpreted, note that CIP 15, which represents majors in the Engineering Technologies (Beta = -.09, t(198) = -1.36, p = .17) explained a small amount of the variance of to time-to-completion. The results research question three indicates that the type of STEM major is not an influential predictor of the amount of time it takes to graduate with a STEM degree for students who identify as female. The slightly significant for CIP 15, Engineering Technologies, should be carefully interpreted as 62.7% (n = 131) of the students that identified as female graduated with a CIP 26, Biological Sciences major as compared to only 2.4% (n = 5) graduated with a CIP 15, Engineering Technologies major. The over-representation of students that identify as female in the Biological Sciences is consistent with the previous literature on women in STEM (White, 2019).

ACT Score and Time to STEM-Degree-Completion

Pre-college academic performance has been studied in the literature on FGCS' STEM degree completion (Crisp et al., 2009). The literature shows that students who enter college with less academic preparation, as indicated by ACT score, may have more difficulty with college-level coursework and passing gatekeeping courses (Greene, Marti, & McClenney, 2008).

Results of this study indicate that time-to-completion for first-time, full-time, degree-seeking, first-generation undergraduate students who completed a STEM degree between 2008 and 2018 (N = 745) at a Midwest comprehensive university was significantly related to higher ACT score, (Beta = -.13, t(738) = -3.82, $p < .001$). Furthermore, the relationship between time to STEM degree completion for FGCS who identified as female (N = 209) was significantly related to higher ACT score (Beta = -.3, t(202) = -4.85, $p < .001$) meaning, that for the FGCS who identified as female in the study, higher ACT score influenced less time to STEM degree completion.

The results are consistent with the hypothesis that this variable would relate to time-to-completion, and the influence on less time-to-completion makes logical sense considering the higher the ACT score, the less likely the student would need to enroll in additional remedial credits before completing the necessary prerequisites for the STEM major. While time-to-completion decreased for both men and women represented in the study, the influence of ACT score on time to degree completion was more significant for the FGCS who identify as female in the study as compared to the general sample of

FGCS. The literature suggests that while the number of students who identify as female earning bachelor's degrees in the Social Sciences and Biological Sciences has increased, more students who identify as female are earning degrees in Psychology and Medical Sciences than their peers who identify as male (Espinosa, 2011, National Science Foundation, 2011, White, 2019). While the results of the study indicate that a higher ACT score influenced time-to-completion for the FGCS who identified as female, it also needs to be emphasized that the final sample of the FGCS who identified as female was only 209 students, so it is essential to use caution in interpreting these results and making inferences or generalizations.

Pell-eligibility and time to STEM-Degree-Completion

Results of this study indicated that time to STEM degree completion among first-time, full-time, degree-seeking, first-generation undergraduate students who completed a STEM degree between 2008 and 2018 (N = 745) at a Midwest comprehensive university was significantly related to Pell-eligibility, (Beta = -.26, t(738) = -7.44, $p < .001$). Furthermore, the relationship between time to STEM degree completion for students who identified as female (N = 209) was significantly related to Pell-eligibility ((Beta = -.33, t(202) = -5.13, $p < .001$) meaning, that for the students who identified as female in the study, Pell-eligibility is related to a decrease in time-to-completion with a STEM degree.

The literature on STEM degree completion indicates that students with significant financial need may enter colleges that well-match their abilities or interests, but may choose to pursue non-STEM fields if they perceive they can complete the degree in less time, or if they perceive the financial costs of completing a non-STEM degree to be lower (Castleman, Long, & Mabel, 2014). Students in this study, for whom, their status as Pell-eligible indicates that they were at a more considerable financial disadvantage than their non-Pell-eligible peers, may have contributed to an expedited approach to completing their STEM degree. Furthermore, additional research indicates that students from low-income families who have access to additional need-based grants were more likely to declare a STEM major than similar peers (Broton & Monaghan, 2018).

