Student Engagement: Factors Affecting the Academic Performance and Persistence of Hispanic Women in STEM

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UNIVERSITY OF MIAMI

STUDENT ENGAGEMENT: FACTORS AFFECTING THE ACADEMIC PERFORMANCE AND PERSISTENCE OF HISPANIC WOMEN IN STEM

By

Maria E. Vaca

A DISSERTATION

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STUDENT ENGAGEMENT: FACTORS AFFECTING THE ACADEMIC PERFORMANCE AND PERSISTENCE OF HISPANIC WOMEN IN STEM

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Hispanics are poised to change the U.S. demographic landscape and account for one-third of the national population in the next forty years (U.S. Census Bureau, 2012). Yet, presently Hispanic students are the most underrepresented ethnic group in higher education with the lowest college completion rates the country (U.S. Department of Education, National Center for Education Statistics, 2015b). Furthermore, Hispanic women are reported to attain only 3% of all STEM bachelor’s degrees nationally (U.S. Department of Education, National Center for Education Statistics, 2015a). The purpose of this study was to examine student engagement as a factor that predicts academic performance and intention to persist in STEM for Hispanic college students and in particular, Hispanic women. Data collected at a public, four-year, Hispanic Serving Institution was analyzed using Hierarchical Linear Regression. Results revealed a significant, but negative relationship between academic performance and the amount of time spent engaged with mentors, for both male and female Hispanic students. There was low variability found for intention to persist, with 85% of Hispanic women indicating intention to graduate from college with a degree in STEM. Study results are interpreted in the context of Hispanic Serving Institutions where Hispanics students are the majority.
DEDICATION

Para mis padres Luis y Jovita,
Dios me ha bendecido con el amor de padres maravillosos.
Todo lo que he logrado es para ustedes y gracias a ustedes.
Gracias por su paciencia, apoyo, y consejos.

For my parents Luis and Jovita,
God has blessed me with the love of wonderful parents.
All that I have accomplished is for you and because of you.
Thank you for your patience, support, and guidance.

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Thank you for your unwavering confidence and enthusiasm in all my endeavors.
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Chapter 1: Introduction

"’I see some women here. We need more. I see some African American and Hispanic women. We need more of them.’" – President Barack Obama (Stern, 2013, p. 46)

In a Presidential award ceremony for scientists and engineers hosted at the White House on October 2012, President Barack Obama remarked on the scarcity of minority women employed within the professional ranks of science, technology, engineering, and mathematics (STEM) (Stern, 2013). The United States is currently facing a shortage of professionals in STEM careers and many scholars argue that the issue partially takes root in higher education (Carnevale, Smith, & Strohl, 2013). Colleges and universities nationwide report that STEM degree completion is a challenge for both male and female students. Specifically, enrollment and retention rates reveal that approximately 50% of all students entering college with a declared STEM major will eventually switch to a non-STEM major or leave college altogether without completing an undergraduate degree (U.S. Department of Education, National Center for Education Statistics, 2013). These high attrition rates are far greater for females in higher education. Although college female enrollment has increased, outnumbering males 56% to 44% at universities nationwide (U.S. Department of Education, National Center for Education Statistics, 2014), male students continue to dominate the attainment of doctoral degrees and all degrees awarded in STEM, with the exception of the biological sciences (National Science Foundation, 2012). According to the U.S. Department of Education, National Center for Education Statistics (2015a), of all bachelor’s degrees in STEM, only 35% are awarded to female college students.

Further widening the minority gap in STEM is the decreasing presence of Hispanic students in higher education. Current demographic trends indicate that the
Hispanic population is poised to change the national demographic landscape accounting for over 30% of the total U.S. population by the year 2060 (U.S. Census Bureau, 2012). Yet presently, Hispanic students maintain the lowest college completion rates in the country (U.S. Department of Education, National Center for Education Statistics, 2015b). Specifically, Hispanics are reported to attain only 8% of bachelor’s degrees, 6% of master’s degrees, and 5% of doctoral degrees in all fields of study (U.S. Department of Education, National Center for Education Statistics, 2015a). In the STEM disciplines, the U.S. Department of Education, National Center for Education Statistics (2015a) revealed that Hispanic women attain only 3% of all bachelor’s degrees awarded nationally. Future research in higher education should further explore factors that lead to the persistence of the small cohort of Hispanic college women succeeding in STEM degree completion, particularly as jobs in these fields will continue to increase (Carnevale, Smith, & Strohl, 2013).

The Urgent Need for STEM Graduates

According to reports from Georgetown University Center on Education and the Workforce, the future of STEM occupations is projected to grow at a 17% rate increase with approximately 1.1 million new jobs by the year 2018 (Carnevale, Smith, & Strohl, 2013). This forecasted growth in STEM occupations has created a national dialogue placing politicians and legislature at the forefront of the issue. In response to the realities of current U.S. employment trends, Governor Jack Markell of Delaware voiced his thoughts and concerns: “If you’re in the STEM fields, take your [job] pick. If you’re not in the STEM fields, join the [unemployment] line. To succeed in the brave new world,
my top priority is making sure our education system prepares our students”” (Sununu & Cardona, 2013, para. 3).

In 2013, in response to the urgent need for STEM graduates, the National STEM Education Fund was created as a short-term solution to this national concern, and it has garnered full bipartisan support from Congress since its inception (Cardona, 2013; Sununu & Cardona, 2013). Tied to the Immigration Reform Bill, the National STEM fund is a sponsorship fee paid by U.S. employers to the U.S. government, which allows employers permission to hire foreign nationals and fill the vacancies of high-skilled STEM jobs (Cardona, 2013). The National STEM Education Fund serves to build the future U.S. workforce by investing the money collected from the sponsorship fees to enhance student training and increase the total number of U.S. born STEM graduates (Cardona, 2013). The national deficit of STEM college graduates has become of heightened interest for higher education administrators, government officials, and a wide range of field experts alike. Furthermore, during the last few decades, federal scholarships and higher education STEM programs have been created and implemented at all educational levels to attract minorities and female students into the fields of science and engineering (Franchetti, Ravn, & Kuntz, 2010; Yelamarthi & Mawasha, 2010).

In recent years, the recruitment of women into STEM has been transformed into highly visible marketing campaigns, ranging from television commercials of science-themed toys for elementary school girls, to science camps and STEM career fairs exposing female adolescents in middle and high school to the world of science and engineering (American Association of University Women, n.d.; Schwalm, 2012). As a result, many organizations have created programs that inspire young women to pursue
careers in STEM. The Girls Scouts of America, for instance, now awards Science and Technology badges, encouraging girls to learn the science of video game development and the physics of roller coaster design (DiMaria, 2013). Yet, while there has been steady progress with these national initiatives, higher education institutions throughout the U.S. continue to confront significant challenges in the retention of women and minorities in STEM (Whalen & Shelley, 2010; Wu & Jing, 2011).

**Persistence Factors Affecting Hispanic Females in STEM**

In the United States, the words *Hispanic* and *Latino* are broad terms, often used interchangeably to describe and categorize a diverse group of people. The term *Latino* is a Spanish word that refers to geography, specifically to individuals from Latin America and countries in the Caribbean with Spanish ancestry (Wolfe, 2016). The term *Latino* is also inclusive of the people of Brazil, where the native language is Portuguese and not Spanish. The term *Hispanic* was first used in the United States in the 1970s to define the U.S. population of Spanish ancestry and Spanish-speaking origin (Flores-Hughes, 2013). The term Hispanic, however, does not include Brazilians, as their language is not Spanish (Wolfe, 2016). In this study, the term *Hispanic* will be used to describe both the Hispanic and Latino populations.

Hispanics are comprised of diverse ranges of cultural, educational, and socioeconomic backgrounds that contribute to unique college experiences for each Hispanic student. The migration history of different Hispanic groups into the U.S. is relevant to the cultural and social capital of each group. For example, some Hispanics migrated to the U.S. for better socioeconomic opportunities, while others migrated escaping political persecution, seeking asylum and freedom (Delgado-Romero &
Hernandez, 2002). As a result, Hispanic students in the U.S., from countries across the
globe, inherit varying levels of educational backgrounds and social networks.

In higher education, factors that contribute to the challenges of persistence for
Hispanic students include low socioeconomic backgrounds, first-generation college
status, and diverse cultural values (Renn & Reason, 2013; Tinto 1993). For many
Hispanic females in particular, balancing college expectations with family responsibilities
is one of the main obstacles to college persistence (Flores, 2011). In addition, many
females who decide to pursue STEM majors often confront the challenges of overcoming
chilly climates and microaggressions within the college environment, in order to succeed
as undergraduates (Camacho & Lord, 2011a; Morris & Daniel, 2008).

Conversely, factors that positively affect Hispanic students in STEM include
different forms of college student engagement. Research shows that mentoring has aided
in increasing persistence and graduation rates for Hispanic women over recent years
(Bordes-Edgar, Arredondo, Kurpuis, & Rund, 2011). Specifically, studies show that
Hispanic female mentors with STEM backgrounds serve as strong role models for
Hispanic college women in STEM (Gloria et al., 2010). Studies also show that student
involvement in minority and STEM organizations contribute to Hispanic student
acculturation in college and in STEM, particularly in predominantly White institutions
(PWIs) (Brown, 2008; Camacho & Lord, 2011b; Delgado-Romero & Hernandez, 2002).
Peer interactions have also been found to influence the educational aspirations and degree
attainment for all undergraduate college students, especially for Hispanic females (Ost,
2010; Pascarella & Terenzini, 2005).
Theoretical Basis of Study

The theoretical basis for this study is grounded on two theories: The Theory of Student Departure and the Theory of Student Involvement. Tinto’s (1988, 1993) Theory of Student Departure posits that student integration is essential for student persistence in college. The Theory of Student Departure states that student integration into academic and social systems are necessary to prevent students from dropping out of college. According to Tinto (1988), student integration involves a three-step process: 1) separation, 2) transition, and 3) incorporation into college. This process delineates that college students must separate themselves physically and socially from communities of the past, for full and successful integration into college. According to the Theory of Student Departure, as academic and social integration increases student commitment to the institution is strengthened (Pascarella & Terenzini, 2005; Tinto, 1993).

Astin (1984, 1999) emphasized in his Theory of Student Involvement, that student engagement is an important component of the learning process, and further explained that student engagement can be quantified and qualified. The Theory of Student Involvement is defined as the “active participation of the student in the learning process” (Astin, 1999, p. 522). The theory explains that the amount of time a student spends engaged in college has significant influence on student development, persistence, and academic performance (Astin, 1984, 1999; Pascarella & Terenzini, 2005). In his I-E-O Model, an extension of the Theory of Involvement, Astin (1991) further explained how student inputs (I), the college environment (E), and outputs (O) are interrelated. The I-E-O model reminds researchers to consider individual characteristics and assess college environments in the study of student outcomes in higher education.
Purpose of Study

The purpose of this study was to explore student engagement as a factor that predicts academic performance and intention to persist in STEM, particularly for Hispanic females. Specifically, this study examined the effects of mentoring, STEM-related student organizations, and peer-group studying. The target population was Hispanic female students, therefore this study was conducted at a public, four-year, commuter, Hispanic Serving Institution (HSI), located in a predominantly Hispanic community in South Florida. Hispanic Serving Institutions report the most growth in Hispanic student retention and graduation rates (Camacho & Lord, 2011b), particularly engineers, which further creates the ideal environment for study. In addition, Hispanic student engagement may differ at HSIs compared to traditional colleges and universities across the country. Ultimately, this study proposed to advance the existing body of literature in STEM for Hispanics, and to provide recommendations to enhance student engagement, academic performance, and college student retention.

Significance of Study

The significance of Hispanic female retention in STEM is based on higher education trends, national demographic trends, and employment trends in the United States. Specifically, Hispanics are underrepresented in higher education (U.S. Department of Education, National Center for Education Statistics, 2015b); Hispanics are also the fastest growing ethnic group in the country (U.S. Census Bureau, 2012); and STEM jobs are forecasted to increase significantly within the next five years (Carnevale, Smith, & Strohl, 2013). As females continue to enroll and graduate from college at much higher rates than males (U.S. Department of Education, National Center for Education
Statistics, 2014), they will soon dominate as the more educated gender and they should be prepared to lead the country in growing STEM careers. The U.S. Department of Labor, Bureau of Labor Statistics (2015) reported that U.S. gender wage gaps persist, with males earning significantly more than females in all fields of study, and STEM jobs pay significantly higher wages compared to careers in the arts and business industries.

