Understanding Latina Undergraduate Engineering Student Persistence

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UNDERSTANDING LATINA UNDERGRADUATE ENGINEERING

STUDENT PERSISTENCE

By

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M.B.A. University of Maine, 2003

A DISSERTATION

Submitted in Partial Fulfillment of the
Requirements for the Degree of
Doctor of Philosophy
(in Higher Education)

The Graduate School
The University of Maine
May 2020

Advisory Committee:

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This qualitative study focused on understanding the persistence of 20 Latina undergraduate engineering students enrolled at two public four-year Hispanic Serving Institutions, located in the Southeast and the Southwest part of the United States. Three complementary theoretical frameworks guided the analysis of this study, Yosso’s community cultural wealth model, an intersectionality framework, and critical systems theory. Key findings in this study showed that in order to contribute to their own persistence in engineering majors these Latina students activated their community cultural wealth: (a) not only to resist different forms of oppression, but also to thrive and excel in academic settings, (b) to take control of difficult and challenging experiences, (c) to take/receive knowledge from others, but also to give/share their knowledge (cyclical tendencies of CCW). Additional findings included: (d) helping others as the reason many chose to become engineers, (e) major finding #1: the influence of faith on persistence, and (f) major finding #2: overt and covert application of capital.

**Keywords:** persistence, Latinas, engineering, community cultural wealth, intersectionality lens, critical systems theory
DEDICATION

To my husband Brian and to our children Brianna Del Mar and Austin Enrique Rafael - this achievement belongs to us all. It is ours. Los amo.
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Whoever said it takes a village was not kidding, I did not achieve this alone. In my case, it took a whole community of family, friends, colleagues, and a few kind strangers for my PhD dream to come to fruition. To all of you I say, “thank you!”

My dream to obtain a PhD came long before I took my first graduate level course at UMaine, but it was a private one. A few years past and while having dinner with my friend Danielle McNichol I told her about my dream. Her response was exactly what I needed, she looked at me straight in the eyes and said: “What is stopping you?” Thank you, Danielle. Nothing, absolutely nothing was stopping me.

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CHAPTER ONE: INTRODUCTION

In the United States, Latinos – defined by the US Census (2012) as “a person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin regardless of race” (p. 2) – represent one of the largest growing segments of the population (Benitez & DeAro, 2004; Motel & Patten, 2013; US Census, 2012, 2016). Recent U.S. Census (2016) data indicated that more than 56,873,000 Latinos were documented as living in the United States. However, while a significant part of the U.S. population, equity of representation within higher education does not yet exist (US Census, 2016). The U.S. Department of Education (2016) and US Census (2016) data indicated that in 2015 there were approximately over 17,030,000 students enrolled in US higher education institutions, of which 3,661,000 (17.9 percent) were Latino. When further disaggregated by field of study, the lack of Latino representation is even more blatant, particularly in the STEM fields – or those representing the sciences, technology, engineering, and mathematics (Chapa & De la Rosa, 2006; De los Santos & Cuamea, 2010; National Science Foundation & National Center for Science and Engineering Statistics, 2017a; Peralta, Caspary, & Boothe, 2013; Riegle-Crumb, King, & Irizarry, 2019). In addition, Riegle-Crumb et al. (2019) reported that when comparing White and Latino/a students, in terms of attrition from STEM majors, Latinos were significantly more likely to switch from a STEM related major into a non-STEM related major; 13 percent more likely. The authors also found that STEM fields are the only majors in which the departure of Latinos and Latinas is significantly greater than that of their White peers (Riegle-Crumb et al., 2019).

The attention given to the issue of underrepresentation in STEM in the United States and elsewhere points to not only racial/ethnic representation in many STEM fields but also to the low representation related to gender (Ismail, Zulkifli, & Hamzah, 2017; Jones, Ruff, & Paretti, 2013).
When viewed together, the lack of representation of Latinos and the lack of representation of women in STEM fields, and engineering in particular, is concerning. In fact, the National Science Foundation (2017a) reported that US higher education institutions awarded 93,950 engineering degrees in 2014, with a mere 2.1 percent (1,954) of those conferred to Latinas. The stark underrepresentation of Latinas in engineering lays the foundation for the significance of this study.

**Significance of Study**

This study’s significance stemmed from the rationale that increasing the number of Latina engineering students who graduate has the potential to act as a bridge between three major issues currently facing US engineering (Camacho & Lord, 2011). These three topics of concern include (a) the underrepresentation of Latinos in engineering fields (Camacho & Lord, 2011; Castellanos & Jones, 2003; Chang, Sharkness, Hurtado, & Newman, 2014; National Action Council for Minorities in Engineering, 2013; National Action Council for Minorities in Engineering & Smith, 2014), (b) future engineering employment projections (Camacho & Lord, 2011; Peralta et al., 2013; Santiago & Soliz, 2012; Tsui, 2007), and (c) diversity in engineering design (Camacho & Lord, 2011; Chubin, May, & Babco, 2005; Guenther, Didion, & National Academy of Engineering, 2015; Tsui, 2007). I discuss each in turn below.

**Latinos, Employment Projections, and Diversity in Engineering**

The National Science Foundation (2017a) reported that US higher education institutions awarded a total of 93,950 engineering degrees in 2014, of those 9.6 percent (9,019) were conferred to Latinos of both genders, while 2.1 percent (1,954) were conferred to Latinas. Latino underrepresentation in higher education, engineering majors, and ultimately the engineering workplace follow a student’s pathway. According to Camacho and Lord (2011), the
underrepresentation of Latinos in engineering produces a diversity gap considered “America’s greatest challenge to prosperity in the globalized era” (p. 135). Diversity is a crucial element in engineering fields since with diversity new designs and technologies will take into account differences in race and gender (Camacho & Lord, 2011; Chubin et al., 2005), key factors in the US engineering industry.

In terms of employment trends, engineering – like many of the STEM fields – is plagued by a diversity gap. Current employment data from the National Science Foundation (2015) showed that 74 percent of engineers were White men. The fact that White men prevail in the engineering field is a two-prong problem, one that has attained national importance (Hernandez, Schultz, Estrada, Woodcock, & Chance, 2012; Tsui, 2007), and one that can be explained by demographic trends in the US. The first part of the problem deals with the fact that a large portion of White males currently in engineering fields are aging and retiring (Camacho & Lord, 2011; Ong, Wright, Espinosa, & Orfield, 2011), the second deals with the fact that younger generations of White males are not increasing in numbers (Ong et al., 2011), consequently leading to future employment projections of deficit among American engineering talent (Camacho & Lord, 2011; Peralta et al., 2013).

At the same time, the National Science Foundation (2017b) reported that in 2015 Latinos comprised 6.9 percent of the total US engineering workforce. Data presented by the National Science Foundation (2017b) showed that in 2015 there were 1,719,000 engineers of all degrees working in the US, of which 5.99 percent (or 103,000) were Latino men and 0.98 percent (or 17,000) were Latinas. Further data disaggregation showed that engineers with a bachelor’s degree resulted in similar percentages (National Science Foundation & National Center for Science and Engineering Statistics, 2017b). From a total workforce consisting of 1,083,000
engineers with a bachelor’s degree, data have shown that Latino men comprised of 6.7 percent of the workforce (or 73,000) and Latinas comprised 0.92 percent (or 10,000) (National Science Foundation & National Center for Science and Engineering Statistics, 2017b). In addition, Santiago and Soliz (2012) found that the majority of Latinos who were part of the STEM workforce were concentrated in lower paying positions, such as electronics, installers, and repairers, instead of higher paying jobs such as managerial positions.