PSEO Credit and Time to STEM-Degree-Completion

The literature indicates that students who complete some college academic credit before entering college, whether it be dual enrollment participation or PSEO credit completion, have an increased probability of attaining a bachelor's degree (An, 2013; Jones, 2013; Lin, Borden, & Chen, 2018). Results of this study indicated that time to STEM degree completion among first-time, full-time, degree-seeking, first-generation undergraduate students who completed a STEM degree between 2008 and 2018 (N = 745) at a Midwest comprehensive university was significantly related to PSEO credit completion, (Beta = -.11, t(738) = -3.26, $p < .001$). Such that, the more PSEO credits completed before college, the less time it will take to complete a STEM degree. Furthermore, the relationship between time to STEM degree completion for students who identified as female (N = 209) was also significantly related to PSEO credit (Beta = -.19, t(202) = -3.16, $p < .002$) meaning, that for the FGCS who identify as female in the study, higher more completed PSEO credits were related to a decrease in time-to-completion with a STEM degree. The results are consistent with the hypothesis that this variable would relate to time-to-completion, and the influence on less time-to-completion makes logical sense considering the more PSEO credits the student completed, the fewer credits the student would need to enroll in to complete the requirements for the STEM major.

Learning Community Participation and Time to STEM-Degree-Completion

Learning communities have been studied as student engagement opportunities positively associated as a predictor of students' motivation to engage in both classroom and extra-curricular activities (Kuh, 2008) and has been associated with positively influencing academic performance and holistic engagement in campus culture, gains in-class attendance and overall satisfaction with the college experience (Zhao & Kuh; 2004).

Results of this study indicated that time to STEM degree completion among first-time, full-time, degree-seeking, first-generation undergraduate students who completed a STEM degree between 2008 and 2018 (N = 745) at a Midwest comprehensive university was significantly related to learning community participation, (Beta = .1, t(738) = 2.85, $p < .005$). Suggesting that the sample results are consistent with the literature in that learning community participation is positively related to STEM degree retention and degree attainment (Mwaikinda & Aruguete, 2016). The relationship between time to STEM degree completion for FGCS students who identified as female (N = 209) was not significantly related to learning community participation (Beta = .11, t(202) = 1.76, $p < .08$) meaning, that for the general sample including both students who identified as male and female in the study, learning community participation influenced a small increase in time-to-completion with a STEM degree. There are a few reasons why students who identify as female may not have experienced the learning community variable influencing time-to-completion. First, there is not enough data on learning communities from the archival data to indicate what learning communities were available to students consistently. It could be that STEM learning communities were not available to students who identified as female. It could also be that the students who identified as female participated in other on-campus communities such as the honors program or undergraduate research instead of living in a learning community with an academic focus.

The literature suggests that first-generation students may experience more significant gains from learning community participation (Pike et al., 2010), and many FGCS lack familiarity with college-going cultural norms, processes, deadlines, bureaucracies and academic expectations, FGCS may, in turn, different experience in learning community participation. For example, FGCS likely are less familiar with the concept of learning communities than their continuing-generation peers and perhaps experience more significant gains in navigating the college-going process and learning how to navigate the system as a result of learning community participation (Bui, 2002). Since the data does not provide the information of when the students declared their STEM major, it might be that the students who identified as female declared their STEM major a semester or more into their undergraduate career. As historically, most of the learning communities at the university targeted students in their first semester, it might be that the students who identified as female might have missed the timeline to join a learning community. Another explanation could be that the students who identified as female may have already completed the learning community curriculum courses like Advanced Placement or PSEO credits; therefore, the course they were registering for in their first semester was not consistent with the learning community courses. Furthermore, while for the general sample of FGCS learning community participation influenced a slightly longer time to complete their STEM degree, it should be noted that students included in the analysis did indeed persist and completed an undergraduate STEM degree.