Presently, Hispanic women represent only 2% of the U.S. workforce in STEM (National Science Foundation, 2015). Clearly, Hispanic women thriving in STEM careers will aid to increase the lower income wages of women and Hispanics in general, but will also serve to diversify the professional ranks of scientists and engineers in the STEM disciplines, creating for a wider range of innovation that takes into consideration race and gender (Camacho & Lord, 2011b). Therefore, increasing the postsecondary educational attainment of an expanding Hispanic population, particularly Hispanic females in STEM, will serve to improve the economic vitality and technological progression of the nation as a global competitor.
Chapter 2: Literature Review

This chapter provides an overview of the literature on the effects of college student engagement on academic performance and intention to persist among students in STEM, specifically Hispanic women. First, statistics on college retention rates and STEM persistence are presented. Second, a conceptual framework and empirical research on student engagement, persistence, and academic performance are discussed. Third, the literature on the challenges of Hispanics in higher education, with a focus on Hispanic females is reviewed. Next, a detailed discussion of student engagement patterns, specifically mentoring, STEM organizations, and peer interactions, are presented. Finally, this chapter provides a summary of the current study, including the rationale behind choosing an HSI and why it was important to the study aims, followed by the research questions.

Retention Statistics and Practices in STEM

The U.S. Department of Education, National Center for Education Statistics (2015b) reported an 80% college student retention rate among first-time, full-time students attending four-year degree-granting institutions, and a 59% graduation rate for the same student population. In the STEM majors, 32% of females and 26% of males leave the STEM fields by switching to non-STEM majors, whereas 14% of females and 24% of males leave STEM and then drop out of college (U.S. Department of Education, National Center for Education Statistics, 2013). As a result, higher education remains focused on developing innovative retention strategies for all students in STEM.

Common retention strategies in higher education for students majoring in STEM, and particularly for Hispanic females, include mentoring programs, math and science
resource centers, paced science courses (Carpi, Ronan, Falconer, Boyd, & Lents, 2013), minority and STEM-related student organizations (Camacho & Lord, 2011b), and peer-group studying (Hughes, 2010). These retention programs and practices are founded on student engagement, which many theorists and scholars have linked to academic achievement and persistence within the higher education setting (Astin, 1999; Kuh, Kinzie, Schuh, & Whitt, 2010; Pascarella & Terenzini, 2005; Tinto, 1993).

**Conceptual Framework**

College student retention theories and models have been studied for over four decades, as documented by various scholars in higher education (Astin, 1984, 1999; Kuh et al., 2010; Pascarella & Terenzini, 2005; Tinto, 1988, 1993, 2007). Among the many studies on retention, two prevalent theories on student engagement have emerged as the Theory of Student Departure (Tinto, 1988, 1993) and the Theory of Student Involvement (Astin, 1984, 1999). These two interrelated theories focus on the behavioral models, which lead to student development and persistence. Each theory describes retention as an outcome of college student involvement, yet Tinto’s theory (1988, 1993) focuses on student outputs and Astin’s theory (1984, 1999) focuses on student inputs.

**Theory of Student Departure.** Vincent Tinto (1988, 1993) proposed the Theory of Student Departure, which posits that college student persistence is an outcome of academic and social integration in the college environment.

Integration is the extent to which the individual shares the normative attitudes and values of peers and faculty in the institution and abides by the formal and informal structural requirements for membership in that community or in subgroups of it. (Pascarella & Terenzini, 2005, p. 54)
Specifically, academic integration is defined as grade achievement and faculty interactions, and social integration is defined as participation in extracurricular activities and peer-group interactions (Tinto, 1993). While full integration into both realms is not necessary for collegiate success, Tinto’s (1993) theoretical perspective argues that students must integrate to “some degree” both academically and socially into the educational institution, in order to prevent institutional departure (p. 120).

Tinto (1988) posited that students must experience three stages of passage in college in order to avoid institutional departure. First, students must separate from past communities. This separation entails parting with old habits and previous affiliations, such as high school and place of residence. Second, college students must transition into their new institution by learning the norms and demands of the university. Third, students must incorporate into their institution by immersing into the higher education community, adopting the new norms, and connecting with peers and faculty through social and academic interaction. According to the Theory of Student Departure, students enter college with pre-entry attributes (family background, skills and abilities, and prior schooling), which have a strong influence on a student’s decision to depart from college (Renn & Reason, 2013). These pre-entry attributes, such as family relationships and previous educational experiences, often interfere with the first and second stages of passage, as separation and transition require students to disassociate from the past and learn different norms. Achieving membership in the new college community may prove especially difficult for minorities because of background. For instance, first-generation college students and low-income students are more likely to experience social and academic integration challenges, primarily due to lower cultural capital than students
from college-educated families who have shared knowledge on the academic rigors of college (Tinto, 1988, 1993, 2012).

In more recent work, Tinto (2012) further presented four conditions for student success in college, whereby higher education institutions should: 1) set clear and high expectations for students from the first year of college, 2) provide students with academic, social, and financial support, 3) conduct assessments and provide feedback to students regularly, and 4) encourage student involvement. Together, these four conditions enhance the college student experience. According to Tinto (2012), the most important condition for college student retention is student engagement: “The more students are academically and socially engaged with other people on campus, especially with faculty and student peers, the more likely (other things being equal) they will stay and graduate from college” (Tinto, 2012, p. 64).

Tinto (2012) also affirmed that student involvement creates both academic and social membership, which results in a sense of belonging for students. This sense of belonging relates to student perceptions of their involvement in college and the support they receive from their environment. More specifically, students must see themselves belonging (i.e., attaining membership) to a significant community on campus. Once involved in these communities, students will engage in activities they perceive as relevant and meaningful to their interests (Tinto, 2012). Therefore, institutions must ensure they provide quality programs and diverse opportunities that foster meaningful and relevant student activities, and as a result increase student retention.

**Theory of Student Involvement.** Alexander Astin (1984, 1999) coined the Theory of Student Involvement, later renamed engagement, which posits that students
learn by being actively involved in college. The Theory of Student Involvement defends student engagement as an essential component of college persistence. In his theory, Astin defined involvement as “the amount of physical and psychological energy that the student devotes to the academic experience” (Astin, 1999, p. 518). More specifically, according to Astin,

A highly involved student is one who, for example, devotes considerable energy to studying, spends much time on campus, participates actively in student organizations, and interacts frequently with faculty members and other students. Conversely, a typical uninvolved student neglects studies, spends little time on campus, abstains from extracurricular activities, and has infrequent contact with faculty members or other students. (Astin, 1999, p. 518)

The theory clearly states that the “most precious institutional resource, may be student time” (Astin, 1999, p. 522). That is, both time and effort are direct functions of student achievement and development. There are, however, limits to involvement, and students who enlist in an excess of activities may become overwhelmed in college. Too much time and too little time spent in activities can negatively affect student performance and success in college.

In addition, the Theory of Student Involvement has five postulates (Astin, 1999). The first postulate states that student involvement requires investment of physical and psychological energy. To be actively engaged requires students to act and think about different activities. According to the second postulate, involvement is continuous and varies from student to student. Students will determine which activities to participate in, and these activities will be different for each student. Although individual activities may
end, involvement continues throughout the college experience. Third, involvement can be measured both quantitatively and qualitatively. That is, the amount of time and the quality of engagement are measurable. Fourth, student development is directly proportional to the quantity and quality of involvement invested by the student. The fifth and final postulate states that the effectiveness of an educational policy or practice is related to its capacity to increase student engagement.

Astin (1977) also introduced the I-E-O Model, which incorporates inputs (I), the college environment (E), and outputs (O). In his model, Astin proposed that students enter college with input characteristics (e.g., gender, race, academic ability), and are exposed to precollege environments (i.e. family and school) as well as college environments (i.e. courses, peers, housing, and faculty), which in turn affect outputs or student outcomes (i.e. content knowledge mastery, critical thinking skills, personal development, moral development, etc.). The I-E-O framework serves to assess student outcomes in a sensible manner and to understand how college affects students in higher education (Renn & Reason, 2013). This study proposed to examine the relationship between student gender and race/ethnicity (I), considering family background, individual student engagement, and the college environment (E), on academic performance and student persistence as (O) outputs.

**Student Engagement, Persistence, and Academic Performance**

**Engagement and Persistence.** Similar to the Theory of Student Departure and the Theory of Student Involvement, Kuh et al. (2010) documented that what students do in college is important to both learning development and persistence. Kuh et al. (2010) further explained that student engagement has two key components. The first component
to student success is student-centered, focused on the amount of time and effort students place on their studies and other activities. The second key factor to student success is institution-centered, focused on institutional resources, learning opportunities, and services provided to encourage students to participate in different activities. Both of these factors are equally essential for the success of students and the institution. According to Kuh et al. (2010), educational environments with higher levels of academic rigor, active and collaborative learning, faculty and peer interactions, enriching educational experiences, and supportive campus environments, experience increased retention rates compared to other schools. In turn, students who are academically engaged and meet more frequently with faculty and peers are more likely to persist and succeed in college (Astin, 1999; Kuh et al., 2010; Tinto, 2012).

Additional research on student engagement, as it pertains to the dichotomy between male and female learning styles, has revealed that social involvement in particular has a stronger impact on the educational commitment of female students when compared to male students (Barrera, 1986; Jones, 2010; Kim & Sax, 2009; Sax & Harper, 2007). In a study of undergraduate students at two urban universities in the eastern United States, social coping was examined for male and female students enrolled in STEM courses (Morganson, Jones, & Major, 2010). The researchers found that women use social coping more than men, but also that social coping is significant to the commitment and persistence of women in STEM, and not for men. Furthermore, “social coping may be more important to persistence outcomes (e.g., commitment, turnover intent) because they more directly reflect attitudes and feelings” (Morganson, Jones, & Major, 2010, p. 176). Female students from this study may seek different forms of social
coping, including peer relationships, which include participating in peer study groups and joining STEM-specific student organizations, to aid in persistence (Morganson, Jones, & Major, 2010). In addition, these female students may seek guidance counselors and mentors as a means to cope with the rigors of STEM majors.

**Engagement and Academic Performance.** Research has also revealed a relationship between engagement and academic performance often measured as GPA (Kim & Sax, 2009; Kokkelenberg & Sinha, 2010; Kuh et al., 2008; Pascarella & Terenzini, 2005). Kuh et al. (2008) explored the effects of student engagement on first-year college grades and persistence, using data from the National Survey of Student Engagement (NSSE). The NSSE collects information from four-year institutions throughout the U.S., focusing on freshmen and college seniors. In 2014, over 716 colleges and universities participated in the survey, and approximately 4.5 million students have participated in the NSSE since the year 2000 (NSSE, 2014). In the study, Kuh et al. (2008) found that students who entered college with lower levels of high school academic performance and engaged in educationally purposeful activities experienced greater increases in first-year college GPA than students who entered college with higher levels of high school academic achievement. A separate finding indicated that for Hispanic students, educationally purposeful activities resulted in a .11 advantage for first-year GPA, while White students achieved a .03 GPA increase (Kuh et al., 2008). These findings suggest that minority students may have more to gain from engagement activities than those students who arrive to college with more knowledge about the college experience.
Kim and Sax (2009) examined the effects of student-faculty interactions on college GPA and integration, among other variables. The study used secondary data from the 2006 University of California Undergraduate Experience Survey, in which approximately 58,000 students participated. Results from the study found that research-related faculty interactions (outside of the classroom) predict higher college GPA, higher degree aspiration, and larger gains in critical thinking and communication for both females and males (Kim & Sax, 2009). In addition, course-related faculty interactions (inside the classroom) also predicted higher college GPA for both females and males, but not for first-generation college students (Kim & Sax, 2009). Results also revealed that first-generation students interacted less frequently with faculty in the classroom, than their non-first-generation peers (Kim & Sax, 2009).

A study on STEM students by Kokkelenberg and Sinha (2010) tested for the percentage of females who received the grade of an A in biology and mathematics courses, and found significant and positive relationships for sophomore students in the mathematics courses. The findings indicate that the gender peer effect, that is, having more female students in a given class, improves individual academic performance for females in STEM (Kokkelenberg & Sinha, 2010). The gender peer effect in this study suggests that female students feel more confident and comfortable in familiar settings, with more female students in a course, and as a result perform better academically. Peer effects are attributable to both academic and social engagement.

**Academic Performance and Persistence.** Research in STEM has also shown that academic performance can be measured as a predictor of persistence. In a study by Whalen and Shelley (2010) analyzed multiple predictor variables to assess persistence
and degree attainment. The study examined full-time, freshmen students at a four-year research institution in the Midwest. The findings in the study revealed, “on average, students with GPAs one-tenth of a point unit higher are 91.73% more likely to graduate or be retained at year six than not graduate or be retained” (Whalen & Shelley, 2010). Furthermore, the study revealed that a one-unit, incremental difference in cumulative GPA (i.e. 3.0 GPA vs. 2.0 GPA) contributes to 12 times greater retention and graduation rates for STEM students. According to this study, STEM students who attain higher cumulative GPAs are more likely to persist and graduate from college, and as GPA increases, retention and graduation rates increase exponentially.

“Absolute grades are one of the largest and most persistent factors in the attrition of undergraduates from STEM departments” (Rask, 2010, p. 899). A study in which graduating class data was analyzed for a period of eight years from 2001-2009, for approximately 5000 students majoring in STEM, Rask (2010) found that higher grades in STEM courses increase overall persistence for students in college. In addition, the results of this study revealed that the grade received in a STEM course determines the probability of a student taking another course in that major. Therefore, students who received a poor grade in a STEM course, were less likely to pursue additional STEM courses.