In terms of gender diversity in the engineering workforce, employment data from the National Science Foundation (2017b) showed that in 2015, while 61 percent of engineers in the workplace were White men, 14.5 percent were women. The reasons for this underrepresentation are varied but literature has pointed to the fact that many women continue to struggle with issues such as balancing a career, a spouse, and children (Ismail, Zulkifli, & Hamzah, 2017; Seymour, 1999). Other factors negatively affecting women in engineering include organizational environment, gender socialization, and gender stereotypes (Baldwin, 2009; Bean, 1980; Blosser, 2017; Chesler & Chesler, 2002; Gloria, Castellanos, & Orozco, 2005; Gusa, 2010; Miller, 2014; Morris & Daniel, 2008; Ryan & Deci, 2000; Seymour, 1999; Tinto, 1997; Tinto & Cullen, 1973; Vaccaro, 2014).

In order to maintain its competitive edge and leadership in science, innovation, and engineering, the US needs to address the disparities between current educational trends, future employment projections, and diversity in design, a process that could benefit from increasing the number of Latino and Latina engineering students who graduate.

**Purpose of Study**

The purpose of this study was to further the knowledge base regarding the underrepresentation of Latinas in engineering fields. More specifically, I explored the
phenomenon of persistence of Latina undergraduate students in engineering majors. Obtaining a deeper understanding of the experiences that contribute to and detract from Latinas’ persisting in engineering programs could allow higher education professionals to effect policy changes and practices and to create programs specifically designed to focus on increasing the number of Latina engineers who graduate.

**Research Questions**

In this research study, I aimed to understand the persistence of Latina undergraduate students in engineering majors through examining the following research questions:

1. How do Latina undergraduate students perceive the experiences that contribute to or detract from their persistence in engineering programs?
2. How do Latina undergraduate engineering students make meaning of persistence in their lives?
3. How do Latina undergraduate engineering students make use of/enact/implement/cultivate their community cultural wealth in order to persist in engineering majors?

**Overview of Theoretical Frameworks**

This study utilized three frameworks, including Yosso’s community cultural wealth model (Yosso, 2005), intersectionality framework (Crenshaw, 1990; Jones & Abes, 2013), and critical systems theory (Watson & Watson, 2011). The community cultural wealth model provides a different perspective by moving away from deficit frameworks focused on determining why students fail, to one that embraces the students’ successes and persistence (Demetriou & Schmitz-Sciborski, 2011; Gonzales, 2012; Samuelson & Litzler, 2016). Yosso’s (2005) model has been described as an optimistic, asset-based framework (Demetriou &
Schmitz-Sciborski, 2011). By developing the community cultural wealth model, Yosso accomplished several things. First, Yosso expanded the concept of funds of knowledge presented by Moll, Amanti, Neff, and Gonzalez (1992) to include skills, abilities, values, social contacts, and other knowledge that communities of color have, use, and share in order to survive and resist racism and other forms of oppression (Gonzales, 2012; Yosso, 2005; Yosso & García, 2007; Yosso & Solorzano, 2005). Second, Yosso (2005) extended Bourdieu’s (2011) cultural capital theory by reconceptualizing what is traditionally considered cultural capital to include additional funds of knowledge. Third, and most important, Yosso’s (2005) model, unlike many other persistence models, was developed by observing and studying peoples and communities of color, such as Latinos.


Both frameworks thus far, Yosso’s (2005) CCW and intersectionality (Crenshaw, 1990; Jones & Abes, 2013), focus on the Latina student herself. In order to expand this study’s perspective, I added critical systems theory to the analysis. Critical systems theory brought a
systems-thinking perspective to evaluate complex educational issues critically and thus added an emancipatory and social justice approach to the analysis (Watson & Watson, 2011), with a more specific focus on the settings of Hispanic Serving Institutions (HSIs) in which this study was situated. Each of these frameworks is elaborated in further in the following chapter.

**Design Overview**

In this study, I chose to use my grammatical voice to share my findings. My grammatical voice may sound colonial to some reading this manuscript, it is. My grammatical voice reflects who I am - a Latina woman who learned to speak, read, and write English as a second language in a country that has been a Spanish speaking colony of the United States since 1898. The years of research, study, and sacrifice that took me to get to this point in my educational journey are reflected in my voice. I chose not to have my work edited; I chose not to change my words so that it follows the way the majority speaks. I chose to use my voice to share my findings because it is mine, it is how I speak, think, and write. I remain truthful to myself by sharing my work using my own grammatical voice and remain hopeful that others can appreciate not only the knowledge, but also the difference.

For this study, I used a qualitative research design in order to focus on the phenomenon of persistence from the perceptions of Latina undergraduate engineering students attending two public four-year Hispanic Serving Institutions located in the Southeast and Southwest of the United States, respectively. In order to provide a more comprehensive understanding of their continued persistence in engineering, the Latina undergraduate engineering students were in their sophomore to senior years.

The main source of data collection consisted of an in-depth phone interview with 20 students. The interview process comprised of one interview lasting between 19 to 58 minutes. I
followed a semi-structured interview guide and a narrative, storytelling format, referred to as *testimonios*. See Appendix A for the interview question protocol and for interview question analysis. As suggested in the literature, the processes of data collection and data analysis were performed concurrently (Maxwell, 2013; Miles, Huberman, & Saldana, 2014). In addition, the data analysis process was based on thematic analysis (Maxwell, 2013; Miles et al., 2014).

**Study Outline**

This research study is divided into five chapters. In chapter two, I provide a review of the literature focused on factors affecting Latina engineering student persistence and an overview of the community cultural wealth model, critical systems theory, and intersectionality framework. In chapter three, I delineate the research design and the methodology used, including defining the participants, data collection and analysis, and limitations and strengths of the study. In chapter four, I present the major findings in this study, while in chapter five, I interpret those findings and proposed changes to policy, practice, and suggest topics for future research.
CHAPTER TWO: LITERATURE REVIEW

Advancing the knowledge base regarding Latina undergraduate engineering student persistence requires an understanding of the concepts contributing to the more general topic of the underrepresentation of Latinos in higher education and then providing a narrower focus of research in terms of the engineering field and gender. In other words, the study of Latina engineering student persistence requires an understanding of the educational pipeline of Latino students, which Chapa and De la Rosa (2006) described as having massive leaks. This literature review starts by presenting the topic of college student persistence in general terms and then focusing on Latino students and the current trends of this ethnic group by gender and by discipline.

College Student Persistence

In 2014, the National Center of Education Statistics (2016) reported that the six-year completion rate for first-time college students attending four-year institutions was approximately 60 percent; meaning that only 6 out of 10 students will graduate in six years. In fact, persistence of students attending higher education institutions has not improved greatly for a few decades, increasing from 58.2 percent to 61.4 percent from 1996 to 2006, according to the National Center of Education Statistics (2016). Since student retention and graduation rates play a vital role in how policy makers determine the performance of colleges and universities (Kerby, 2015; McKinney & Hagedorn, 2015; Tinto, 1982; Titus, 2004), understanding what facilitates or hinders college persistence is essential when determining policies and programs geared to increase college graduation rates (Garza, Bain, & Kupczynski, 2014; Hu, 2011).