Institutional Housing and Time to STEM-Degree-Completion

The literature on college student persistence and retention has established that Institutional housing can influence students' social and cognitive gains during their college experience (Blimling, 2015a; Pascarella, 1993). Results of this study indicated that time to STEM degree completion among first-time, full-time, degree-seeking, first-generation undergraduate students who completed a STEM degree between 2008 and 2018 (N = 745) at a Midwest comprehensive university was not significantly related to living on campus, (Beta = .01, $t(738) = .43$, $p = .66$). Furthermore, the relationship between time-to-completion for students who identify as female (N = 209) was also not significantly related to living on campus (Beta = -.01, $t(202) = -.22$, $p = .83$). These results are not consistent with the literature in that this variable did not relate to time-to-completion. Reasons, why this variable may not be significantly related to time-to-completion for FGCS or specifically for female FGCS, could be influenced by the fact that many FGCS at this comprehensive Midwestern university might choose to live at home with their family. Reasons cited in the literature for FGCS choosing to live off-campus included both the cost associated with institutional housing and because many FGCS continue to hold family responsibilities and obligations that make on-campus living sometimes more of a hindrance than a help (Choy, 2001; Warburten, 2001; McCarron et al., 2006; Saenz, 2007).

Additionally, because much of the research about institutional housing and engagement was collected and analyzed in the 1980s and 1990s, perhaps the type of on-campus living arrangements present on college campuses in the 2000s do not promote the same time of engagement experience as the traditional on-campus living on college and university campus in the 1980s and 90s (Blimling, 1989; Pascarella, 1993; Velez, 1985). Differences in residential living on college campuses now include options such as private rooms or suite-style living, these types of living arrangements are different from the traditional single room with one or three roommates and a shared bathroom, living area (Blimling, 2015b). Furthermore, institutional housing participation and engagement research was normed on primarily continuing-generation students. Therefore, it cannot be presumed that FGCS would have the same experience of engagement as their continuing-generation peers. During the 2008-2018 timeframe, the university established different on-campus living options. For example, students in the study may have correctly been coded as living on campus; however, they may have been living in apartment complexes off-campus leased by the university. As the style of institutional housing has evolved on college and university campuses, this factor as an engagement factor may no longer be relevant as it was in the early years of American college and university education on primarily residential campuses (Blimling, 1989; 1999; Blimling & Schuh, 2015a, 2015b).

Working On-campus and Time to STEM Degree-Completion

The literature indicates that even while working as a college student is currently the norm for many undergraduate students, students who hold on-campus jobs have a higher probability of finishing college (Astin, 1993; Pike, Kuh, & Massa-McKinley, 2008; Velez, 1985).

Results of this study indicated that time to STEM degree completion among first-time, full-time, degree-seeking, first-generation undergraduate students who completed a

STEM degree between 2008 and 2018 (N = 745) at a Midwest comprehensive university was significantly related to on-campus employment, (Beta = -.1, t(738) = -2.94, $p < .003$). The relationship between time to STEM degree completion for students who identified as female (N = 209) was also significantly related to on-campus employment (Beta = -.13, t(202) = -2.09, $p < .038$) meaning, that the more terms a student worked on-campus during their academic career suggesting a relationship to decreasing their time to degree completion with a STEM degree. The results are consistent with the hypothesis that this variable would relate to time-to-completion.

On-campus employment might influence less time to degree completion because during their time employed on-campus, they likely were able to connect with their supervisor, who could explain the university's cultural norms, processes, deadlines, bureaucracies, and academic expectations (Bui, 2002). Also, depending on the size of the office and the number of other students employed, perhaps the more terms the student worked on campus, the more likely they were to connect with the academic and social network to help them acquire the social and cultural capital to navigate college and persist with their STEM degree (Bui, 2002; Thayer, 2000).

Type of STEM Degree and Women's Time to STEM-Degree-Completion

Research question three was designed to explore the relationship between the type of STEM degree and time-to-completion for first-time, full-time, degree-seeking, federally defined first-generation college students who identified as female who graduated from the university between 2008 and 2018 (N = 209) The findings indicated that type of STEM degree was not significant in explaining the relationship between time-to-completion $F\ (10{,}198) = 1.41$, $p = .18$, $R^2 = .07$, $R^2_{adjusted} = .02$.