While there are many studies that indicate academic performance is linked to student persistence, research on academic performance and persistence in STEM is limited. Additional studies on student GPA and college retention are needed, specifically for Hispanic females in STEM. It is the goal of this study is to add to the literature on
student engagement, academic performance, and intention to persist in STEM for Hispanic females.

**Hispanics in Higher Education**

There is a wide range of characteristics that comprise the Hispanic culture and the Hispanic student. It is important to understand that Hispanics represent a diverse array of countries, cultures, races, and socioeconomic backgrounds. These differences in characteristics and backgrounds often present a challenge in research when endeavoring to generalize to large populations (Brown, 2008). For instance, some Hispanic students may come from financially disadvantaged families often with limited literacy skills, while some come from privileged societies with advanced literacy skills (Brown, 2008). Some Hispanic students are bilingual in the English and Spanish languages, some Hispanic students are fluent in English, while some may have little if any proficiency in English. As a result, many Hispanic students spend time learning to master the basics of the English language, which “displaces important [focus on] math and science concepts and skills that need to be learned early” when preparing for the STEM fields (Flores, 2011, p. 330). These significant differences weigh heavily on the academic achievement of Hispanic students in the U.S., from grammar school to post-secondary educational levels, particularly as high school and college curricula are designed for White middle-class students (Flores, 2011). The college experience for many Hispanic students then is often described as “uncomfortable, unfamiliar, and in some regards hostile” (Gonzales, 2012, p. 124; Hurtado & Ponjuan, 2005). Studies have shown that previous academic experiences, high school grades, and SAT scores, have an impact on the college experience of students from every ethnic background, race, and gender (Renn & Reason,
However, compared to their non-Hispanic White peers, Hispanics are more likely to experience greater challenges in these areas as they transition to college (Brown, 2008; Gonzales, 2012; Sánchez, Esparza, Colón, & Davis, 2010; Tinto, 2007).

Family background and socioeconomic status have emerged as the most prevalent variables contributing to the high attrition rates in college for Hispanic students (Cerna, Pérez, & Sáenz, 2009; Gloria, Castellanos, Segura-Herrera, & Mayorga, 2010; Hernandez & Lopez, 2005). Studies have shown that many Hispanic students in the U.S. are first-generation college students, indicating that they come from households where both parents have less than a high school education, which typically places these families in lower wage earning occupations (Oseguera, Denson, & Hurtado, 2008; Pascarella & Terenzini, 2005). Studies have also revealed that first-generation college students lack a shared knowledge base on the college process, as opposed to second-generation college students typically from more affluent families with readily available resources (Pascarella & Terenzini, 2005; Tinto, 1988, 1993, 2012). First-generation college students are also less likely to persist in higher education, and attain college degrees at lower rates compared to second-generation students whose parents (at least one parent) have attained a college education (Pascarella & Terenzini, 2005). Economic stratification is relevant to education because socioeconomic status often determines where a student goes to college. For example, students from low-income families are less likely to attend college as full-time students and far more likely to work in full-time jobs, compared to students from families of higher income levels (Tinto, 2007). Low-income students are also less likely to attend traditional four-year institutions because of the higher costs involved, and they are less likely to persist through community colleges compared to their high-income
peers (Malcom, 2010; Tinto, 2007). Furthermore, low-income students are too often academically underprepared, because they attend high schools with limited resources and weak curricula (Crisp, Nora, & Taggart, 2009; Renn & Reason, 2013).

In the context of STEM, many Hispanic students have shared that “they were never encouraged to take a science class, but when they did, the language and the content challenged them,” which made many of them feel “unprepared to perform well at school” (Peralta, Caspary, & Boothe, 2013, p. 911). Consequently, Hispanic students are reported to be the least equipped to successfully integrate into college life, as many enter higher education with less social and cultural capital than any other ethnic group (Wells, 2009).

Although access to higher education for low-income students has increased over the years, “for too many low-income students access to higher education has become a revolving door, the promise of a Bachelor’s degree unfulfilled” (Tinto, 2007, p. 12). Many scholars today argue that Hispanic students are often “’pushed out’” of higher education versus “’drop out’” of college due to the flawed system in higher education (Castellanos & Gloria, 2007, p. 383; Gonzales, 2012). Many Hispanic students fail to succeed in college because they have limited knowledge of the process and lack the appropriate support during the experience.

**Hispanic females in Higher Education.** The cultural norms of many Hispanic families often still place barriers on the academic achievement of Hispanic college students today (Brown, 2008; Flores, 2011; Wells, 2009; Zell, 2010). For Hispanic females, the traditional adjustment challenges of college life are further compounded by the pressures of negotiating between home and college expectations, as family needs often take precedence over academic responsibilities (Castellanos & Gloria, 2007; Flores,
2011). That is, the college experience for Hispanic females can be significantly different than that of their male counterparts due to gender role differences in the Hispanic culture. Cultural norms such as family caretaking can have a negative outcome for Hispanic females, as many fail to persist in college due to increased obligations at home (Sy & Romero, 2008). Studies have revealed that Hispanic females may experience higher levels of housekeeping responsibilities and often play the role of parental surrogate to younger siblings (Sánchez et al., 2010; Sy & Romero, 2008). These culturally sex-segregated attitudes and beliefs often categorize Hispanic females into caretaking careers, and continue to limit career potential for Hispanic women (Flores, 2011).

Maintaining deep personal connections with family members is also important for many Hispanic students (Castellanos & Gloria, 2007). These strong family relationships become a source of moral and emotional support during college for many Hispanic students. Although Hispanic parents may not fully understand the higher education process, they are supportive of their children attending college (Gonzales, 2012; Peralta, Caspary, & Boothe, 2013). For decades, positive and affective relationships between family support and personal-emotional adjustment have been found for Hispanic students, specifically during their first year of college (Hurtado, Carter, & Spuler, 1996). For example, a qualitative study by Peralta, Caspary, and Boothe (2013) on the success factors that influence the persistence of Hispanic college students majoring in STEM, revealed:

Another student shared that if it were not for her mother, she would not be in college. She and her husband are working and going to school, but now they are also juggling parenthood. She commented how hard it has been, and that without
her mother’s help; she would not be able to do it all. (p. 913)

As an example of parental support and family unity, this case characterizes the culture for many Hispanic families. Concurrently, this testimony also illustrates “the conflict experienced by Latina women between gender role socialization toward marriage and childbearing and educational aspirations” (Risco & Duffy, 2010, p. 241).

For many Hispanics, cultural values still emphasize that motherhood and family take priority over personal career goals for Hispanic females (Risco & Duffy, 2010). A study on the decision-making profiles of Hispanic students by Risco & Duffy (2010) revealed that Hispanic females display significantly more indecisiveness in career choices, and view their future careers as a less salient part of their identity, when compared to their male counterparts who display more confidence in career choices. Hispanic females also placed significantly more importance on careers that matched their interests, as well as making a difference in their line of work than Hispanic males in this study. For many Hispanic females in this study, meeting family expectations superseded all career decisions, as these are culturally sanctioned norms (Risco & Duffy, 2010). Conversely, for Hispanic men cultural values emphasize the responsibility of providing for the family financially, which “might fortify one’s career identity and goals” (Risco & Duffy, 2010, p. 248). The reality is that many Hispanic female students today confront several cultural barriers to college persistence in general, without considering the additional obstacles many will also face as STEM majors.

**Hispanic females in STEM.** Early in their educational careers, most teenage girls will decide not to pursue a degree in STEM before entering high school because it is highly stigmatized as an unfeminine career choice (Cho, Goodman, Oppenheimer,
Codling, & Robinson, 2009; Sax & Harper, 2007). By the time they enter high school, many female students will have developed stereotypical images of professional women in STEM as more intelligent, yet unfeminine and less attractive than women in non-STEM professions (Cho et al., 2009; Hughes, 2010). These misguided patterns of thinking lead female students to make uninformed decisions early in their educational careers and miss the opportunity to develop the fundamental knowledgebase of science, physics, and math to declare a STEM major and succeed in college, particularly for Hispanic females (Kokkelenberg & Sinha, 2010; Wang 2013). Studies have shown that students who enroll in pre-college preparation courses in mathematics and sciences in high school are more likely to succeed and graduate with a degree in STEM than students with no exposure to STEM (Kokkelenberg & Sinha, 2010). Studies have also revealed that female students will choose to study careers in the social sciences and education rather than prepare for careers in science and math, due to their lack of intellectual self-confidence in technical fields (Hughes, 2010). Once in college, female students report feeling more overwhelmed than male students, and “report greater interest in raising a family, while men exhibit a stronger commitment to making a contribution to science” (Sax and Harper, 2007, p. 682). The decision to study a non-STEM field may further limit salary potential in an already disproportionate gender wage gap for females, and limit the pool of qualified STEM graduates.

Furthermore, studies aimed at increasing the presence and participation of Hispanic college students in STEM careers reveal Hispanic women are generally not exposed to careers in STEM. According to Flores (2011), “the general perception is that STEM careers are largely a male-dominated domain…[and] college educated Latinas are
‘hyper-segregated’ into occupations associated with professional versions of ‘carework’ such as sex-segregated fields like teaching and social service jobs” (p. 331). Flores (2011) also reported that most Hispanic families are unaware of the vast number of diverse careers and opportunities available within STEM disciplines, and many Hispanic parents are unaware of how to prepare their children to succeed in these careers.

In addition, common factors affecting college persistence in STEM for Hispanic females include environmental influences. Specifically, the presence of chilly climates and microaggressions in departments within colleges nationwide, as reported by female students in STEM, have alienated many females from STEM fields and college altogether (Camacho & Lord, 2011a; Morris & Daniel, 2008). Microaggressions are “‘verbal, behavioral, or environmental indignities, whether intentional or unintentional, that communicate hostile, derogatory, or negative racial [and sexist] slights and insults toward [women and] people of color’” (Camacho & Lord, 2011a, p. S3H-1). A Hispanic female majoring in engineering shared her experiences of the chilly climate, and explained that when she makes suggestions to her peers during group projects she is often ignored. However, when a male student proposes the same suggestion, others will listen. She stated: “‘Whenever the other guy said the same thing, it would just kinda like, all of a sudden click. I don’t think they do it on purpose, but I guess nothing came out of it. It just –it shows…’” (Camacho & Lord, 2011a, p. S3H-3). Clearly, this student is aware of the gender disparity displayed by her male peers, although she does not articulate it as an injustice (Camacho & Lord, 2011a). In response to these harsh climates, female students have adopted several strategies to cope in STEM departments, including calling out their male peers when they transgress, and/or disengaging from hostile situations altogether
In terms of academic persistence, for many Hispanic females, self-confidence and expectations often take new form as they relate to college STEM courses. Studies have shown that many Hispanic women have described that adapting to the grading curve in STEM courses is key to persistence in college (Camacho & Lord, 2011a). A Hispanic female described her frustrations as a STEM student in college: “’classes are being curved. I just remember…crying to my mom, ‘I’m going to fail! [chuckles]. Hope’s going to be gone! I’ll be home next semester!’ [giggles; joined by others]’” (Camacho & Lord, 2011a, p. S3H-5). Hispanic women in this study agreed that “’learning to fail, learning that you’re not good at everything’” early on in college helped them succeed in STEM (Camacho & Lord, 2011a, p. S3H-5). In many ways, these female students lowered their expectations and subscribed to new academic norms in order to persist in college.

Additional studies have also documented that gender and racial stereotypes contribute to a lack of student academic self-confidence and performance (Steele, 1997), which further reinforce feelings of not belonging in STEM for Hispanic women (Seymour & Hewitt, 1997). In a study by Johnson (2012), perceptions of a positive campus racial climate were revealed to be significant to the overall sense of belonging for Hispanic women and all women of color. The lack of racial and ethnic diversity of professors within STEM departments can be a challenge for many Hispanic students, particularly in PWIs (Johnson, 2012).

**Hispanic Females in Engineering.** Despite the many challenges confronted by Hispanic females in college, this ethnic group has made significant gains in one of the
STEM fields. The professional world of engineering in particular has increased from 4% to 25% in the population of Hispanic female engineers within the last 40 years (Camacho & Lord, 2011b). According to Camacho and Lord (2011b), Hispanic females have higher representation among Hispanic engineers than White females among White engineers. However, the national college enrollment of Hispanic women in engineering majors remains low, and Hispanic males continue to outnumber Hispanic females in the engineering professions. For those Hispanic females majoring in the STEM disciplines today, academic and social engagement patterns in college may be the keys to academic performance and persistence.