College student persistence is considered a complicated issue due to the many factors that can influence its outcome (Pascarella & Terenzini, 1980; Tinto, 1997; Tinto & Cullen, 1973;
Consequently, persistence has been the central focus of scholarship for many researchers including work linking persistence to school choice,

First-generation students and under-preparedness (Aguinaga & Gloria, 2015; Downs et al., 2008; Garza et al., 2014; Irizarry, 2012; Núñez & Crisp, 2012); climate and culture (Castillo et al., 2006; Museus, Palmer, Davis, & Maramba, 2011), cultural fit (Gloria et al., 2005), student background characteristics (Garza et al., 2014; Page, 2013); family (Gonzalez, 2015); motivation, resilience, self-efficacy (Edman & Brazil, 2009; Garza et al., 2014; Gloria et al., 2005; Gloria & Ho, 2003; Kouyoumdjian, Guzmán, Garcia, & Talavera-Bustillos, 2015; Kuh, Kinzie, Buckley, Bridges, & Hayek, 2006; Lechuga, 2012; National Academy of Sciences, 2011; Nora, 2003; Swail, Cabrera, Lee, & Williams, 2005; Tsui, 2007), and pedagogical techniques (Ramaley, 2009), among others.

Such a complex understanding of persistence is further complicated when one considers the individual student characteristics and the academic disciplines that the students pursue. As such, scholarly research on the phenomenon of college student persistence has not only extended to include the study of persistence of specific majors and fields such as engineering and other STEM related disciplines, but also to specific ethnic groups, such as Latinos (Brown, Morning, & Watkins, 2005; Chapa & De la Rosa, 2006; Crisp, Nora, & Taggart, 2009; Espinosa, 2011).

**US Latinos**

With approximately 56.87 MM Latinos in the US, encompassing 17.8 percent of the population, this ethnic group is currently the largest minority group in the US (Benitez & DeAro, 2004; Motel & Patten, 2013; US Census, 2012). Latinos in the US are a heterogeneous and complex group, as people from over twenty different countries of origin identify themselves as Latino (Torres et al., 2003). In fact, Latinos are the largest minority group in the US and one that
is expected to continue to increase (Benitez & DeAro, 2004; Motel & Patten, 2013; US Census, 2012, 2016). Furthermore, reviewing the Latino educational pipeline showed that the educational achievement of this ethnic group is not parallel to this group’s growth (Chapa & De la Rosa, 2006).

Definitions

Latinos and Latinidad

According to Dill and Zambrana (2009), the term Latinos is a gendered, ethnic, and racial concept. The meaning of the term Latino differs based on the context of conversation, such as in social issues or political identities, among others. However, the term itself needs addressing as it mistakenly presents a clearly defined category, a homogenous group of people – also referred to as the brown race (Dill & Zambrana, 2009). This homogenization dismisses the heterogeneous identity of Latinos, including not only differences in race, but also to ethnic subgroups, and socioeconomic status (Dill & Zambrana, 2009). Overlooking the differences among Latino identities, may have an impact on future research and inquiry, and more pertinent to this study it may negatively affect the knowledge base of Latinas (Dill & Zambrana, 2009). The term Latinidad was used by several authors when referring to the concept of Latino identity (del Alba Acevedo, 2001; Laó-Montes, 2001; Rojas, 2004), however, researchers not always agreed when defining the concept of Latinidad.

del Alba Acevedo (2001) defined Latinidad as the Latino or Latina identity, acknowledging different natural origins of Latinos and allowing for their differences. Similarly, Laó-Montes (2001) defined it as a category of identification, familiarity, and affinity, in essence identifying the state of being Latino within the historical position of living in the US. This sentiment was not mirrored by Rojas (2004), who defined the concept of Latinidad as a term
representing Latino cultural unity, and hence challenged the term. Despite the controversy around the term Latinidad and the different constructs Latinos and Latinas may identify with, such as Chicano/a, Mexican-American, Boricua, for this research study the term Latino will follow the US Census (2012) definition as “a person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin regardless of race” (p. 2). Moreover, I will use the term Latinos to represent both genders, to identify each gender separately I will use Latino men and Latina or Latina women.

**Latino Educational Pipeline**

Disaggregated data presented by the National Center of Education Statistics (2016) showed the completion rate for White students was 63.2 percent compared to 53.5 percent for Latinos. The concept of a “pipeline” of education is typically used to explain persistence or retention of students, beginning in elementary school through higher education (Chapa & De la Rosa, 2006). In regard to the Latino educational pipeline, Chapa and De la Rosa (2006) observed an inverse or negative correlation between the current demographic and educational trends of Latinos. In terms of demographics, Latinos are currently the largest minority group in the US, comprising of 17.8 percent of the population (Benitez & DeAro, 2004; Motel & Patten, 2013; US Census, 2012, 2016); yet, this ethnic group is also lacking in educational achievement (Núñez & Murakami-Ramalho, 2012). Fewer Latinos hold a bachelor’s degree than the rest of the US, 13 percent compared to 28 percent (Chapa & De la Rosa, 2006; De los Santos & Cuamea, 2010; Nunez & Elizondo, 2012; US Census, 2012). US Census (2012) data show that the Latino US population is expected to increase to 19 percent by the year 2020, and to 31 percent by the year 2060, making their underrepresentation one of the critical issues in higher education. This
disparity is of concern (Chapa & De la Rosa, 2006; Peralta et al., 2013) with De los Santos and Cuamea (2010) expressing the urgency of the situation best when they wrote:

In a global economy that depends on a prepared, educated workforce and in which wealth is created by knowledge, the people who are projected to make up more than one fifth of the US population by 2030-Hispanics-are some of the least educated and least prepared. (De los Santos & Cuamea, 2010, p. 93)

The persistence of Latinos and other minority populations has gained interest in recent years especially when it comes to STEM related fields. In fact, the underrepresentation of Latinos in US higher education extends to engineering majors and consequently to the US engineering employment industry. However, in order to understand the underrepresentation of Latinos in higher education, it is important to understand the history of Latinos in the US educational system.

**Latino Youth History of Education**

Since the Treaty of Guadalupe Hidalgo in 1848, Mexican Americans were thought of as being not only indifferent, but also opposed to education as they were perceived as being unable to recognize its value (San Miguel, 2011). Several authors reported that Latinos in the US educational system posed significant challenges for public schools from the very beginning, as this ethnic group was perceived to be intellectually and culturally inferior and thus treated as members of a subordinate class (Delgado Bernal, 2002; San Miguel, 2011; San Miguel & Donato, 2009). The less than ideal treatment and the poor quality education Latino children received in public schools contributed to their continued membership as part of a subordinate group (San Miguel & Donato, 2009). The mistreatment, marginalization, and exclusion were apparent as Latino students attended integrated schools, but separate classrooms. Latino
segregation, which expanded during 1890s to 1960s, (San Miguel & Donato, 2009) was marked by Latino students attending schools with teachers and staff that had less training and were less qualified than teachers employed at schools for White children (San Miguel & Donato, 2009). Moreover, and a crucial point for the Latino educational pipeline is that many Latino children were classified as slow-learning and routed to curriculums that lacked academic rigor, such as a vocational track or general courses, were they remained until achieving graduation (Alexander, 2002; Romo, 1998; San Miguel & Donato, 2009). In sum, Latino students were denied equal opportunity at every level of the educational pipeline, from elementary schools to post-secondary education. However, despite these conditions of marginalization and subordination some Latinos resisted, persisted, and went on to college (Delgado Bernal, 2002; Peralta et al., 2013; San Miguel & Donato, 2009).