The only CIP code that appeared to be related to time-to-completion for students who identified as female was CIP 15, Engineering Technologies (Beta = .19, t(198) = 2.74, p = .01). It should is important to note that CIP 26, Biological Sciences, was intentionally left out of the analysis to prevent perfect multicollinearity. The results are not consistent with the hypothesis that type of STEM degree would relate to time-to-completion for FGCS who identified as female, however, the over-representation of FGCS who identify as female in CIP code 26 Biological Sciences was not surprising provided given the previous literature on the prevalence of this major for women in the STEM fields (National Research Center, 2006). The results of question three relate to Espinosa's (2011) findings that the major conceptual factors that likely contribute to the persistence of women in STEM majors are complex. Factors from Espinosa’s 2011 student included not only the type of STEM major but also, a combination of the students’ college experiences, the college environment, and several pre-college factors such as high school performance, and family background characteristics (Espinosa, 2011).

Future Practice Directions

Students arrive on campus with characteristics identified in the previous literature as relevant to academic persistence and retention. For instance, ACT score has emerged in the literature as an indicator of persistence and retention (Kuh et al., 2008) along with earning college credit through dual enrollment of PSEO opportunities while in high school (Jones, 2013; An, 2013; Lin et al., 2018). In order to influence levels of student engagement, universities have been called upon by organizations such as the Association of American Colleges and Universities to provide more consistent and widespread use of

"High-Impact Educational Practices" such as learning communities, undergraduate research opportunities, first-year seminars, and capstone courses (Peden et al., 2017, p. 7). Opportunities to more deeply engage with faculty and the campus community such as participating in learning communities (Kuh et al., 2008; Zhao & Kuh; 2004), living on campus (Blimling, 1989; Pascarella, 1993; Velez, 1985) and working on campus (Astin, 1993; Pike et al., 2008; Velez, 1985) not only influence college outcomes, but also "can help every student get more out of higher education and be better prepared for work and life" (Peden et al., 2017, p. 3). The literature suggests that students from historically underserved groups such as FGCS benefit from engagement, and some student populations may benefit more than others from specific engagement experiences (Lopez Turly & Wodtkey, 2010; Pascarella & Terenzini, 2005; Pike et al., 2010). The implications for professional practice as a result of this study, coupled with the previous literature on FGCS, point to the importance of academic preparation for FGCS before they arrive on campuses such as ACT score and PSEO credit completion. The level of income and access to grant aid is relevant to FGCS academic experiences such as Pell-eligibility status. Promoting a sense of belonging, engaging with the campus culture and community, such as learning community participation and part-time on-campus employment opportunities, are essential components of STEM degree completion for FGCS.

Academic preparation before college has implications for practitioners who work with prospective-FGCS, beginning at the K-12 levels, specifically within targeted programs like TRIO Upward Bound and Educational Talent Search. The emphasis of these programs has historically been accessing college, navigating the Financial Aid process, and believing that college was even an option. Perhaps the results of this study, coupled with the previous literature, will promote a shift to that of programming that influences better academic preparation for FGCS at the K-12 levels. Academic preparation to better prepare students for not only the ACT exam but furthermore teach essential study habits and expectations of college students. The literature indicated that FGCS who pursued STEM majors in college might not have needed to study or write many papers in high school and were surprised when they arrived on campus by the level of academic expectations. Some FGCS expressed that no one ever taught them how to study for an exam (Reed & Moore, 2008). Programming in high school that can intervene and assist even high achieving students to be prepared with study tips and habits may make a significant difference in who attains a STEM degree and who does not.

Interventions to assist FGCS with academic preparation likely needs to begin before the high school level. Advanced Placement (AP) and Postsecondary Enrollment Options (PSEO) credits are only able to be accessed if the student has completed the appropriate prerequisites for enrollment. Therefore, it can be deduced that getting on track to participate in AP or PSEO courses as a high school student likely starts at the K-8 level. An emphasis for K-12 teachers, school counselors, school social workers, and especially at the administrative level is suggested to be a holistic, programmatic assessment of what is working and not working to increase the academic performance for FGCS to increase composite ACT scores and PSEO credit completion before and in high school.