Engagement for Hispanic Females in STEM

Mentoring in STEM. Research reveals that the inherent evasion of careers in STEM by women is not solely a consequence of deeply rooted social gender roles, but also partly due to the underrepresentation of female role models, female mentors, and female professors within STEM departments at college institutions throughout the U.S. (Hughes, 2010; Nolan, Buckner, Marzabadi, & Kuck, 2008). Although female students are more likely to be influenced by social relationships such as mentoring (Barrera, 1986), in STEM 62% of males versus 53% of females report receiving help from a professor or mentor during their undergraduate college experience (Nolan et al., 2008). In addition, for females more than males, negative faculty interactions can influence declines in academic self-confidence (Sax, Bryant, & Harper, 2005). In addition, the study by Nolan et al. (2008) revealed that retaining college students in STEM requires exposure to different forms of student engagement, particularly it requires mentoring prior, during, and beyond the undergraduate college years.
Currently, there is no clear operational definition agreed to by scholars that distinctly defines mentoring. However, according to Crisp and Cruz (2009), there are three ways in which researchers agree to the characteristics of mentoring. First, mentoring relationships are focused on growth and accomplishment. Second, the mentoring experience includes assistance with professional and career development, role modeling, and psychological support. And third, mentoring relationships are personal and reciprocal. Many researchers have also agreed that mentoring relationships are not limited to faculty-student interactions, but also include peer interactions and family relationships (Crisp & Cruz, 2009; Zalaquett & Lopez, 2006). For the purpose of this study, mentoring relationships included those with faculty, family, friends, peers, and industry experts.

Studies on Hispanic students have indicated a preference by students for teachers of their own background (Brown, 2008), and upper division Hispanic females are reported to have more help-seeking attitudes than their lower-division Hispanic female counterparts (Gloria et al., 2010). The mere presence of females in an institution can have a positive impact on retention, as Griffith (2010) reported that female and minority students in STEM are more likely to persist at institutions that have a higher percentage of graduate students in STEM who are females and minorities. This is an indication that role models may also serve to ameliorate the chilly STEM environments in higher education institutions today.

In a longitudinal study of Hispanic females at a southwestern university, Bordes-Edgar, Arredondo, Kurpius, and Rund (2011) revealed that Hispanic females who graduated from college reportedly believe to have received more mentoring than
Hispanic female students who dropped out. The study also revealed that female students relied significantly on peer support for persistence, particularly during their first year of college. Over the course of their college careers, “having a mentor or someone on campus who believed in them became a key factor influencing actual persistence” (Bordes-Edgar et al., 2011, 364). However, the race/ethnicity of the mentors was not found to be a significant factor on persistence. Social support systems, specifically peer relationships in this study, also proved to be an integral component for the success of college students, especially for first year students. Bordes-Edgar et al. (2011) found that relationships with mentors from any racial/ethnic background proved to be extremely important to the persistence of Hispanic females majoring in any field, specifically for sophomores, juniors, and seniors.

**Minority and STEM Organizations.** Previous research has revealed that many Hispanic students feel isolated and dissatisfied in college due to lack of cultural congruity (Castellanos & Gloria, 2007). Similar studies of Hispanic students have also revealed a difference in learning styles compared to White students, indicating that Hispanic students “value community and cooperation more than individualism and competition” (Brown, 2008, p. 111). In response to these feelings of isolation and different learning styles of Hispanic students, research has shown that minority student organizations can provide specific advantages in terms of academic and social integration and engagement for students from diverse ethnic backgrounds (Castellanos & Gloria, 2007; Delgado-Romero & Hernandez, 2002; Núñez, 2009). For instance, Hispanic student organizations can help students in the development of self-identity and acculturation in college life (Delgado-Romero & Hernandez, 2002). That is, the integration of cultural activities in
Hispanic student organizations serve to support academic self-confidence and increase student learning for Hispanic college students (Castellanos & Gloria, 2007; Núñez, 2009). According to Castellanos and Gloria (2007), “the key ingredient to produce successful Latino undergraduates is the integration of [culture]” (p. 394), as cultural activities serve to support the academic self-confidence of Hispanic students, and increase student satisfaction and learning (Núñez, 2009). In addition, advisors of minority student organizations serve to help Hispanic students by imparting an appreciation of ethnic cultural heritage while in college (Yang, Byers, Salas, & Salazar, 2009). Harper and Quaye (2007) also revealed that participation in student organizations enhanced student identity.

A study by Delgado-Guerrero, Cherniack, and Gloria (2014) explored the reasons why undergraduate women of color choose to join culturally specific sororities. The study was administered via an online survey to different sororities from four-year public and private, PWIs in the Midwest. Respondents in the study totaled 159 women of color, the majority of which were Hispanic from Hispanic-based sororities. Four themes emerged from this study as reasons why participants joined sororities: 1) Elements of the Sorority, 2) Emphasis on Relationships, 3) Importance of Growth, 4) and Personal Needs. Some of the illustrative statements of these themes by the survey participants include:

I saw great role models that would serve as guidance and network systems to enable me to accomplish my goals.

I found in the sorority, the comfort I needed, the family away from home, the motivation to stay (and graduate) at a predominantly White institution.

The sorority helped me in ‘maintaining structure throughout my college career.’
The authors of this study concluded that culturally specific student organizations are necessary “‘counterspaces,’” which provide students with safe refuge in hostile campus environments (Delgado-Guerrero, Cherniack, & Gloria, 2014, p. 54).

Likely, for minorities and students in STEM, *sense of belonging* is most often fostered in communities of like individuals (Soldner, Rowan-Kenyon, Inkelas, Garvey, & Robbins, 2012; Tinto, 2012). More specifically, professional student organizations designed for underrepresented groups, including the Society of Women Engineers (SWE), Society of Hispanic Professional Engineers (SHPE), and Society of Mexican American Engineers and Scientists (MAES) serve to guide and support Hispanic female students to succeed within the STEM fields (Camacho & Lord, 2011b). Hispanic women in particular “claim that their identity is shaped by ethnicity/culture first, and they are more likely to join engineering societies that offer support to women of color (such as SHPE)” (Camacho & Lord, 2011a, p. S3H-5). In addition, studies have shown that students who are actively engaged in student organizations are more likely to interact with their peers than with students who are not engaged in extra-curricular activities, increasing their academic and social engagement outlets (Pascarella & Terenzini, 2005).

**Peer Interactions.** Studies show that peer interactions are among the most influential factors in college student persistence and degree attainment (Bordes-Edgar et al., 2011; Ost, 2010; Pascarella & Terenzini, 2005). Hurtado, Carter, and Spuler (1996) reported that Hispanic students often cite college peers as their strongest support system in college: “‘the upperclass Latino students took me under their wing academically and socially’” (p. 149). More importantly, building social relationships with fellow ethnic
peers not only provides Hispanic students with a sense of comfort and adjustment in college, but also results in academic achievement (Baker, 2008). Therefore, student organizations and peer interactions combined should contribute to increased student persistence and academic performance for students.

In alignment with research on learning style differences between male and female students (Barrera, 1986; Jones, 2010; Kim & Sax, 2009; Sax & Harper, 2007), additional studies have found that “females are more influenced by their peers than males” (Ost, 2010, p. 931). A study by Ost (2010), which explored the determinants of persistence in physical and life sciences for students in a large elite research university, revealed:

While both males and females benefit from exposure to higher quality peers, the effect is more than twice as large for women as compared to men. A 10% point increase in the propensity scores of one’s peers [to persist] increases the likelihood of a female persisting by 3.70% points compared to only 1.37% points for males. (Ost, 2010, p. 931)

In addition, Ost (2010) found that students who are at risk of failing are more likely to be influenced by their peers to persist through college. Specifically, women, minorities, and low-income students are more likely to be influenced by their peers, as they maintain high attrition rates in college (Ost, 2010).

Peer interactions are not only limited to social engagement within student organizations, but also often involve academic engagement, including intellectual conversation, critical thinking, and time spent studying (Pascarella & Terenzini, 2005). Recent studies of college students in STEM have revealed that successful forms of academic and social engagement include living and learning communities, particularly
for women (Hughes 2010; Tinto, 2012). Hughes (2010) analyzed a group of female engineers in single-sex, living and learning community, and revealed that sharing a living space with peers helps build camaraderie and support networks for students. According to Hughes (2010), if a few female students are seen studying extra hours, more females will join them and put in the same long hours. This is the power of peer influence, which in this case creates a learning environment of positive study habits. Living and learning communities provide social support and encourage productive competition among students. This setting allows students to share their college experience and goals with peers in the same disciplines, and it has proven to be of great advantage, particularly for the success of females in STEM.

**Contrasting Research**

Differing studies on Hispanic students have found that college student persistence is a result of individual study habits. In particular, a study conducted by Zell (2010), which explored subjective student experiences, revealed that *sense of purpose* is the motivating agent behind persistence for Hispanic college students. Through qualitative interviews, Zell (2010) captured the sentiments of a group of 15 Hispanic students attending a predominantly White community college. The interviews revealed that for Hispanic students, college represented an opportunity to make “‘meaningful contributions’” to family, community, and society (Zell, 2010, p. 176). According to Zell (2010), *sense of purpose* represented a desire to achieve academic success, become role models, and serve as a source of motivation for nieces, nephews, friends, and community for the students in this study. Students in the Zell (2010) study stated that they decided not to get involved in extracurricular activities outside of the classroom in order to avoid
becoming distracted and rather remain focused on their studies. Although these students did not spend their free time socializing with their college peers, the study also revealed that these particular Hispanic students did not experience cultural incongruence, which may be typical in predominantly White, four-year institutions. Similarly, González and Ting (2008) reported that many Hispanic undergraduate students do not join student organizations in college due to primary commitments with family. While these findings are specific to community colleges and PWIs, commitment to family is an integral norm within the Hispanic culture and for many Hispanic students (Castellanos & Gloria, 2007; Hurtado, Carter, & Spuler, 1996; Peralta, Caspary, & Boothe, 2013).

**Current Study**

The concern of minority student retention in STEM is not new, and in fact has been a leading topic of conversation in higher education for decades (Franchetti, Ravn, & Kuntz, 2010; Yelamarthi & Mawasha, 2010). Yet today the topic has received heightened awareness, as the rapid pace of expanding technology has created an increased demand and urgency for STEM graduates, particularly minorities (Cardona, 2013; Sununu & Cardona, 2013; Franchetti, Ravn, & Kuntz, 2010; Yelamarthi & Mawasha, 2010). For many Hispanic students, there is great opportunity to emerge from the shadows of lower socioeconomic backgrounds via higher education and the growing careers in STEM. In order to achieve success in STEM, Hispanic students and in particular Hispanic females should develop and maintain mentor relationships throughout their college career (Bordes-Edgar et al., 2011; Gloria et al., 2010; Griffith 2010). The college experience for Hispanic students should also incorporate student engagement activities, such as membership in STEM-related organizations, which resonate with their culture and serve
to support their academic self-confidence (Castellanos & Gloria, 2007; Delgado-Guerrero, Cherniack, & Gloria, 2014; Delgado-Romero & Hernandez, 2002; Núñez, 2009). Hispanics would also benefit from peer interactions to achieve greater academic success in college and in STEM (Hughes, 2010; Hurtado, Carter, & Spuler, 1996; Ost, 2010; Pascarella & Terenzini, 2005; Tinto, 2012).

As the U.S. becomes an increasingly diverse society and the nation builds the future workforce of Hispanic STEM professionals, new research should reflect this change. Current research on student engagement and the retention of Hispanic students in STEM has been limited to the study of community colleges and transfer students, with a focus on freshmen and senior college students alone (Camacho & Lord, 2011b; Malcom, 2010; Tinto, 2007). This study is inclusive of full-time students across all four academic years. Given the dearth of research on minorities in STEM, this study intended to explore the dynamics of student engagement patterns with mentors, STEM-related organizations, and peers for undergraduate Hispanic students majoring in STEM at a public, four-year, commuter, HSI.

**Institution.** Previous studies of Hispanic students have been focused on PWIs. Data for this study were collected via a survey conducted at a public, four-year, HSI located in South Florida. As an “important point of access for Hispanic students in STEM” (Crisp, Nora, Taggart, 2009, p. 939), an HSI was the ideal institution for data collection. Designated as a top-tier research institution with over 50,000 students, this university enrolls the largest number of Hispanic students in the nation, totaling over 24,000 Hispanic students (CollegeXpress, 2013). More specifically, this institution enrolls the largest number of females majoring in STEM in South Florida. The U.S.
Department of Education requires that HSIs have at least a 25% Hispanic, full-time, undergraduate student enrollment, and must have high enrollment of students with financial need (U.S. Department of Education, 2016).

Hispanic Serving Institutions also report the most growth in graduating Hispanic engineers, compared to PWIs (Camacho & Lord, 2011b). Clearly, further exploring HSIs is critical to identify the factors that contribute to the persistence of Hispanic women and the retention of Hispanic college students in STEM. Furthermore, whereas previous research has revealed that student engagement is an important component to the success of students in traditional, four-year PWIs, the student engagement culture may differ at an HSI. This HSI in particular is located in a predominantly Hispanic community in South Florida. Hispanic students enrolled in the HSI may already feel a sense of belonging both in the institution and within the city. The institution is also a commuter school, where student engagement in extra-curricular activities and participation in social organizations may be less likely than in PWIs, due to the limited amount of time students have on a commuter campus.