**Latino Undergraduate Student Persistence**

Scholarly research on Latino undergraduate student persistence is varied and comprehensive, including work linking persistence to factors identified as being (a) relational, (b) individual, and (c) systemic. While relational factors included people other than the student; individual factors have to do with the students themselves and systemic factors pertaining to the institutional environment (Espino, 2014; Gonzalez, 2015). I discuss each of these factors below.

**Relational Factors**

Relational factors are based on people other than the student and their capability to affect the student’s college experience (Gonzalez, 2015). Relational factors may include family members, friends, and members of the community (Gonzalez, 2015). Researchers have noted the important and dual-role families play in terms of Latino college student persistence both as supporting agents and as challenges (Kouyoumdjian et al., 2015; Kuh et al., 2006). Factors
relating Latino families with positive effects on persistence and student success included parental expectation, parental education, support, social-economic-status, and income (Abada & Tenkorang, 2009; Bergerson, 2009a, 2009b; Gloria et al., 2005; Kuh et al., 2006; Nora, 2003; Swail et al., 2005). Conversely, having low socio-economic-status, lack of parental education or being uninformed about the college process, having diverse citizenship status, various immigration or migration patterns, colonial identities, and multiple positionalities may affect Latino’s persistence negatively (Arcidiacono, Aucejo, & Hotz, 2013; Downs et al., 2008; Garza et al., 2014; Irizarry, 2012; Kuh et al., 2006; Museus et al., 2011; National Academy of Sciences, 2011; Núñez & Crisp, 2012; Page, 2013; Walsh, 1998).

In addition to the family characteristics listed above, in Latino cultures the concept of familism or familismo in Spanish, also known as familial responsibility, can have an impact in terms of college student persistence (Kouyoumdjian et al., 2015; Núñez & Crisp, 2012; Page, 2013; Rodríguez, Bingham Mira, Myers, Morris, & Cardoza, 2003). Some examples of familism experienced by Latinos included having family financial responsibilities, the need to care for a sibling – especially for Latinas – or not wanting to put the financial burden of paying for college on the family (Bergerson, 2009b; Gloria et al., 2005; Kouyoumdjian et al., 2015; Núñez & Crisp, 2012; Page, 2013; Rodríguez et al., 2003).

**Early Exposure**

Another example of a factor known to impact Latina undergraduate student persistence is early exposure to the engineering field. Researchers in STEM fields have emphasized the need for future American talent in engineering and other STEM fields (Camacho & Lord, 2011; Peralta et al., 2013. This need has encouraged programs focusing on the readiness of the American youth and other initiatives to expose more children to engineering and STEM fields
(DeJarnette, 2012). Researchers have shown a relationship between early exposure to engineering and other STEM-related activities and the students’ disposition toward and readiness to pursue these fields (Bagiati, Yoon, Evangelou, & Ngambeki, 2010; DeJarnette, 2012). As such, the need to expose American children to STEM through early programs, summer camps, or after school programs while in their early years of education has increased (Bagiati et al., 2010; DeJarnette, 2012). Bagiati et al. (2010) reported, “Early exposure to engineering may spark interest in and increase preparation to undertake engineering as a career” (p. 1).

**Individual Factors**

The second type of factors explained in the literature linking Latino students and the concept of persistence were individual factors. Individual factors have to do with the students themselves and may include being a first-generation student, under-preparedness, and low-academic readiness (Arcidiacono et al., 2013; Downs et al., 2008; Garza et al., 2014; Irizarry, 2012; Kuh et al., 2006; Museus et al., 2011; National Academy of Sciences, 2011; Núñez & Crisp, 2012; Page, 2013; Swail et al., 2005; Walsh, 1998). In fact, many first-generation low-income students tend to drop out within their first year of college due to a lack of knowledge of the higher education system (Aguinaga & Gloria, 2015; Downs et al., 2008; Garza et al., 2014; Irizarry, 2012; Núñez & Crisp, 2012). Negative personal experiences such as discrimination and stereotypes were also presented in the literature (Daniels, 2011; Delgado Bernal, 2002; Litzler & Young, 2012; Nora, 2003; Núñez & Murakami-Ramalho, 2012; Ramaley, 2009).

Conversely, other important individual factors having a positive effect on college student persistence were comprised of academic self-efficacy, self-belief, resilience, aspirations, motivation, and confidence (Edman & Brazil, 2009; Garza et al., 2014; Gloria et al., 2005; Gloria & Ho, 2003; Kouyoumdjian et al., 2015; Kuh et al., 2006; Lechuga, 2012; National
Academy of Sciences, 2011; Nora, 2003; Swail et al., 2005; Tsui, 2007).

**Code Switching**

One tool that might be considered an individual factor that has a positive effect, especially when considering the student group under consideration in this study, is that of code switching. Code switching (CS), defined as the act of inserting, transferring, alternating, borrowing, and mixing two or more different languages within the same conversation, is a valuable communication tool used by many bilinguals, including Latinos (Duran, 1994; Gumperaz, Cook-Gumperaz, & Szymanski, 1999; Milroy & Muysken, 1995; Montes-Alcalá, 2005; Reyes, 2004). Generally speaking, every CS utterance fulfills a need, fills a gap, and results in an important communicative function for bilinguals (Duran, 1994; Gumperaz et al., 1999; Montes-Alcalá, 2005). Gumperaz et al. (1999), Montes-Alcalá (2005), and Qi (1998) found that bilinguals revert to CS in order to clarify or verify a point, such as meaning, and to elaborate on an idea. The authors also found bilinguals used CS in order to convey a message with the right amount of force, to articulate a thought more efficiently, and by means of the right assertion, as in idiomatic expressions (Montes-Alcalá, 2005; Qi, 1998). Similarly, CS functioned as an aid in the encoding of an idea and to facilitate and support the thinking processes taking effect in oral and written forms of CS (Duran, 1994; Qi, 1998). Bilinguals also use CS to clearly mark a topic shift, or to mark an utterance in order to draw attention to it (Gumperaz et al., 1999; Reyes, 2004). Another function, resulting in a sign of competence development, was presented by Reyes (2004) and Qi (1998) in which bilinguals’ use of CS was emphasized while performing high cognitive tasks.

Moreover, bilinguals, age notwithstanding, were found to use varying degrees of CS regardless of their surroundings, similar to having the context take a secondary place in the
speakers’ mind (Hussein, 1999; Reyes, 2004). Researchers have concluded that bilinguals use CS in educational contexts within the educational setting, in social contexts within the educational setting, and in social contexts outside of the educational setting, including at home, at a store, and at restaurants, among others (Hussein, 1999; Reyes, 2004).