Moreover, there is an urgent need to improve the educational experience of college students to work in science, technology, engineering, and mathematics (STEM) fields (Byars-Winston, 2013). As there is not currently a standard definition of what constitutes a STEM career exploration of the majors that qualify for the STEM extension by the United States Department of Homeland Security (2016) is used as the criteria for STEM qualifying degrees. An important implication is systematically defining STEM degrees at the college and university levels and helping students self-select into degree pathways that produce STEM graduates from four-year colleges and universities.

Additionally, implications for professional practice in academic and student affairs suggests a need to emphasize the importance of both the pre-college characteristics and the engaging experiences that can be leveraged to promote a sense of belonging and a culture of inclusion in the student's university experience (Biu, 2002). FGCS have already demonstrated resiliency by being the first in their family to attend college. From a social justice perspective, it appears that universities need to intentionally focus on creating an inclusive campus community so that students are provided with an infrastructure of student support. When FGCS are confronted with setbacks, they may have the resiliency to persist, and some FGCS may need additional support in place to foster resiliency as they move through the different stages of degree completion with a STEM major. Influencing a sense of belonging on-campus can be promoted through the student's on-campus worksite and their access and involvement in learning communities. Additional areas that have emerged from the literature to consider exploring to promote a sense of belonging for FGCS include individualized advising on remedial course completion and a systematic review of courses that students identify as consistent gate-keeping courses in the STEM major curriculum.

Limitations of the Study

A limitation of this study was that the program award data are from one university, which limits the ability to generalize the findings. The experiences of the students involved in the study may differ significantly from FGCS students who earned STEM degrees between 2008 and 2018 from different institutions. The study sample of FGCS who graduated with a STEM undergraduate degree between 2008 and 2018 as first-time, full-time, degree-seeking federally defined FGCS was very ethnically homogeneous, the majority, 87.4% (n = 643) identified as White. This sample size and primarily White sample limit the ability to generalize the findings to FGCS, who identify as multiple races/ethnicities or are members of historically underrepresented racial/ethnic minority groups.

Lastly, learning community participation also was not consistently collected. Thus, there was no possibility of distinguishing what learning community a student participated in when they participated and or how many terms they were involved in a learning community. Furthermore, between 2008 and 2018, there may have been inconsistencies in the quantity, type, and structure of offered learning communities at the university under study.

Future Research Direction

Given the findings of the study, there are some areas of inquiry that could be further analyzed related to STEM degree completion and FGCS and female FGCS. Many of the students included the analysis had completed PSEO credits at the university and then entered the university as first-time, full-time, degree-seeking students, therefore may be prudent to explore post-secondary educational opportunity (PSEO) programing as a recruiting and retention tool for students in the STEM majors. For example, future research could analyze the types of courses taken as PSEO students, the teaching styles, the grading and feedback methodology of instructors, and the students' perception of the experience to see if this is statistically significant to STEM degree completion.

Additionally, the students included in the analysis of university data were all coded by the university as the first-time, full-time, degree-seeking undergraduate students pursuing their first degree at the university. However, in analyzing the descriptive statistics for the 745 FGCS students who earned a STEM degree and the 5,868 who earned either a STEM or non-STEM degree, it was apparent that the FGCS are entering the university between the 21 and 24 age range 91.8% (n = 684) and 89% (n = 5,224) respectively. It may be prudent to explore if prospective-FGCS who are older than their prospective-continuing-generation peers at high school graduation and or if prospective-FGCS are taking a gap-year and or working for some time before entering college for the first time.

Because learning community participation was statistically significant, however, increased students' time to degree completion, a future direction for research could be exploring the learning community curriculum for STEM majors, and assessing if prerequisite credits could be waived in the case of learning community participation to expedite these students' time to degree completion.

Additionally, working on campus was significantly related to the time it took to earn a STEM undergraduate degree. Implications for future research could explore the training, support, and mentoring that were intentional in the student's on-campus work site or explore the student's perspective of their on-campus work experience and if this positively contributed to their STEM degree completion. Work-study opportunities may be more inviting to students to use "free time" to study and be less likely to impose on students beyond set time constraints (e.g., student-friendly flexibility). Also, it would be interesting to know if the type of employment, for example, on-campus employment in an academic department or student affairs office related to different experiences for student's STEM degree completion versus off-campus employment.