**Research Questions**

The purpose of this study was to explore student engagement as a factor that predicts academic performance and intention to persist for students. Based on the literature reviewed previously, three forms of student engagement are of particular focus: (1) engagement with mentors, (2) engagement with student organizations, and (3) engagement with peers. Thus, the study proposed to answer the following research questions, as they relate to Hispanics students in STEM, and in particular Hispanic females in STEM, at HSIs:
(1) Does student engagement with mentors significantly predict academic performance and intention to persist?

(2) Does student engagement in STEM-related organizations significantly predict academic performance and intention to persist?

(3) Does student engagement in peer study groups significantly predict academic performance and intention to persist?
Chapter 3: Methods

This chapter will discuss the population of focus for the study, procedures, instruments, variables, power analysis, and data analysis.

Population of Focus

The population of focus was Hispanic students majoring in STEM, in particular Hispanic female students. Hispanic males were briefly analyzed in this study, strictly as a comparison group. The survey sample included undergraduate students enrolled in the College of Engineering and Computing at a public, four-year, HSI in South Florida. STEM majors within the college are as follows: Biomedical Engineering, Civil Engineering, Computer Engineering, Computer Science, Construction Management, Electrical Engineering, Engineering Management, Environmental Engineering, Information Technology, Material Science and Engineering, Mechanical Engineering, Telecommunications and Networking.

During Fall 2013, total undergraduate enrollment in the College of Engineering and Computing was 4,861 students, with 3,016 students enrolled full-time. Hispanic student enrollment in the College of Engineering and Computing was 3,288 and female student enrollment was 815. Approximately 17% of total student enrollment in the College of Engineering and Computing was female. In this study, students of all ethnic/racial backgrounds and gender were encouraged to participate in the survey.

Procedures

The questionnaire for this study was administered via Qualtrics, a web-based survey program. Students enrolled in the College of Engineering and Computing received an email from directors at the Office of Student Access and Success requesting their
participation in the survey. As shown in Appendix A, the email included a link to the questionnaire. Data were collected during the summer of 2015. Participants had one month to complete the online questionnaire. Two email reminders were submitted after the first and second weeks of the original invitation email.

During the Institutional Review Board (IRB) process for this study, the Human Subject Research Office at the University of Miami indicated that drawings are prohibited by an amendment to the Florida game promotion law, which bars not-for-profit entities from conducting sweepstakes and other promotions in which the elements of chance and prize are present. According to the new law, prizes are only allowed if they are divided among everyone who participates and completes the survey. Therefore, due to the potential of over 4,000 students completing in the survey, an incentive for participation was not financially feasible.

**Instruments**

The 35-question survey, as shown in Appendix A, was an adaptation of two surveys from the University of Miami: Graduating Student Survey and Doctoral Exit Survey. The questionnaire was limited to 35 questions to minimize respondent abandonment of the survey (Colton & Covert, 2007). Questions were divided into three sections: 1) Academics and Persistence, 2) Involvement and Mentorship, and 3) Demographics (Appendix A).

**Variables**

**Demographic Variables.** The questionnaire asked participants to indicate demographic information as follows: gender, race/ethnicity, age, parent educational background, and socioeconomic status. For the question on race/ethnicity, participants
were allowed to select all choices that applied from the following selection: American Indian or Alaskan Native, Asian or Asian American, Black or African American, Hispanic or Latino, Native Hawaiian or Other Pacific Islander, White, Anglo, European American, not Hispanic, and Other. Age was used to identify any students under 18 years of age. Participants under 18 were not considered for this study. Parent educational background was asked to determine respondents’ college generation status. The survey also included a question on socioeconomic status, with the following choice selection: upper class, upper middle class, middle class, lower middle class, and lower class.

**Dependent Variables.** The dependent variables were academic performance and intention to persist. *Self-reported student GPA* served as the measure of academic performance and was reported as a continuous variable ranging from 0.0 to 4.0.

Self-reported student GPA is the grade value reported by the college student (as opposed to school reported grades), which is widely used to assess college student academic performance, mostly because it is often the only value researchers can obtain for their study (Caskie, Sutton, & Eckhardt, 2014; Zimmerman, Caldwell, & Bernat, 2002). In higher education, confidentiality policies often deny researchers access to student records, or place many barriers before disclosing official student GPAs. This protocol renders researchers with only one alternative, to simply ask students for their grades. The main concern with self-reported GPAs is their accuracy. A study by Caskie, Sutton, and Eckhardt (2014) revealed that only 50% of study participants self-reported accurate GPAs, while 28% overestimated their GPAs, and 20% underestimated their GPAs. Female students particularly tended to self-report greater GPAs than their actual value. However, the average discrepancy in GPA value was small (M = -.01). Despite the
discrepancy, self-reports highly correlated with the true student GPA (Caskie, Sutton, & Eckhardt, 2014).

A different study by Kuncel, Credé, and Thomas (2005), which reviewed and conducted a meta-analysis summary of previous literature on the validity of self-reported GPA, found that actual levels of school performance and cognitive ability have a strong influence over self-reported grades. The analyses found that the validity of self-reported GPA was relatively high across all samples, particularly college self-reported GPA was more accurate than high school GPA. There were no differences found in self-reported GPA between males and females. The validity of self-reported GPA was also higher for White students than for non-Whites (Kuncel, Credé, & Thomas, 2005). “Results suggest that self-reported grades are reasonably good reflections of actual grades for students with high ability and good grade point averages” (Kuncel, Credé, & Thomas, 2005, p.74).

*Intention to persist* was measured by the following item on the questionnaire: *I intend to graduate from college with a bachelor’s degree in STEM* (Appendix A). The questionnaire item on intention to persist is adapted from the Morrow and Ackermann (2012) study, which surveyed 960 freshmen via an online questionnaire. Morrow and Ackermann measured intention to persist with the statement “‘I will obtain a bachelor’s degree from this university’” using a six-point Likert scale (Morrow & Ackermann, 2012, p. 485). Participants in this study were asked to select from a five-point Likert scale: 1-Strongly disagree, 2-Disagree, 3-Neutral, 4-Agree, and 5-Strongly agree (Appendix A).

*Control Variables.* The two control variables in the analysis included: 1) parent education and 2) socioeconomic status. According to previous research, students who are first-generation college students and students of low socioeconomic status are less likely
to persist in college (Crisp, Nora, & Taggart, 2009; Pascarella & Terenzini, 2005; Renn & Reason, 2013; Tinto, 1988, 1993, 2012). As defined by Pascarella & Terenzini (2005) and to control for first generation college status, students who indicated having at least one parent with a Bachelor’s degree or higher level of education were grouped together, creating the variable for second generation college students. For socioeconomic status, participants who selected upper class, upper middle class, and middle class were grouped together, creating the variable for students of higher socioeconomic status. In order to account for the possible confounding effect between these two variables (parent education and student socioeconomic status), both variables were entered together in the same block of the multiple regression, and only their combined effect will be interpreted.

**Independent Variables.** According to the third and fourth postulates of the Student Involvement Theory (Astin, 1999), student engagement can be quantified. In this study, three independent variables were quantified and examined as predictors of academic performance and intention to persist in STEM: 1) engagement in mentor relationships, 2) engagement in STEM organizations, and 3) engagement in peer study groups. Specifically, the survey instrument measured the amount of time (in hours) invested by students in STEM organizations, the time spent with mentors, and time spent studying with peers, and its effect on academic performance and intention to persist were explored. The response options for the types of mentor relationships in this study, included those with professors, family, friends, peers, industry experts, other.

The survey also included a question on students’ perceptions of their success in college and STEM. Specifically, the survey asked: *What do you perceive to be the most influential factor for your success in STEM at college?* Response options included: 1)
involvement in student organizations, 2) mentoring/advising, 3) studying with peers, and 4) other, please specify. The open-ended option provided an opportunity to explore additional variables affecting student persistence in STEM.

**Hispanic Female dummy code.** This variable was created to assess whether or not Hispanic females versus Hispanic males added to the prediction of GPA and intention to persist, after taking account the model of student engagement.

**Power Analysis**

A priori power analysis was conducted to determine the minimum sample size required for the study using G*Power 3.1 (Faul, Erdfelder, Buchner, & Lang, 2009). An effect size of 0.1, significance level (α) of .05, an acceptable power of .80, and six predictors (parent education, socioeconomic status, engagement in mentor relationships, engagement in STEM organizations, and studying with peers, and Hispanic females) were used to calculate the study sample size. G*Power indicated that the minimum sample size for this study was 98 participants.

**Data Analysis**

Descriptive statistics were used to determine the range of student GPA, frequency of intention to persist in college and in STEM, and hours per week meeting with mentors, engaged in STEM-related student organizations, and studying with peers. Frequency of student perception on the most influential factor for success in STEM was also analyzed, for both male and female Hispanic participants. Pearson Product Moment Correlation Coefficients (r) were used to identify significant correlations among variables, as they related to student GPA. Hierarchical linear regression was then calculated to examine independent and control variables, and examine their effect on student GPA. There was
no variability found for intention to persist as a dependent variable, as most participants
selected *Strongly Agree* to intend to graduate with a degree in STEM. As a result, the
proposed regression model was conducted exclusively on student cumulative GPA as the
dependent variable.

As shown in Figure 1, the Proposed Model of Hierarchical Linear Regression
explored variables in three blocks. In the first block (1) parent education and
socioeconomic status were entered as the control variables. The second block (2)
included hours spent engaged with mentors, hours spent engaged in STEM organizations,
and hours spent studying with peers. The third block (3) examined Hispanic female
respondents exclusively.
Chapter 4: Results

In this chapter, characteristics of the sample are described first, followed by descriptive statistics of the variables. Next, an analysis of Hispanic female student intention to persist in college and STEM is reviewed. Pearson Product Moment Correlation Coefficients are then calculated to identify correlations among variables. Finally, hierarchical linear regression is conducted to examine all variables. The data collected in this study was analyzed using the Statistical Package for the Social Sciences (SPSS), Version 22.0 (IBM Corp., 2013).

Sample Characteristics

A total of 123 students from the College of Engineering and Computing at the HSI participated in the survey. As shown in Table 1, demographics for the sample population ($n = 123$) included 49 females, 73 males, and 1 other for gender; 1% American Indian or Alaskan Native, 7% Asian or Asian American, 10% Black or African American, 74% Hispanic or Latino, 19% White Anglo/European American/not Hispanic, and 1% Other. Survey respondents included 91 Hispanics/Latinos, represented by 39 Hispanic females (Table 1). The sample of Hispanic female students was comprised of 3% freshmen, 21% sophomores, 42% juniors, and 34% seniors. Full-time enrollment for Hispanic female students was represented at 87% and part-time enrollment was represented at 13%. The most popular major among Hispanic females was Mechanical Engineering represented at 28%, followed by Biomedical Engineering represented at 21%, and Civil Engineering represented at 18%. Computer Engineering and Information Technology majors were represented at 10% each, followed by Computer Science majors.
represented at eight percent. Environmental Engineering majors and Telecommunications and Networking majors were represented at 3% each.

There was missing data for some of the responses in the questionnaire. However, the number was small, as the valid sample was 77 out of 91 Hispanic students. As a result, the default option in SPSS was utilized, thus excluding the data listwise.

**Descriptive Statistics**

As shown in Table 2, the mean cumulative GPA for Hispanic female students was 3.20 ($SD = 0.57$) with a minimum value of 2.0 GPA and a maximum value of 4.0 GPA. Student engagement was measured by hours and reported as a weekly mean for Hispanic female students. The mean hours spent engaged by Hispanic female students meeting/talking with their primary mentor was 3.54 ($SD = 5.35$), with time ranging between 0 and 20 hours. The mean time spent engaged in STEM-related organizations was 2.78 hours ($SD = 5.77$), with time ranging between 0 and 30 hours. Hispanic female respondents reported a mean of 5.32 hours ($SD = 5.68$) engaged studying/preparing for class with peers, with time ranging between 0 and 25 hours. For Hispanic men, as shown in Table 2.1, the mean cumulative GPA was 3.07 ($SD = 0.57$), the mean hours spent engaged with their primary mentor was 4.09 ($SD = 5.69$), the mean time spent engaged in STEM-related organizations was 3.32 hours ($SD = 6.30$), and the mean hours spent engaged studying/preparing for class with peers was 5.77 hours ($SD = 6.33$).

In response to the single most influential factor for their success in the STEM, a total 45% of Hispanic female students reported “studying with peers” (Table 3). Twenty-three percent (23%) of Hispanic females indicated “mentoring/advising” as the most influential factor for their success in STEM, 16% selected “involvement in student
organizations,” and 16% of Hispanic women selected “other” (Table 3). For Hispanic men, as shown in Table 3.1, a total of 35% reported “studying with peers,” and 35% selected “other” as the most influential factor to their success in STEM. Eighteen percent (18%) of Hispanic males indicated “involvement in student organizations,” and 12% indicated “mentoring/advising” as the factor for their success in STEM.