**Impostor Syndrome**

Conversely, a negative individual factor that might work against many students, especially those who are in underrepresented settings is impostor syndrome. According to Villwock, Sobin, Koester, and Harris (2016), the concept of impostor syndrome presents itself as intellectual self-doubt and a fear of being discovered as a fraud. This fear of not belonging is internalized and, as a result, the individual, or in this case the student, is unable to feel accomplished or competent despite of having evidence of their level of skill and abilities (Solorzano & Yosso, 2001; Villwock et al., 2016). For women in communities of color, impostor syndrome represents the legacy that years of oppression have had on women of color and that it shines bright when these women have an accomplishment (Solorzano & Yosso, 2001).


**Systemic Factors**

Systemic factors are the third type of factors explained in the literature linking Latino students and the concept of persistence. Systemic factors are often referred to as organizational background or institutional environment (Gonzalez, 2015). The organizational environment includes the social and cultural conditions that make up the learning and work settings within an organization, including behaviors, policies, and practices. These behaviors, policies, and practices can be described as institutional barriers and may include barriers to access,
application, admission, retention, attrition, and graduation (Cerezo & Chang, 2013; Downs et al., 2008; Hernandez, 1995; Hurtado, Carter, & Spuler, 1996; Núñez & Crisp, 2012; Page, 2013; Rodríguez et al., 2003; Walsh, 1998).

For example, Latinos in the US are inclined to attend less selective schools, such as community colleges, which in many cases are demographically close to home, more affordable, but tend to have lower persistence and graduation rates than four-year institutions (Bergerson, 2009a, 2009b; Martinez, 2012; Núñez & Crisp, 2012; Núñez & Murakami-Ramalho, 2012; Page, 2013). Several researchers have reported that the cost of college and limited financial aid can also be factors influencing Latino access and persistence in higher education (Bergerson, 2009a, 2009b; Downs et al., 2008; Kouyoumdjian et al., 2015; Museus et al., 2011).

Moreover, researchers have examined the influence of cultural fit and achievement of Latino college students, and found a connection between GPA and support from ethnic minority peers, such as a Latino community, minority organizations, friends, and family (Cerezo & Chang, 2013; Gloria et al., 2005; Gloria & Ho, 2003; Rodríguez et al., 2003).

The underrepresentation of Latino faculty members also plays a role in student retention. Latinas hold only four percent of tenured or tenure-track positions, and only three percent of full professors are female (Ek, Quijada Cerecer, Alanís, & Rodríguez, 2010; Núñez & Murakami-Ramalho, 2012). Studies have shown that improving the representation of Latinos (Laden, 1999) in the professorship by recruiting, retaining, and promoting is a critical factor in fostering and improving college student attainment by having mentors and role models of similar backgrounds (Chesler & Chesler, 2002; Hu & Ma, 2010; Núñez & Murakami-Ramalho, 2012). Latino faculty members who act as mentors and advisors to Latino students may share similar experiences, struggles, and barriers, thereby creating a sense of understanding, a bond, and a feeling of
support in terms of campus climate, sensitivity, empathy, and responsiveness (Dayton, Gonzalez-Vasquez, & Martinez, 2004; Museus et al., 2011).

**Culture, Climate, and Latino Student Persistence**

The campus environment can also be seen as a systemic factor influencing Latino student persistence in higher education. In higher education institutions, the campus environment, or the organizational environment, is influenced by both organizational climate and organizational culture (Castillo et al., 2006; Museus et al., 2011). Organizational culture and organizational climate have been shown to be important systemic factors in terms of Latino college student persistence and success, as well as other minority groups (Bean, 1980; Bess & Dee, 2012; Deci & Ryan, 2009; Edman & Brazil, 2009; Kuh et al., 2006; Litzler & Young, 2012; Tierney, 1988; Tinto, 1975). Researchers have not only presented a relationship between climate and culture with Latino student persistence in higher education, with a specific focus on Latinos’ persistence in engineering majors (Astin & Astin, 1992; Castillo et al., 2006; Edman & Brazil, 2009; Espino 2014; Gloria & Ho, 2003; Hurtado, 1992; Litzler & Young, 2012; Tinto, 1997; Vaccaro, 2014; Walton, Peach, Logel, Spencer, & Zanna, 2015), but also with women in engineering majors (Blosser, 2017; Chesler & Chesler, 2002; Ismail et al., 2017; Jones et al., 2013; Malicky, 2003; Seymour, 1999).

Several researchers have shared the importance of organizational culture on college student persistence and success (Bess & Dee, 2012; Castillo et al., 2006; Kuh et al., 2006; Tierney, 1988). Culture can be defined as a shared ideology, a shared way of thinking, communicating, giving meaning, and as a guiding force of behaviors in a social system (Alvesson & Sveningsson, 2015; Bess & Dee, 2012; Tierney, 1988). The shared philosophies among the organizational members are deemed culturally important by the dominant group and
directly affect policy and practices (Bess & Dee, 2012; Castillo et al., 2006; Kuh et al., 2006; Tierney, 1988). These philosophies are reflected in the values, beliefs, expectations, assumptions, norms, symbols, artifacts, myths, and rituals of the organization (Bess & Dee, 2012; Castillo et al., 2006; Kuh et al., 2006; Tierney, 1988). Organizational members promulgate the existing culture by sharing their experiences and assumptions through stories, using special language, and by offering their interpretations of historic events and symbolic customs (Alvesson & Sveningsson, 2015; Bess & Dee, 2012; Tierney, 1988). The culture is largely entrenched in the history and stories of the organization and is passed down to new members; as a result it is difficult to change (Alvesson & Sveningsson, 2015). Because the university culture can guide and drive communications, behavior, and norms, minority students whose background diverges from their predominant White peers might experience life on campus differently (Alvesson & Sveningsson, 2015; Bess & Dee, 2012; Castillo et al., 2006).

Organizational climate is the second aspect of the organizational environment and it reflects the current beliefs or current perceptions and appraisals of members of the organization by expressing their views of the organizational context (Bess & Dee, 2012; Miller, 2014; Vaccaro, 2014). In other words, climate encompasses an individual’s current reality within the larger culture (Bess & Dee, 2012; Miller, 2014; Vaccaro, 2014). As a result, climates are less embedded and more malleable and prone to changes through educational policy and practice (Astin & Astin, 1992; Bess & Dee, 2012; Miller, 2014; Museus et al., 2011; Vaccaro, 2014).

Several researchers have written about the link between climate and college student persistence and success (Astin & Astin, 1992; Bourdieu, 2011; Deci & Ryan, 2000; Edman & Brazil, 2009; Gonzalez, 2015; Hurtado, 1992, 1994; Hurtado & Carter, 1997; Kuh et al., 2006; Litzler & Young, 2012; Miller, 2014; Tinto, 1975; Vaccaro, 2014), and have shown a linear or
proportional relationship. In other words, having positive views of climate may have a positive impact; while having negative views of climate may have a negative impact on a student’s college persistence and success (Baldwin, 2009; Bean, 1980; Chesler & Chesler, 2002; Gloria et al., 2005; Gusa, 2010; Hurtado & Carter, 1997; Miller, 2014; Morris & Daniel, 2008; Ryan & Deci, 2000; Tinto, 1997; Tinto & Cullen, 1973; Vaccaro, 2014; Yosso, Smith, Ceja, & Solórzano, 2009). The relationship between climate and persistence has been shown to be especially strong for Latinos and other minority groups (Bean, 1980; Bess & Dee, 2012; Deci & Ryan, 2009; Edman & Brazil, 2009; Kuh et al., 2006; Litzler & Young, 2012; Tierney, 1988; Tinto, 1975).