Considering the overrepresentation of students who identify as female in the Biological Sciences, 62.7% (n = 131) of the 209 students who identified as female in the sample graduated with CIP 26 Biological Sciences major as compared to 3.8% (n = 8) who graduated with a CIP 14, Engineering major. It was beyond the scope of the current study to decipher if the students who identified as female graduating major was their first choice of major or if they transitioned into a new major. Future studies should explore what is attracting students who identified as female and retaining them in biological science majors to see if other STEM major areas can make some necessary shifts in order to attract and retain women in STEM. While there are likely many factors that contribute to the disproportionate representation of women in the STEM fields, directions for future research should incorporate a positive psychology perspective of what is going right for specific STEM degree programs and universities to explore what enabled students who identified as female to graduate with a STEM degree. An important area for further exploration is to examine STEM programs that are significantly under-represented by both students who identified as female and female faculty such as engineering, engineering technology, computer science, and physics, as the research indicates these fields currently have the least female representation in the U.S. workforce (Hughes, 2014). Variables to consider as potential positive influential factors could include access to female role models, and the perception of family-friendly flexibility in the STEM fields (Beede et al., 2011). Building on the work of Hughes (2014), perhaps an analysis of the gender diversity in faculty representation in the STEM majors could offer some perspectives and initiatives to fund students who identified as female at the masters and doctoral level to shift the under-representation of women in faculty leadership on college campuses.

Conclusions

This study explored the relationship between ACT score, Pell-eligibility, PSEO credit, learning community, institutional housing, on-campus employment, identity as female, the type of STEM degree, and time-to-completion for first-time, full-time, degree-seeking, federally defined first-generation undergraduate students who completed a STEM degree between 2008 and 2018 (N = 745) at a comprehensive Midwest university. The results suggest that the relationship between time to STEM degree completion was significantly related to ACT score, Pell-eligibility, PSEO credit completion, learning community participation, Institutional housing, and on-campus work participation ($R^2 = .12$, $p < .001$). The relationship between time to STEM degree completion for students who identified as female (N = 209) was significantly related to ACT score, Pell-eligibility, PSEO credit completion, learning community participation, Institutional housing, and on-campus work participation ($R^2 = .26$, $p < .001$). No significant relationship between time to STEM degree completion for students who identified as female (N = 209) was found to be related to the type of STEM degree, F (10,198) = 1.41, p =.18. R^2 for the model was .07, and the adjusted R^2 was .02.

Of the six measures of analysis for research questions one and two that proved statistically significant in the model for first-generation college students STEM degree completion, three are pre-college measures, and two are engagement measures variables related to the study's guiding theoretical framework. The results of research questions one and two can contribute to the literature on FGCS and potentially influence future research on pre-college factors and engagement factors associated with degree completion for FGCS in STEM majors as each of these variables emerged from the literature review as pre-college characteristics and engagement variables associated Nora's student engagement model normed on a Latino population for community college students pursuing STEM degrees.

The results of this study provide support the interactional relationship between pre-college characteristics and engagement characteristics on time-to-completion and thus offers additional support for Nora's (2006) student engagement model as an appropriate theoretical orientation to examine the relationship between college engagement and historically underrepresented students. Results of this study inform the current literature on FGCS who identify as female and STEM degree completion as the previous literature indicates that FGCS are less likely to declare majors in Science, Technology, Engineering and Mathematics (STEM) (Chen, 2005) yet, STEM majors out-earn majors in the liberal arts such as education and the humanities (Wolniak, 2016).

In examining FGCS STEM degree completion from a positive psychology perspective, this study adds to the literature on FGCS degree attainment and STEM degree competition by considering what went right instead of what went wrong for the students in the study who successfully navigated the university and persisted to degree-completion with a STEM major. While the findings of the study should be interpreted carefully as the sample size for research question was 745, and the sample size for research questions two and three was 209, the significant results might enable higher education professionals to develop early interventions to retain both FGCS and continuing-generation students in STEM majors.