As shown in Table 4, open-ended responses to the question on the most influential factor for success in STEM for Hispanic females specifically, included “myself,” “personal ambition and dedication,” and “studying from different textbooks.” The same question had a variety of open responses from survey participants: “hard work,” “study independently,” “working as an intern,” “inclination to study and persevere in difficult subjects,” “having the resources to study without worry (a quiet place, money to get food, etc.),” “extensive preparation,” and “personal drive to succeed.”

**Analysis of Intention to Persist for Hispanic Females**

An analyses of the 39 Hispanic female respondents was conducted to review the frequency of intention and confidence to persist in college and in STEM. Results showed that 92% of Hispanic females indicated “strongly agree” for intention to graduate with a bachelor’s degree (Table 5), and 85% indicated “strongly agree” for intention to graduate with a bachelor’s degree in STEM (Table 6). The descriptive statistics for confidence to persist was similar, with 82% of Hispanic females selecting “strongly agree” to being confident to graduate with a bachelor’s degree (Table 7), and 76% selecting “strongly agree” to being confident to graduate with a bachelor’s degree in STEM (Table 8). These results showed that there was low variability for intention to persist and for confidence to persist in college and in STEM for Hispanic women. As a result, student GPA was the
only outcome variable measured in the next phase of the study, which included Pearson Product Moment Correlations and Hierarchical Linear Regression.

**Pearson Product Moment Correlations**

Pearson Product Moment Correlation Coefficients were computed to identify significant correlations among variables in the regression model (Figure 1). As shown in Table 9, there was a positive and significant correlation between parent education and cumulative GPA \((r = .24, p < .05)\), indicating that students whose parents (at least one parent) had a college education, reported higher cumulative GPAs. The same positive and significant correlation was found between socioeconomic status and cumulative GPA \((r = .24, p < .05)\), indicating that students with higher socioeconomic status reported higher cumulative GPAs. A negative and significant correlation was found between hours spent meeting with mentors and cumulative GPA \((r = -0.24, p < .05)\), indicating that students who spent more time engaged with mentors reported having lower cumulative GPAs. There was a positive and significant correlation found between hours spent engaged in STEM organizations and cumulative GPA \((r = 0.22, p < .05)\), indicating that students with more hours spent engaged in STEM organizations, reported higher cumulative GPAs. There was no significant correlation found between hours spent studying with peers and cumulative GPA; and no significant correlation found between Hispanic females and cumulative GPA.

**Hierarchical Linear Regression Analysis**

The Hierarchical Linear Regression model examined a set of three blocks, for the 91 Hispanic student participants: (1) the control variables of parent education and socioeconomic status; (2) the student engagement variables of hours spent engaged with
mentors, in STEM organizations, and studying with peers; (3) the Hispanic female respondent dummy code. As shown in Table 10, Block 1 of the multiple regression was significant ($\Delta R^2 = .08, F(2, 74) = 3.30, p = .04$), indicating that parent education and socioeconomic status significantly contributed to GPA. However, when examining the coefficients of these variables, neither parent education ($\beta = 0.17, p > .05$) nor socioeconomic status ($\beta = 0.18, p > .05$) were significant, indicating that only the linear combination of these variables contributed to the model. All variables in Block 2 explained a significant variance in cumulative student GPA, ($R^2 = .20$, adjusted $R^2 = 0.14$, $\Delta R^2 = .12, F(5, 71) = 3.55, p = .006$). More specifically, the variables in Block 2 accounted for 20% total variance in student GPA. In Block 2, hours spent meeting with mentors was a significant, yet negative predictor of student cumulative GPA ($\beta = -0.3, p < .01$). Cumulative student GPA was lower for students who spent more hours engaged with mentors. The variables of hours spent engaged in STEM organizations and hours spent studying with peers were found not to be significant in Block 2. Finally, model 3 was significant ($F(6, 70) = 3.20, p = .008$), however, no additional variance in GPA was explained by being a Hispanic female in Block 3, $\Delta R^2 = .02, p = .25$. 
Chapter 5: Discussion

This study proposed to answer three research questions in relation to student engagement for students in STEM, in particular for Hispanic women, enrolled at a Hispanic Serving Institution: (1) Does engagement with mentors significantly predict GPA and intention to persist? (2) Does engagement in STEM-related organizations significantly predict GPA and intention to persist? (3) Does engagement in peer study groups significantly predict GPA and intention to persist? The findings of this study are interpreted in the context of participants attending a Hispanic Serving Institution in South Florida.

The demographics of survey participants were not representative of the national statistics and trends in higher education and STEM. In this study, the survey population included 49 females and 73 males, revealing that approximately 40% of participants were female, a statistic close to the 35% of female students that graduate from college with a bachelor’s degree in STEM on a national level (U.S. Department of Education, National Center for Education Statistics, 2015a). In contrast, 39 Hispanic females participated in the survey, representing approximately 32% of the survey population and far exceeding the 3% of Hispanic females graduating from college with degrees in STEM (U.S. Department of Education, National Center for Education Statistics, 2015a). The goal in higher education is to retain the percentage of these females and Hispanics currently majoring in STEM, particularly at HSIs where they are more likely to enroll and succeed.

Study findings revealed no positive relationships between student engagement and academic performance, after controlling for socioeconomic status and first generation college students. The only significant relationship in the multiple regression analysis was
a negative relationship between time spent engaged with mentors and cumulative GPA for both male and female Hispanic students. In this relationship, student cumulative GPA began to decline in cases where students indicated spending more hours on average per week meeting/talking with their mentors. The Hispanic female participant response range for this question was between zero to 20 hours per week. It can be argued that this finding is congruent with Astin’s (1999) Theory of Student Involvement, which states that there are limits to student involvement, and students who exhibit an excess of involvement may become overwhelmed in college. The maximum amount of hours per week spent engaged with mentors, as reported by Hispanic females in this study, is equivalent to working in a part-time job. Twenty hours per week on average engaged with mentors might exceed, and perhaps interfere, with individual student study time. On average, Hispanic male students reported more time spent engaged in with mentors, in STEM organizations, and with peers, than that of their female counterparts. Yet, the average cumulative GPA for Hispanic male students was lower than the Hispanic female average GPA. It can be interpreted that student grades, for both male and female Hispanic students may be suffering as a result of an excess of involvement, especially for students with 2.0 GPAs and below. However, it may also be the case that these students are spending an increased amount of time with mentors as a result of their failing grades.

While Pearson Product Moment Correlation Coefficients indicated a positive and significant relationship between student hours spent engaged in STEM organizations and cumulative GPAs, the regression analysis found no significant relationship between STEM organizations and academic performance for Hispanic students after controlling for socioeconomic status and first generation college student status. These findings were
incongruent with previous research, which states that STEM organizations serve to guide and support the success of Hispanic female students within the STEM fields (Camacho & Lord, 2011b). Yet, there are a few elements specific to HSIs which may contradict previous research on student engagement in STEM organizations. Primarily, many Hispanic students attending HSIs may not feel as compelled to join minority or STEM associations as students enrolled at PWIs because they may already have an established network of friends and/or peers from similar race/ethnic backgrounds attending the same institution, and therefore do not feel a lack of cultural congruity. Furthermore, the HSI in this study is mainly a commuter school enrolling students who, for the most part, live at home with their families. Students attending this HSI may receive support at home, whereas many minority students attending PWIs seek the support of a family away from home, by joining minority organizations (Delgado-Guerrero, Cherniack, & Gloria, 2014). The surrounding community of this HSI is also primarily Hispanic, adding to the sense of belonging, inside and outside the classroom for these students. As a result, student engagement in HSIs and commuter schools may not be as high as in PWIs. The HSI in this study is also a growing institution with many newly established departments, as well as new student organizations and clubs, which may take time to cultivate as the norm for these college students.

Hierarchical linear regression indicated no significant relationship between peer study groups and cumulative GPA, for all Hispanic students. However, frequency results for Hispanic female students revealed that 45% perceived studying with peers as the most influential factor to their success in STEM (Table 3). Similarly, 35% of Hispanic males indicated studying with peers as the most influential factor to their success in STEM
In addition, 35% of Hispanic males indicated “other” as the most influential factor to their success in STEM (Table 3.1). This finding was congruent with previous research on Hispanic students citing peer relationships as their greatest support system in college (Hurtado, Carter, & Spuler, 1996). While there was no correlation found between academic performance and studying with peers, Hispanic female students in particular, seem to acquire a heightened sense of confidence and success through peer relationships, rather than academic achievement.

Additional factors cited by survey participants as influential to their success in STEM, had an emphasis on student grit - a positive, non-cognitive personality trait based on passion and perseverance to achieve long-term goals (Duckworth et al., 2007). Open responses included: “hard work,” “effort,” “working as an intern,” “inclination to study and persevere in difficult subjects,” “personal ambition and dedication,” “extensive preparation,” and “personal drive to succeed” (Table 4). These responses reveal that students acknowledge the difficulty of STEM courses, and the understanding that perseverance is an essential component to succeed in the STEM disciplines. Open responses also revealed an awareness and appreciation for resources: “studying at home,” “having the resources to study without worry (a quiet place, money to get food, etc.),” and “studying from different text books” (Table 4). These responses support previous empirical research on the persistence challenges of students from low socioeconomic backgrounds (Renn & Reason, 2013; Tinto 1993). Whether enrolled in a Hispanic Serving Institution or a predominantly White institution, students with limited resources confront a list of challenges to gain an upper hand in higher education. Ultimately, family background and socioeconomic status, as pre-entry attributes according to Tinto (1988),
and as factors of precollege environments according to Astin (1977), have significant influence on college student persistence.

**Limitations**

The findings of this study are pertinent to students attending HSIs, and not necessarily to students enrolled in PWIs. As a limitation of this study, findings should not be generalized to the larger population. Specifically, HSIs enroll a larger percentage of Hispanic students than PWIs. In addition, HSIs can be different from traditional four-year institutions in terms of not only demographics, but also in the types of student organizations and extracurricular activities on campus based on student culture.

A second limitation of this study was the small number of survey participants, particularly the 39 Hispanic female respondents, which limited data analysis options. Due to low survey participation by Hispanic females, a hierarchical linear regression model was conducted with responses from male and female students, totaling 91 respondents. Thus, it is possible that the insignificant findings regarding the relation between participation in STEM organizations and GPA, and the relation between involvement with peers and GPA, resulted from low power as opposed to the fact that there really is no relation among these respective variables.

A third limitation of this study is found in the email letter to survey participants. The letter explains that the purpose of the survey is to conduct “research on the success factors of undergraduate students in science, technology, engineering, and mathematics (STEM)” (Appendix A). The phrase “success factors” expresses a demand characteristic that may have led to response bias. Specifically, the phrase may have limited survey
participation to students who believe they are successful, and perhaps alienated potential participants who may not deem to have yet achieved success.

Social desirability bias is also a limitation of this study. Specifically, respondents who participated in the survey may have overestimated and/or underestimated the amount of time they spent engaged in mentor relationships, STEM organizations, and in peer interactions. Social desirability bias is a limitation for studies with self-reported surveys, because respondents may answer questions in a manner that will be viewed favorably by others.

Another limitation of this study is the broad definition of mentor relationships. As defined in this study, mentor relationships included relationships with professors, family, friends, peers, and STEM experts. This limits the interpretations of the findings in terms of distinguishing between academic and familial mentor relationships.

The aggregate classification of survey participants may also have led to a response bias in the study. This contributes to the low variability of the confidence to persist in STEM variable and further limits the interpretation of the findings. That is, student confidence should increase gradually in college, explaining why most of the survey participants, being juniors and seniors, were very confident.

**Implications for Practice**

According to Astin’s (1999) Theory of Student Involvement, specifically the fourth postulate, student development is directly proportional to the quantity and quality of involvement by the student. Therefore, as it relates to this study, students who reported spending increased amounts of time with mentors and had lower cumulative GPAs, should question the level of effectiveness of the mentoring taking place. According to
Crisp and Cruz (2009), mentor relationships should be centered on growth and accomplishment. Yet for survey participants in this study, academic accomplishment decreased despite spending time with their mentors. Depending on the relationships, it may be that participants in this study were not receiving quality guidance on their academics. Many survey participants listed their family, friends, and/or peers as their mentors, all who qualify as mentors, but may not necessarily be equipped with the expertise of a professional to provide appropriate guidance in the STEM disciplines. Likely, previous studies support the concept of exposure to “higher quality peers” to be beneficial for male and female students (Ost, 2010, p. 931). Therefore, it can be surmised that the key to productive mentoring is in distinguishing between professional mentor relationships measured on academic growth versus personal mentor relationships measured on emotional growth. Students should aim to grow both professionally and personally through mentor guidance and support. Most importantly, maintaining a balance between academic and emotional growth is essential to gain confidence and persist in college.