Researchers found great variations and dimensions of climate perception based on a person’s characteristics, including gender, race, ethnicity, sexual orientation, institutional role, and other demographics (Harper & Hurtado, 2007; Hurtado, 1992; Hurtado et al., 1996; Miller, 2014; Vaccaro, 2012, 2014). Higher education researchers have concluded that dominant racial groups’ perceptions of climate tend to be more positive than members of racial minority groups (Edman & Brazil, 2009; Harper & Hurtado, 2007; Hurtado, 1992). In addition, minority populations have often described their perceptions of predominantly White campus climates as unfriendly, unwelcoming, chilly, and exclusionary (Miller, 2014; Vaccaro, 2012, 2014).

Negative perceptions of climate are usually shaped by experiences of racial intolerance, racism, sexism, prejudice, discrimination, being stereotyped, and other forms of oppression lived by many students of color including African Americans and Latinos (Brown et al., 2005; Crisp et al., 2009; Griffith, 2010; Gusa, 2010; Harper & Hurtado, 2007; Hurtado, 1992; Hurtado et al., 1996; Miller, 2014; Vaccaro, 2012, 2014). Students of color may also face traditional Eurocentric views that have been ingrained in a dominant society that forward a normative White
and middle class population as the standard by which others are measured against (Daniels, 2011; Delgado Bernal, 2002; Martinez, 2012; Nora, 2003; Núñez & Murakami-Ramalho, 2012). In turn, these normative assumptions deny people from other cultures and backgrounds the legitimacy of their own identity, thus creating negative stereotypes around these ethnic groups (Daniels, 2011; Delgado Bernal, 2002; Martinez, 2012; Nora, 2003; Núñez & Murakami-Ramalho, 2012).

It follows, then, that members from groups with contrasting views of climate from the predominant culture, such as Latinos, might be stigmatized and stereotyped (Delgado Bernal, 2002; Núñez & Murakami-Ramalho, 2012), resulting in marginalization and silencing thereby negatively impacting Latino college student persistence and success (Espino, 2014; Litzler & Young, 2012; Museus et al., 2011; Ramaley, 2009).

**Effects of Climate Perceptions**

In general, humans tend to have a basic need to feel they are part of something, the need to belong, to fit in, and to feel connected (Deci & Ryan, 2009; Gloria et al., 2005; Ryan & Deci, 2000). If the need to belong is not met, in part due to negative climate perceptions, it may affect a student’s motivation to pursue goals and to graduate (Deci & Ryan, 2009; Gloria et al., 2005; Ryan & Deci, 2000), in addition to affecting a student’s self-efficacy and confidence (Crisp et al., 2009). Negative perceptions of climate can affect a student’s commitment to the university, as well as a student’s academic performance (Bean, 1980; Hurtado et al., 1996; Tinto, 1975; Tinto & Cullen, 1973).

In contrast, campus climates in which a student perceives being welcomed can have a positive impact, especially for Latino students (Gloria et al., 2005). Minority Serving Institutions (MSIs), such as Hispanic Serving Institutions (HSIs) and Historically Black Colleges and
Universities (HBCUs), exemplify success on student persistence and success by graduating a large portion of racial and ethnic minorities in the US, including those in STEM fields (Museus et al., 2011; Perrakis & Hagedorn, 2010). Besides having a larger racial and ethnic representation, MSIs tend to have a supportive nature in their campus environment and climate (Arbelo-Marrero & Milacci, 2015; Dayton et al., 2004; Museus et al., 2011). HSIs and other MSIs have been shown to provide a climate of support and comfort where students tend to feel safer by the commonality of their shared experiences and find themselves being at ease with other Latino students, while developing a sense of community (Arbelo-Marrero & Milacci, 2015; Dayton et al., 2004; Deci & Ryan, 2000; Yosso, 2005). I discuss HSIs more specifically in depth further below.

**Climate in Engineering**

The concept of microclimate has been used to describe the climate within a department or a small and relatively self-contained setting within which a member operates (Ackelsberg, Hart, Miller, Queeny, & Van Dyne, 2009; Vaccaro, 2012). Similar to climate, microclimates can be perceived differently by members of underrepresented communities (Vaccaro, 2012). Some adjectives describing microclimates found in STEM fields have included chilly, unsupportive, individualistic, competitive, unwelcoming, and spaces where only certain forms of capital were legitimized (Chesler & Chesler, 2002; Espino, 2014; Museus et al., 2011).

**Racial and Gender Minorities in Engineering**

Similar to Latinos, women are considered a minority when it comes to engineering majors and fields (Ismail et al., 2017; Jones et al., 2013). Not unlike Latinos, women in engineering have been shown to experience negative cultures, chilly climates, lack of role models, and stereotypes that negatively affect their persistence (Blosser, 2017; Chesler &
Moreover, women and other minorities have been found to describe the microclimates in STEM disciplines and other male-dominated fields as hostile (Baldwin, 2009; Bean, 1980; Chesler & Chesler, 2002; Gloria et al., 2005; Gusa, 2010; Miller, 2014; Morris & Daniel, 2008; Ryan & Deci, 2000; Tinto, 1997; Tinto & Cullen, 1973; Vaccaro, 2014), and even unwelcoming (Baldwin, 2009; Bean, 1980; Chesler & Chesler, 2002; Gloria et al., 2005; Gusa, 2010; Miller, 2014; Morris & Daniel, 2008; Ryan & Deci, 2000; Tinto, 1997; Tinto & Cullen, 1973; Vaccaro, 2014). Others have found that women suffer from subtle discouragement from pursuing an engineering degree even before they set foot in higher education institutions, whether by setting lower aspirations for themselves, by dealing with the social stigma of being good in mathematics, or by being encouraged by their parents to take on specific feminine-oriented hobbies (Ismail et al., 2017; Seymour, 1999).

The negative perception of climate experienced by women in engineering majors is often heightened because the current social environment in engineering programs is male-dominated (Blosser, 2017; Chesler & Chesler, 2002; Seymour, 1999). The stereotypes experienced by women in engineering are such that several authors have written about how engineering majors were further classified as “soft” or “hard,” and as having either feminine or masculine characteristics (Blosser, 2017; Brawner, Camacho, Lord, Long, & Ohland, 2012; Ismail et al., 2017). Engineering fields, such as industrial engineering and biological engineering, where a large number of women were present were classified as “soft” engineering majors; whereas mechanical engineering, civil engineering, and petroleum engineering were mostly populated by males and perceived as “hard” engineering majors (Blosser, 2017; Brawner et al., 2012; Ismail et al., 2017). Based on the importance of gender diversity and the need for gender equity in
engineering (Blosser, 2017; Chesler & Chesler, 2002), many researchers continue to pursue this line of inquiry and strive to understand the factors affecting the persistence of women in engineering programs (Blosser, 2017; Chesler & Chesler, 2002; Huang, Taddese, & National Center for Education Statistics, 2000; Johnson, 2013; Jones et al., 2013; Malicky, 2003; Seymour, 1999). Perceptions of climate in engineering majors extend to teaching strategies and instruction in the field.