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Tables

Table 1
Race/Ethnicity of the First-Generation STEM degree Sample and the whole Program Awards Population, N = 745

Race/Ethnicity	**First-Generation Stem Sample (N = 745)**	**Entire Program Award First-Generation Population of the Institution (5,868)**
American Indian or Alaska Native	.1%	.2%
Asian	3.3%	3.2%
Black or African American	4.3%	3.4%
Hispanic of any Race	2.9%	2.6%
Native Hawaiian or Other Pacific Islander	0%	.1%
Two or more races	2.0%	2.0%
White	87.4%	87.1%

Note. All data quoted from the Office of Institutional Research program awards data, (2018).

Table 2
Sex of the First-Generation STEM degree Sample and the whole Program Awards Population, N = 745

Sex	First-Generation Stem Sample (N = 745)	Entire Program Award First-Generation Population of the Institution (5,868)
Students identifying as Female	28.1%	58.7%
Students identifying as Male	71.9%	41.3%

Note. All data quoted from the Office of Institutional Research program awards data, (2018).

Table 3
Age of the First-Generation STEM degree Sample and the whole Program Awards Population, N = 745

Age	First-Generation Stem students (N = 745)	Entire Program Award First-Generation Population of the Institution (5,868)
Age 19 - 20	2.1%	2.6%
Age 21 - 24	91.8%	89%
Age 25 - 34	5.8%	7.1%
Age 35 - 44	.3%	.8%
Age 45 - 54	.0%	.4%
Age 55+	.0%	.1%

Note. All data quoted from the Office of Institutional Research program awards data, (2018).

Table 4
Model Summary of Linear Regression Research Question 1, N = 745

Model	**R**	**R^2**	**Adjusted R^2**	**Std. Error of the Estimate**
1	.35	.12	.12	1.04

Note. Predictors: ACT score, Pell-eligibility, institutional PSEO credit completion, learning community participation, on-campus employment, terms of participation in institutional housing. Dependent Variable: time-to-completion with a STEM major. R is the multiple correlation coefficient. R^2 is the proportion of variation explained by the model in the sample. The Adjusted R Square is the percentage of variation explained by the model in the population.

Table 5
ANOVA for Linear Regression Research Question 1, N = 745

Model		**Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig**
1	Regression	115.14	6	19.19	18.73	.001***
	Residual	803.43	738	1.08		
	Total	918.57	744			

Note. Predictors: ACT score, Pell-eligibility, PSEO credit completion, learning community participation, on-campus employment, terms of participation in institutional housing. Dependent Variable: time-to-completion with a STEM major. Degrees of freedom ("df"). F-distribution ("F") indicates the comparison to and *F*-test.
*** Indicates significance at $p < .05$.

Table 6
Coefficients for Research Question 1, N = 745

Model		**B**	**Std. Error**	**Beta**	**T**	**Sig**
1	Constant	6.08	.39		15.34	.001***
	ACT score	-.04	.01	-.13	-3.82	.001***
	Pell-eligibility	-.61	.08	-.26	-7.44	.001***
	PSEO credits	-.02	.01	-.11	-3.26	.001***
	Learning community	.36	.13	.10	2.85	.005***
	On-campus employment	-.03	.01	-.10	-2.94	.003***
	Institutional housing	.01	.02	.01	.43	.66

Note. Predictors: ACT score, Pell-eligibility, PSEO credit completion, learning community participation, on-campus employment, terms of participation in institutional housing. Dependent Variable: time-to-completion with a STEM major. B is the Unstandardized Coefficients; Std. Error is the Standard error of the unstandardized Coefficients. Beta is the Standardized Coefficients.
*** Indicates significance at $p < .05$.

Table 7
Model Summary of Linear Regression Research Question 2, N = 209

Model	**R**	**R^2**	**Adjusted R^2**	**Std. Error of the Estimate**
2	.51	.26	.24	.84

Note. Predictors: (Constant), ACT score, Pell-eligibility, PSEO credit completion, learning community participation, on-campus employment, terms of participation in institutional housing. Dependent Variable: time-to-completion for students who identified as female with a STEM major. R is the multiple correlation coefficient. R^2 is the proportion of variation explained by the model in the sample. The Adjusted R Square is the percentage of variation explained by the model in the population.