Higher education institutions across the country have implemented Learning Assistant Programs, whereby undergraduate students (often in STEM) provide support for student learning in interactive classroom settings. Based on this study’s findings, particularly peer-relationships being perceived as the single most influential factor to student success in STEM, higher education administrators should consider expanding their Learning Assistant Programs to allow both the assistant and the student increased opportunities for academic and personal growth. Furthermore, based on the amount of time spent by survey participants with mentors, both academic and familial, higher
education administrators may consider conducting study groups to include faculty and parents. Study group sessions would include discussions on how to lead effective mentoring sessions with students, and sharing successful study habits and opportunities for students in STEM.

Previous studies have revealed that cultural activities can increase self-confidence for Hispanic students in PWIs (Delgado-Romero & Hernandez, 2002). However, the self-identity and acculturation process may involve a different approach for Hispanics students at HSIs. Hispanic Serving Institutions are not representative of the traditional college student population, and as a result, findings from this study do not translate to PWIs. In an HSI, where the Hispanic culture is naturally ingrained within the college environment, cultural activities and student/STEM organizations may not be as greatly sought after by Hispanic students as in PWIs. Student engagement on average may be lower in HSIs, and even more so in commuter HSIs because students go home to their families at the end of the day. In addition, this study focused on a single HSI in South Florida, which may be unique to other HSIs across the country. For instance, the prevalent cultures in the HSI for this study are Cuban-American and South American, whereas HSIs across the country may have a greater prevalence of Mexican-American students. While each of these cultural subgroups is Hispanic, each subgroup possesses significant differences in terms of social and cultural capital. These differences create a diverse range of needs for the Hispanic student population, which do not translate to all HSIs nor to PWIs. Ultimately, the diverse range of needs affect the persistence of Hispanic college students.
In consideration of the wide range of needs for each cultural subgroup and individual students, college advisors at HSIs in particular, should be well-versed on the different Hispanic cultures to better understand the Hispanic student. College advisors and administrators should also plan creative events that would engage Hispanic students to stay on campus and interact with their peers outside of the classroom, particularly at commuter schools. Perhaps student retreats and/or trips on weekends may further engage Hispanic college students to join and participate in clubs and organizations.

As it relates to college persistence, the self-confidence of females in STEM, has long been a concern in higher education (Camacho & Lord, 2011a; Hughes, 2010; Morris & Daniel, 2008; Steele, 1997). Yet in this study, Hispanic females in STEM reported high scores for survey questions on confidence and intention to persist in college and in STEM, ranging between 76%-92% on the “strongly agree” choice selection. Clearly, Hispanic female respondents are confident both in college and in STEM. These findings do not align with previous research on females lacking academic self-confidence (Camacho & Lord, 2011a; Hughes, 2010; Steele, 1997) and having feelings of not belonging in STEM (Seymour & Hewitt, 1997). However, more recent research on college students, describes Millennials as a highly confident and high achieving generation (Wilson & Gerber, 2008). Kokkelenberg and Sinha (2010) found that for female students, having more females in a class increased their confidence and comfort levels, resulting in increased academic achievement. The same can be argued for female students attending Hispanic Serving Institutions, where peers from similar cultures help to create familiar environments, and in turn increase student confidence. In addition, as students progress through college, they gradually increase in knowledge and confidence,
which was revealed, as most participants in this study were juniors and seniors in college.

Griffith (2010) reported that college persistence for minority students in STEM and females in particular, increases when there are higher numbers of STEM graduate students, also females and minorities. This finding indicates that familiarity within the college environment, specific to peers of the same backgrounds, positively impacts persistence for minorities and females. In alignment with this finding, results from this study revealed that Hispanic female students in STEM who are enrolled in an HSI with peers of similar backgrounds report high percentages for intention to persist. Specifically, 85% of Hispanic females in STEM reported “strongly agree” to intention to persist in STEM, and 92% reported “strongly agree” to intention to persist in college. Ultimately, peer interactions and relationships, in combination with being enrolled in an HSI, have a positive effect on Hispanic students.

**Recommendations for Future Research**

Identifying the factors that contribute to the academic achievement and persistence of Hispanic college females in STEM is critical in increasing the representation of all Hispanic students in STEM. Based on this study’s findings, future research should analyze how mentor and peer relationships help shape and/or strengthen the self-confidence of college students. Students who are more confident are more likely to persist when confronted with the rigors of college. In this study, Hispanic females in STEM were extremely confident and peer relationships were important to students. Likely, previous studies have demonstrated that peer relationships are of strong influence to college students (Hurtado, Carter, & Spuler, 1996). As a result, higher education practitioners should consider designing mentor programs that are led by students. That is,
older classification of students could mentor younger students. This may result in increased confidence and engagement both for the student/mentor and student/mentee. Moreover, future studies should examine the effects of academic versus personal mentor relationships on college students. Specifically, for HSIs across the country, higher education practitioners may consider implementing programs where faculty and family members have an opportunity to meet throughout the academic year to discuss best mentoring practices and demonstrated outcomes. This is due to the strong family relationships that prevail for many Hispanics students and their parents and siblings.

Future research should also seek to discover new factors which contribute to student success. Specifically, new studies may ask students to define what success in college means to them. For decades, studies have evaluated academic performance and persistence as measures to student achievement. Considering the different factors that students regard as important to their success may assist higher education professionals in designing innovative support programs for college students. Students today may rely more on the support of family and friends than college students of previous generations. Parental involvement may be key to the success of students, even at the college level. Therefore, maintaining a healthy balance between academics and personal relationships may be more important for today’s college students, particularly Hispanic students. In addition, for some students, receiving a “C” in a course and maintaining good family and peer relationships equates to success. It may be that receiving straight A’s in college courses is not the main goal for all students.

Based on findings from this study, future research on Hispanic students in STEM should focus on the relationship between individual student grit, the quality of family
relationships, and persistence. Contrasting research on student engagement has revealed that Hispanic students did not engage in college student activities because their *sense of purpose* guided them to study independently from peers and student organizations (Zell, 2010). Previous studies also revealed that Hispanic students did not engage with mentors and peers, nor in student organizations due to time and primary commitments to family (González & Ting, 2008). It would be interesting to explore the additional activities which Hispanic students are engaging in while attending an HSI, particularly as HSIs enroll, retain, and graduate more Hispanic students than any other colleges and universities in the country. These activities may include sports and other extra-curricular clubs and interests, which may contribute to the retention and persistence of Hispanic college students in general.

In conclusion, as supported by previous studies and theorists, the way in which students spend their time is extremely important to their success in college (Astin, 1999; Delgado-Romero & Hernandez, 2002; Gonzales, 2012; Tinto 1993, 2012). Yet, student engagement is different for every student (Astin, 1999), and there is no universal formula which will ensure that every student will succeed in STEM or college. Each student arrives to college with different sets of characteristics and backgrounds, which will uniquely influence their college experience. Every college environment will differ in culture, practices, and activities. Therefore, every college student should receive individual counseling and academic guidance to ensure emotional stability, as well as to track progress toward graduation. As proposed by Tinto (2012), retention strategies should be a coordinated effort across institutional departments, from assessing the right student fit for the college culture (Admissions), to setting clear expectations and
providing academic support (Academics), to providing complementary student
engagement activities and a trusting environment (Student Affairs), to providing financial
support (Financial Aid), whereby students feel welcomed and supported from the onset of
and throughout their college careers. For Hispanics and females in STEM in particular,
all of these factors combined are important for success in college (Astin, 1999; Kuh,
2010; Tinto, 2012). College campuses are more diverse today than previously in the
history of higher education, and research should continue to explore and document these
changes in order to address the needs of an ever changing student population and society.
References


Table 1.

Frequency of Sample by Gender, Race/Ethnicity, Classification, Enrollment and Major

<table>
<thead>
<tr>
<th>Variable</th>
<th>Hispanic Females $(n = 39)$</th>
<th>Sample $(n = 123)$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$n$</td>
<td>%</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>39</td>
<td>100</td>
</tr>
<tr>
<td>Male</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Race/Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>American Indian or Alaskan Native</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Asian or Asian American</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Black or African American</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hispanic or Latino</td>
<td>39</td>
<td>100</td>
</tr>
<tr>
<td>White, Anglo, European American; not Hispanic</td>
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<td>5</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Classification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freshmen</td>
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<td>3</td>
</tr>
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<td>Sophomore</td>
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<td>21</td>
</tr>
<tr>
<td>Junior</td>
<td>16</td>
<td>42</td>
</tr>
<tr>
<td>Senior</td>
<td>13</td>
<td>34</td>
</tr>
<tr>
<td>Enrollment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full-time Student</td>
<td>34</td>
<td>87</td>
</tr>
<tr>
<td>Part-time Student</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>Major</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biomedical Engineering</td>
<td>8</td>
<td>21</td>
</tr>
<tr>
<td>Civil Engineering</td>
<td>7</td>
<td>18</td>
</tr>
<tr>
<td>Computer Engineering</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Computer Science</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Construction Management</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Electrical Engineering</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Engineering Management</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Environmental Engineering</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Information Technology</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Material Science and Engineering</td>
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<td>0</td>
</tr>
<tr>
<td>Mechanical Engineering</td>
<td>11</td>
<td>28</td>
</tr>
<tr>
<td>Telecommunications and Networking</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Table 2.

**Descriptive Statistics of Hispanic Female Student Engagement and GPA**

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumulative GPA</td>
<td>3.20</td>
<td>0.57</td>
<td>2</td>
<td>4</td>
<td>38</td>
</tr>
<tr>
<td>Hours per week meeting with mentor</td>
<td>3.54</td>
<td>5.35</td>
<td>0</td>
<td>20</td>
<td>37</td>
</tr>
<tr>
<td>Hours per week in STEM-related organizations</td>
<td>2.78</td>
<td>5.77</td>
<td>0</td>
<td>30</td>
<td>37</td>
</tr>
<tr>
<td>Hours per week studying with peers</td>
<td>5.32</td>
<td>5.68</td>
<td>0</td>
<td>25</td>
<td>38</td>
</tr>
</tbody>
</table>

Valid n (listwise) 35

Table 2.1

**Descriptive Statistics of Hispanic Male Student Engagement and GPA**

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumulative GPA</td>
<td>3.07</td>
<td>0.57</td>
<td>2</td>
<td>4</td>
<td>52</td>
</tr>
<tr>
<td>Hours per week meeting with mentor</td>
<td>4.09</td>
<td>5.69</td>
<td>0</td>
<td>20</td>
<td>54</td>
</tr>
<tr>
<td>Hours per week in STEM-related organizations</td>
<td>3.32</td>
<td>6.30</td>
<td>0</td>
<td>30</td>
<td>53</td>
</tr>
<tr>
<td>Hours per week studying with peers</td>
<td>5.77</td>
<td>6.33</td>
<td>0</td>
<td>28</td>
<td>53</td>
</tr>
</tbody>
</table>

Valid n (listwise) 49

Table 3.

**Frequency of Hispanic Female Student Perception of Most Influential Factor for Success in STEM**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mentoring/advising</td>
<td>9</td>
<td>23</td>
</tr>
<tr>
<td>Involvement in student organizations</td>
<td>6</td>
<td>16</td>
</tr>
<tr>
<td>Studying with peers</td>
<td>17</td>
<td>45</td>
</tr>
<tr>
<td>Other</td>
<td>6</td>
<td>16</td>
</tr>
<tr>
<td>Total</td>
<td>38</td>
<td>100</td>
</tr>
</tbody>
</table>
Table 3.1

*Frequency of Hispanic Male Student Perception of Most Influential Factor for Success in STEM*

<table>
<thead>
<tr>
<th>Measure</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mentoring/advising</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Involvement in student organizations</td>
<td>9</td>
<td>18</td>
</tr>
<tr>
<td>Studying with peers</td>
<td>18</td>
<td>35</td>
</tr>
<tr>
<td>Other</td>
<td>18</td>
<td>35</td>
</tr>
<tr>
<td>Total</td>
<td>51</td>
<td>100</td>
</tr>
</tbody>
</table>
Table 4.

*Open Responses of Student Perception of Most Influential Factor for Success in STEM*

Survey Question No. 27: What do you perceive to be the most influential factor for your success in STEM at college?