**Pedagogy in Engineering**

Institutions that place a higher value on research than teaching tend to have engineering faculty members focused on research, publishing, and tenure (Astin & Astin, 1992; Baldwin, 2009; Brainard, 2007; Ramaley, 2009). In some cases where teaching is not a priority, instruction has been delegated to teaching assistants (Astin & Astin, 1992). In addition to issues around who is teaching engineering courses, there is also concern with the techniques used (Brainard, 2007; Ramaley, 2009; Smith, Douglas, & Cox, 2009) and the quality of the teaching (Litzinger, Koubek, & Wormley, 2009). Several researchers have suggested pedagogical changes regarding the way knowledge is being disseminated in higher education where the banking system, heavily criticized by Freire (2014), still predominates. The banking system of education can be thought of as a system in which education is centered on narration and where knowledge is deposited onto the students to be memorized and stored (Freire, 2014). In the banking system, teacher and students are at opposite ends of the spectrum – the teacher is knowledgeable, is considered the thinker, talker, and disciplinarian; while the students are believed to know nothing, they get to listen, and get disciplined (Freire, 2014). One of the biggest criticisms of the banking system is that it resists dialog, so the information only flows in one direction - toward the student (Freire,
In turn, the banking system minimizes the creativity and the critical thinking skills of students (Freire, 2014).

Therefore, more inclusive pedagogical changes might include a broad approach of integrating STEM education and development with the overall student experience (Ramaley, 2009). Some pedagogical techniques suggested include cooperative learning, problem-based learning and research-based learning (Astin & Astin, 1992; Considine, Mihalick, Mogi-Hein, Penick-Parks, & Van Auken, 2014; Coppola, 2009; Freire, 2014; Kuh et al., 2006; Museus et al., 2011; Ramaley, 2009; Smith et al., 2009). Furthermore, in terms of strategies for faculty members, researchers have suggested teacher development workshops that are longer than one day, since faculty members may have no teaching strategies and may lack awareness on the different ways students learn (Baldwin, 2009; Considine et al., 2014; Peralta et al., 2013).

Hispanic Serving Institutions

Hispanic Serving Institutions (HSI) are defined as degree granting, public or private non-profit institutions with at least 25 percent Hispanic undergraduate full-time equivalent (FTE) student enrollment, of which 50 percent must be low income individuals and first-generation students, among other requirements (Benitez & DeAro, 2004; Dayton et al., 2004; Ek et al., 2010; García, 2019; HACU, 2013, 2019; Perrakis & Hagedorn, 2010). HSIs tend to have open enrollment policies, are generally low cost, offer comprehensive fields of study and remedial courses, among other features matching the Hispanic community’s demographic needs (Benitez & DeAro, 2004; Dayton et al., 2004; García, 2019). As HSIs continue to enroll a high number of Latino and Latina students, the derogatory term of Hispanic-enrolling has been used as a form of critique to suggest that enrolling and not graduating students is not serving this population effectively (García, 2019).
In the 2017-18 academic year, a total of 523 institutions met the federal definition of an Hispanic Serving Institution (HSI). These 523 institutions enrolled 66 percent of all Hispanic undergraduate students in the US (HACU, 2019). The 523 HSIs comprised of 222 public two-year institutions, 133 public four-year institutions, 146 private four-year, and 22 private two-year institution (HACU, 2019). The increase in the US Hispanic population accentuates the key role HSIs play in today’s environment (Benitez & DeAro, 2004; Dayton et al., 2004; Macdonald, Botti, & Clark, 2007; Nunez & Elizondo, 2012; Perrakis & Hagedorn, 2010; Swail et al., 2005).

The current demographic changes in US resulted and continues to result in an increase of Hispanic students enrollment in higher education, which signals and reiterates the urgency of the situation and the critical role HSIs have in the realm of higher education in the US, and the Hispanic communities (De los Santos & Cuamea, 2010; HACU, 2013; Macdonald et al., 2007).

One of the biggest challenges currently facing this type of institution is that a large percentage of HSIs did not start out as HSIs, according to García (2019). In other words, many of these institutions began as predominantly white institutions and only transitioned to Hispanic Serving Institutions as demographics shifted in the region or in their enrollment (Dayton et al., 2004; García, 2019; Macdonald et al., 2007; O’Brien & Zudak, 1998), with a few noteworthy exceptions of Boricua College, Hostos Community College in New York, and the National Hispanic University in California that were purposely designed to serve the Hispanic population from their inception (Macdonald et al., 2007). As such, the geographic location of HSIs is not a random coincidence. Their concentrated distribution, mostly in California, Texas, Florida, New York, Illinois, New Mexico, and Puerto Rico correlates with increases in the Hispanic population (HACU, 2019; Macdonald et al., 2007; Nunez & Elizondo, 2012; Wolanin, 1998).
With so many HSIs built upon predominantly white institutional beginnings, many HSIs have not been designed to best support the needs of Latino students. Therefore, other challenges HSIs face include an increase in future enrollment, the aging and retirement of the more experienced faculty, the lack of and decreasing funds, student retention, and student persistence beyond undergraduate degrees (Benitez & DeAro, 2004; Dayton et al., 2004; De los Santos & Cuamea, 2010; Perrakis & Hagedorn, 2010).

**Theoretical Frameworks**

Certainly, techniques like pedagogical strategies as well as microclimates affecting college student persistence have received much attention among researchers from a wide variety of disciplines, which allows the topic itself to be studied from different perspectives and thus furthering the understanding of the phenomenon (Bean, 1981; Cabrera, Castañeda, Nora, & Hengstler, 1992; Cabrera, Nora, & Castaneda, 1993; Demetriou & Schmitz-Sciborski, 2011; Hu, McCormick, & Gonyea, 2012; Kerby, 2015; Tinto, 1982, 1998; Titus, 2004). However, while there is a plethora of research supporting individual, systemic, and relational factors as contributing elements to low Latino persistence, studying the underrepresentation of Latinas, much like any other underrepresented group in academia, often takes on a deficiency mindset. The deficiency-oriented perspective of most prominent persistence models is observed while attempting to predict persistence behavior in terms of both social and academic integration (Bean, 1980, 1981; Cabrera et al., 1992; Tinto, 1975; Tinto & Cullen, 1973; Titus, 2004).

Much of the premise of such deficit models is based on experiences lived by the norm - White, middle class students (Tierney, 1992, 1999). Instead, by explaining persistence issues based on integration and assimilation each of the most prominent persistence models exclude students from communities of color (Bean, 1980, 1981; Cabrera et al., 1992; Tinto, 1975; Tinto
& Cullen, 1973; Titus, 2004), such as Latinos. In fact, Tierney described the postulation of required assimilation as “cultural suicide” and extended his reasoning to reiterate that the most prominent persistence models, although extensively used, were not right for Latinos (Tierney, 1992, 1999). Therefore, the very foundation of design and assumptions of the most prominently used persistence models reflected their inadequacy to properly study Latinos or members of communities of color (Tierney, 1992, 1999). In general, deficit theorists place the onus for failure on students for their lack of educational achievement and low performance while discounting the larger ethnocentric, structural, and institutional barriers, while simultaneously overlooking other systemic factors that exist in the education system (Delgado Bernal, 2002; Gonzales, 2012). A perspective that Bourdieu’s cultural capital theory attempted to address prior to being misappropriated (Bourdieu, 2011).