Table 8
ANOVA for Linear Regression Research Question 2, N = 209

Model		**Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig**
2	Regression	50.14	6	8.36	11.86	.001***
	Residual	142.38	202	.70		
	Total	192.51	208			

Note. Predictors: ACT score, Pell-eligibility, PSEO credit completion, learning community participation, on-campus employment, terms of participation in institutional housing. Dependent Variable: time-to-completion for students who identified as female with a STEM major. Degrees of freedom (“df”). F-distribution (“F”) indicates the comparison to and *F*-test.
*** Indicates significance at $p < .05$.

Table 9
Coefficients for Research Question 2, N = 209

Model		**B**	**Std. Error**	**Beta**	**T**	**Sig**
2	Constant	7.13	.56		12.67	.001***
	ACT score	-.08	.02	-.30	-4.85	.001***
	Pell-eligibility	-.65	.13	-.33	-5.13	.001***
	PSEO credits	-.03	.01	-.19	-3.16	.002***
	Learning community	.32	.18	.11	1.76	.079
	On-campus employment	-.04	.02	-.13	-2.09	.038***
	Institutional housing	-.01	.03	-.01	-.22	.83

Note. Predictors: ACT score, Pell-eligibility, PSEO credit completion, learning community participation, on-campus employment, terms of participation in institutional housing. Dependent Variable: time-to-completion for students that identify as female with a STEM major. B is the Unstandardized Coefficients; Std. Error is the Standard error of the unstandardized Coefficients. Beta is the Standardized Coefficients.
*** Indicates significance at $p < .05$.

Table 10
Model Summary of Linear Regression Research Question 3, N = 209

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate
3	.26	.07	.02	.95

Note. Predictors: CIP 01, CIP 03, CIP 11, CIP14, CIP 15, CIP 27, CIP 30, CIP 40 CIP 49, CIP 51. Dependent Variable: time-to-completion for students who identified as female with a STEM major. Constant: CIP 26. R is the multiple correlation coefficient. R^2 is the proportion of variation explained by the model in the sample. The Adjusted R Square is the percentage of variation explained by the model in the population.

Table 11
ANOVA for Linear Regression Research Question 3, N = 209

Model		**Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig**
3	Regression	12.82	10	1.28	1.41	.18
	Residual	179.69	198	.91		
	Total	192.51	208			

Note. Predictors: CIP 01, CIP 03, CIP 11, CIP14, CIP 15, CIP 27, CIP 30, CIP 40 CIP 49, CIP 51. Dependent Variable: time-to-completion for students who identify as female with a STEM major. Constant: CIP 26. Degrees of freedom (“df”). F-distribution (“F”) indicates the comparison to and *F*-test.

Table 12
Coefficients for Research Question 3, N = 209

Model		**B**	**Std. Error**	**Beta**	**T**	**Sig**
3	Constant (CIP 26)	4.47	.08		53.71	.000***
	CIP 01	-.18	.96	-.01	-.19	.85
	CIP 03	.27	.29	.07	.96	.34
	CIP11	.09	.48	.01	.18	.86
	CIP 14	.38	.38	.08	1.09	.28
	CIP 15	1.19	.43	.19	2.74	.01***
	CIP 27	-.47	.35	-.09	-1.36	.17
	CIP 30	-.25	.43	-.04	-.57	.57
	CIP 40	.41	.29	.10	1.44	.15
	CIP 49	-.09	.35	-.02	-.26	.79
	CIP 51	.15	.26	.04	.58	.56

Note. Predictors: CIP 01, CIP 03, CIP 11, CIP14, CIP 15, CIP 27, CIP 30, CIP 40 CIP 49, CIP 51. Dependent Variable: time-to-completion for students who identify as female with a STEM major. Constant: CIP 26. B is the Unstandardized Coefficients; Std. Error is the Standard error of the unstandardized coefficients. Beta is the Standardized Coefficients.
*** Indicates significance at $p < .05$.