<table>
<thead>
<tr>
<th>Factor</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard Work</td>
<td>Effort</td>
</tr>
<tr>
<td>Myself*</td>
<td>Study independently</td>
</tr>
<tr>
<td></td>
<td>Working as an intern</td>
</tr>
<tr>
<td></td>
<td>Inclination to study and persevere in difficult subjects</td>
</tr>
<tr>
<td></td>
<td>Studying at home</td>
</tr>
<tr>
<td>Personal ambition and dedication*</td>
<td>I don't know</td>
</tr>
<tr>
<td></td>
<td>Having the resources to study without worry (a quiet place, money to get food, etc.)</td>
</tr>
<tr>
<td></td>
<td>Individual study</td>
</tr>
<tr>
<td></td>
<td>Genuine interest</td>
</tr>
<tr>
<td></td>
<td>Yourself and God</td>
</tr>
<tr>
<td></td>
<td>My father</td>
</tr>
<tr>
<td></td>
<td>Helping us get jobs</td>
</tr>
<tr>
<td></td>
<td>High School programming background</td>
</tr>
<tr>
<td></td>
<td>Personal drive</td>
</tr>
<tr>
<td>Studying from different text books*</td>
<td>All of the above*</td>
</tr>
<tr>
<td></td>
<td>Mentoring and studying alone and with peers</td>
</tr>
<tr>
<td></td>
<td>Extensive preparation</td>
</tr>
<tr>
<td></td>
<td>Personal research</td>
</tr>
<tr>
<td></td>
<td>Research/STEM Societies</td>
</tr>
<tr>
<td></td>
<td>Family support</td>
</tr>
<tr>
<td></td>
<td>Internships/research program</td>
</tr>
<tr>
<td></td>
<td>My determination</td>
</tr>
<tr>
<td></td>
<td>Studying alone</td>
</tr>
<tr>
<td></td>
<td>Focusing</td>
</tr>
<tr>
<td></td>
<td>Studying, classes, independent projects</td>
</tr>
<tr>
<td></td>
<td>Studying</td>
</tr>
<tr>
<td></td>
<td>Personal drive to succeed. Military background.</td>
</tr>
<tr>
<td></td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>Personal growth</td>
</tr>
</tbody>
</table>

Note: *Hispanic female student responses*
Table 5.

*Frequency of Hispanic Female Intention to Graduate with a Bachelor's Degree*

<table>
<thead>
<tr>
<th>Measure</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly disagree</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Agree</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Strongly agree</td>
<td>36</td>
<td>92</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>39</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Table 6.

*Frequency of Hispanic Female Intention to Graduate with a Bachelor's Degree in STEM*

<table>
<thead>
<tr>
<th>Measure</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly disagree</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Neutral</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Agree</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Strongly agree</td>
<td>33</td>
<td>85</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>39</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Table 7.

*Frequency of Hispanic Female Confidence to Graduate with a Bachelor's Degree*

<table>
<thead>
<tr>
<th>Measure</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly disagree</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Neutral</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Agree</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>32</td>
<td>82</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>39</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
Table 8.

*Frequency of Hispanic Female Confidence to Graduate with a Bachelor's Degree in STEM*

<table>
<thead>
<tr>
<th>Measure</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly disagree</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Neutral</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Agree</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>30</td>
<td>76</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>39</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 9.

*Pearson Product Moment Correlation Coefficients among Variables in Proposed Model*

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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<tr>
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<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.35**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.12</td>
<td>-0.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0.09</td>
<td>0.12</td>
<td>0.08</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0.15</td>
<td>0.2*</td>
<td>0.24*</td>
<td>0.39**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>0.17</td>
<td>-0.01</td>
<td>0.03</td>
<td>-0.05</td>
<td>-0.01</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>0.24*</td>
<td>0.24*</td>
<td>-0.24*</td>
<td>0.22*</td>
<td>0.15</td>
<td>0.13</td>
</tr>
</tbody>
</table>

Note. 1. Parent Education, 2. Socioeconomic Status, 3. Hours meeting with mentor, 4. Hours in STEM-related organizations, 5. Hours studying with peers, 6. Hispanic females, 7. Cumulative GPA; * $p < .05$; ** $p < .01$
### Table 10.
Hierarchical Linear Regression Analysis for Proposed Model

<table>
<thead>
<tr>
<th>Variable</th>
<th>Block 1</th>
<th>Block 2</th>
<th>Block 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$b$</td>
<td>SE</td>
<td>$\beta$</td>
</tr>
<tr>
<td>Constant</td>
<td>2.89**</td>
<td>0.1</td>
<td>2.69</td>
</tr>
<tr>
<td>1</td>
<td>0.2</td>
<td>0.14</td>
<td>0.17</td>
</tr>
<tr>
<td>2</td>
<td>0.2</td>
<td>0.14</td>
<td>0.18</td>
</tr>
<tr>
<td>3</td>
<td>-0.03**</td>
<td>0.01</td>
<td>-0.3</td>
</tr>
<tr>
<td>4</td>
<td>0.02</td>
<td>0.01</td>
<td>0.18</td>
</tr>
<tr>
<td>5</td>
<td>0.01</td>
<td>0.01</td>
<td>0.1</td>
</tr>
<tr>
<td>6</td>
<td>0.1</td>
<td>0.12</td>
<td>0.12</td>
</tr>
</tbody>
</table>

$\Delta R^2$ | 0.08 | 0.12 | 0.02 |
$F(\Delta R^2)$ | 3.3* | 3.5* | 1.33 |
$df_1$ | 2 | 3 | 1 |
$df_2$ | 74 | 71 | 70 |
$F$ | 3.3* | 3.55** | 3.2** |
$df_1$ | 2 | 5 | 6 |
$df_2$ | 74 | 71 | 70 |
$R$ | 0.29 | 0.45 | 0.46 |
$R^2$ | 0.08 | 0.2 | 0.22 |
Adjusted $R^2$ | 0.06 | 0.14 | 0.15 |

Note. 1. Parent Education, 2. Socioeconomic Status, 3. Hours meeting with mentor, 4. Hours in STEM-related organizations, 5. Hours studying with peers, 6. Hispanic females; * $p < .05$; ** $p < .01$
Figure 1

Proposed Model for Hierarchical Linear Regression
Appendix A

Email Letter

Dear Participant:

My name is Maria Vaca and I am a doctoral candidate at the University of Miami, conducting research on the success factors of undergraduate students in science, technology, engineering, and mathematics (STEM).

I would like to invite you to participate in a survey designed for students in the STEM disciplines. This questionnaire will collect data on student academics, involvement and mentorship, and demographics. Your honest responses are greatly appreciated, as information collected will be used to enhance the college experience for students.

Your participation and responses in this survey are confidential and used strictly for the purpose of this study. Your responses are anonymous and all data will be stored in a password-protected computer.

There are no risks involved in your participation and you will not benefit directly from participating in this research. Your participation is voluntary. You can decline to participate, and you can stop your participation at any time, if you wish to do so, without any negative consequences to you.

The average time to complete the questionnaire is 10-15 minutes. You can access the survey online at www.umiami.qualtrics.com.

If you would like additional information on this study, please feel free to contact me at m.vaca@umiami.edu. If you have questions regarding your rights as a research participant, contact the University of Miami, Human Subject Research Office at (305) 243-3195.

Sincerely,

Maria E. Vaca
Doctoral Candidate
University of Miami

cc:

Dr. Debbiesiu Lee, Associate Professor, Department of Educational & Psychological Studies
Survey of Undergraduate Student Engagement

Directions: Please select only one answer for each question, unless instructed differently. Take your time in completing the questionnaire and answer all questions honestly. (Please note: STEM refers to Science, Technology, Engineering, and Mathematics)

Academics and Persistence:

1. What is your current student classification status?
   - Freshman
   - Sophomore
   - Junior
   - Senior

2. What is your current cumulative college GPA?
   - ______

3. What is your current college major GPA?
   - ______

4. What is your major?
   - Biomedical Engineering
   - Civil Engineering
   - Computer Engineering
   - Computer Science
   - Construction Management
   - Electrical Engineering
   - Engineering Management
   - Environmental Engineering
   - Information Technology
   - Material Science and Engineering
   - Mechanical Engineering
   - Telecommunications and Networking
   - Other. Please specify:

5. What is your college enrollment status (during the fall/spring semesters)?
   - Full-time student (12 or more credits per semester)
   - Part-time student (less than 12 credits per semester)
   - Not enrolled

6. What is your work status (during the fall/spring semesters)?
   - Work full-time (40 or more hours per week)
   - Work part-time (less than 40 hours per week)
   - Do not work
7. I intend to graduate from college with a bachelor’s degree.
   ◦ Strongly disagree
   ◦ Disagree
   ◦ Neutral
   ◦ Agree
   ◦ Strongly agree

8. I intend to graduate from college with a bachelor’s degree in STEM.
   ◦ Strongly disagree
   ◦ Disagree
   ◦ Neutral
   ◦ Agree
   ◦ Strongly agree

9. I am confident that I will graduate from college with a bachelor’s degree.
   ◦ Strongly disagree
   ◦ Disagree
   ◦ Neutral
   ◦ Agree
   ◦ Strongly agree

10. I am confident that I will graduate from college with a bachelor’s degree in STEM.
    ◦ Strongly disagree
    ◦ Disagree
    ◦ Neutral
    ◦ Agree
    ◦ Strongly agree

**Involvement and Mentorship:**

11. How many STEM-related student organizations do you belong to?
    ◦ ______

12. On average, how many **hours per week** do you spend engaged in STEM-related student organizations?
    ◦ ______

13. How many minority student organizations do you belong to?
    ◦ ______

14. On average, how many **hours per week** do you spend engaged in minority student organizations?
    ◦ ______

15. How many non-STEM student organizations (i.e. business fraternities, sororities,
student government, etc.) do you belong to?
  ○ ______

16. On average, how many hours per week do you spend engaged in non-STEM student organizations (i.e. business fraternities, sororities, student government, etc.)?
  ○ ______

17. On average, how many hours per week do you spend studying/preparing for class with peers?
  ○ ______

18. On average, how many hours per week do you spend studying/preparing for class alone?
  ○ ______

19. How many mentors do you have who are readily available to advise you on academic and professional matters beyond your immediate coursework? (A mentor is someone who you seek for professional advice and career guidance, and can be a professor, family member, friend, peer, or industry expert; NOT your academic advisor.)
  ○ ______

20. What is your relationship to your primary mentor (NOT your academic advisor)?
  ○ Professor
  ○ Family member
  ○ Friend (NOT a peer)
  ○ Peer
  ○ Industry expert
  ○ Other. Please specify:

21. Does your primary mentor have a STEM background?
  ○ Yes
  ○ No

22. What is the gender of your primary mentor?
  ○ Female
  ○ Male
  ○ Other

23. What is the race/ethnicity of your primary mentor?
  ○ American Indian or Alaskan Native
  ○ Asian or Asian American
  ○ Black or African American
  ○ Hispanic or Latino
  ○ Native Hawaiian or Other Pacific Islander
  ○ White, Anglo, European American; not Hispanic
24. On average, how many **hours per week** do you spend meeting/talking with your primary mentor (NOT your academic advisor)?
   o  ______

25. How satisfied are you with the quality of the relationship between you and your primary mentor?
   o Very dissatisfied
   o Dissatisfied
   o Neutral
   o Satisfied
   o Very Satisfied

26. Would any of the following have helped to improve your level of satisfaction with your primary mentor? Check all that apply.
   o More time
   o Research guidance
   o Better quality of time
   o Teaching guidance
   o Career/professional guidance
   o Other. Please specify:

27. What do you perceive to be the most influential factor for your success in STEM at college?
   o Involvement in student organizations
   o Mentoring/advising
   o Studying with peers
   o Other. Please specify:

28. In the context of studying STEM, how often do you feel that you have been discriminated against, given less than fair treatment, or been seen as less capable than others, because of your gender?
   o Never
   o Rarely
   o Sometimes
   o Often
   o Very Often

29. In the context of studying STEM, how often do you feel that you've been discriminated against, given less than fair treatment, or been seen as less capable than others, because of your race/ethnicity?
   o Never
   o Rarely
   o Sometimes
   o Often
Very Often

Demographics:

30. What is your gender?
   o Female
   o Male
   o Transgender
   o Other. Please specify:

31. What is your race/ethnicity? *(Select all that apply)*
   o American Indian or Alaskan Native
   o Asian or Asian American
   o Black or African American
   o Hispanic or Latino
   o Native Hawaiian or Other Pacific Islander
   o White, Anglo, European American; not Hispanic
   o Other. Please specify:

32. What is your age?
   o ______

33. What is the highest level of education completed by your mother?
   o Did not complete high school
   o High school diploma
   o Post-secondary school other than college
   o Some college or associate's degree
   o Bachelor's degree
   o Master's degree (MA, MS, MBA, M.S.W., M.S.N.)
   o Medical degree (MD, D.O., DDS, or D.V.M.)
   o Law degree (JD)
   o Doctorate (Ph.D., Ed.D., D.B.A.)

34. What is the highest level of education completed by your father?
   o Did not complete high school
   o High school diploma
   o Post-secondary school other than college
   o Some college or associate's degree
   o Bachelor's degree
   o Master's degree (MA, MS, MBA, M.S.W., M.S.N.)
   o Medical degree (MD, D.O., DDS, or D.V.M.)
   o Law degree (JD)
   o Doctorate (Ph.D., Ed.D., D.B.A.)
35. What is your family’s socioeconomic status?
   o Upper class
   o Upper middle class
   o Middle class
   o Lower middle class
   o Lower class

   Thank you for your participation!