**Bourdieu’s Cultural Capital Theory**

In traditional views of capital, capital is seen as power (Bourdieu, 1977, 2011; Bourdieu & Thompson, 1991). Bourdieu developed cultural capital theory as a critique in order to highlight institutional and structural biases in education systems that resulted in the reproduction of social inequalities (Chang & Kanno, 2010; Gonzales, 2012; Yosso, 2005; Yosso & García, 2007; Yosso & Solorzano, 2005). In his theory of cultural capital, Bourdieu identified three main categories of capital: (a) economic capital, such as money or property, (b) social capital such as social obligations, networks, groups, and connections; and (c) cultural capital in terms of educational qualifications (Bourdieu, 2011; Chang & Kanno, 2010). Regrettably, Bourdieu’s cultural capital theory was appropriated by deficit theorists and used to explain differences in success rates among students of different backgrounds (Bourdieu, 2011).
By manipulating Bourdieu’s (2011) cultural capital theory, deficit theorists have created a narrow and traditional view of what cultural knowledge is, identifying what and whose knowledge is considered valuable in society (Gonzales, 2012; Yosso, 2005; Yosso & García, 2007). With the misinterpretation of Bourdieu’s theory it follows that deficit theorists asserted White, middle class communities as culturally and capitally “wealthy” (Chang & Kanno, 2010; Espino, 2014; Gonzales, 2012; Yosso, 2005; Yosso & García, 2007; Yosso & Solorzano, 2005), and as the norm or the standard for others to adopt, mimic, and strive for in order to gain cultural capital (Delgado Bernal, 2002; Gonzales, 2012; Yosso, 2005; Yosso & García, 2007); which, in turn, labeled cultural communities outside of the norm as culturally poor (Chang & Kanno, 2010; Espino, 2014; Gonzales, 2012; Yosso, 2005; Yosso & García, 2007; Yosso & Solorzano, 2005), or as lacking, damaged, and needing to be fixed (Gonzales, 2012; Samuelson & Litzler, 2016; Yosso, 2005; Yosso & García, 2007). This limited definition of cultural wealth stems from an Eurocentric perspective that disregards the experiences, cultures, languages, and histories of Latinos and other communities of color (Delgado Bernal, 2002; Yosso, 2005; Yosso & García, 2007).

Consequently, according to Yosso (2005) and Gonzales (2012), Latinos’ cultural wealth has been looked at from a perspective of deficit, or one of cultural poverty and disadvantages. In order to move away from the largely deficiency-oriented perspective that typically frames the research on Latino college student persistence, I will utilize Yosso’s (2005) community cultural wealth model for this study.

**Community Cultural Wealth**

Unlike other models, Yosso’s (2005) community cultural wealth model postulates the belief that a student does not need to let go of their social or cultural identity, or integrate into the
normative culture to persist in higher education (Gonzales, 2012; Yosso, 2005). On the contrary, a student can draw upon their communal knowledge to help them succeed (Yosso, 2005).

In addition, Yosso created the community cultural wealth model specifically with communities of color in mind. By changing the inquiry paradigm to one that not only challenges the status quo, but also expands epistemologies, Yosso’s (2005) model allows researchers to create knowledge by listening, without prejudice, to the voices of the people in question. Yosso’s model provides a new lens with which we can further study and analyze situations pertinent to this ethnic group that may not be discerned by other frameworks.

With the conception of the community cultural wealth model, Yosso (2005) not only extended Bourdieu’s (Bourdieu, 2011) cultural capital theory, but also reconceptualized cultural capital by presenting the construct of community cultural capital and acknowledging an array of founts of knowledge (Moll et al., 1992), that extended traditional beliefs. These sources of knowledge included the skills, values, abilities, knowledge, and social networks communities of color draw upon in order to survive and resist racism and similar forms of oppression (Gonzales, 2012; Yosso & García, 2007; Yosso & Solorzano, 2005). Yosso’s model shifts the focus from the traditional White, middle class culture to that of communities of color in order to underscore these sources of knowledge as valuable and rich (Yosso & García, 2007; Yosso & Solorzano, 2005).

These sources of knowledge are known as community cultural wealth and are lived, shared, and transferred in communities of color through the following forms of capital: (a) aspirational, (b) familial, (c) social, (d) navigational, (e) resistant, and (f) linguistic (Espino, 2014; Gonzales, 2012; Kouyoumdjian et al., 2015; Peralta et al., 2013; Samuelson & Litzler, 2016; Yosso & García, 2007; Yosso & Solorzano, 2005). I discuss each of these in turn below.
The first concept presented in Yosso’s (2005) community cultural wealth model is aspirational capital. The concept of aspirational capital in Yosso’s (2005) model refers to the ability to maintain future hopes and dreams alive even when faced with barriers and obstacles, it is a way of thinking, an example of resilience (Martinez, 2012; Peralta et al., 2013; Samuelson & Litzler, 2016; Yosso, 2005; Yosso & García, 2007; Yosso & Solorzano, 2005).

The second concept presented in Yosso’s (2005) community cultural wealth model is familial capital. Within the community cultural wealth model the concept of familial capital stretches the meaning of family so that it includes aunts, uncles, grandparents, and close friends. The members of the extended family act as a link to members of the larger community. This connection helps carve a sense of community, history, and promotes well-being (Delgado Bernal, 2002; Samuelson & Litzler, 2016; Yosso, 2005; Yosso & García, 2007; Yosso & Solorzano, 2005).

The third concept in Yosso’s (2005) community cultural wealth model – social capital – recognizes the value of social contacts and networks within communities of color as resources of information and skills. These social contacts are also a source of moral and emotional support that higher education upon which students rely on (Yosso, 2005; Yosso & García, 2007; Yosso & Solorzano, 2005).

The next concept – the fourth in Yosso’s (2005) model – is that of navigational capital. It represents qualities and competencies students used to be successful in higher education settings. They include strategies used to survive and succeed racially hostile social institutions and climates (Samuelson & Litzler, 2016; Yosso, 2005; Yosso & García, 2007; Yosso & Solorzano, 2005).
The next concept in Yosso’s (2005) model is resistant capital and it tends to act as a catalyst in motivation. It includes the behaviors and attitudes that push back and refute stereotypes and other forms of oppression (Peralta et al., 2013; Samuelson & Litzler, 2016; Yosso, 2005; Yosso & García, 2007; Yosso & Solorzano, 2005).

Finally, the last concept presented in Yosso’s (2005) community cultural wealth model is the concept of linguistic capital. With the concept of linguistic capital, Yosso acknowledged that students in communities of color have multiple language and communication skills considered important within the community members and that are shared through storytelling, cuentos (or stories), translation skills, and cross-cultural awareness, to name a few (Chang & Kanno, 2010; Yosso, 2005; Yosso & García, 2007; Yosso & Solorzano, 2005).

I followed Yosso’s (2005) community cultural wealth model for this study. Applying Yosso’s model to Latina student college persistence changed the perspective of the analysis, from one of deficit - filled with barriers- to one that portrayed resilience, motivation, persistence, and positivism (Espino, 2014; Gonzales, 2012; Peralta et al., 2013; Samuelson & Litzler, 2016; Yosso, 2005; Yosso & García, 2007). By extending what is considered valuable knowledge - community cultural wealth – one can restate, determine, and understand the tools Latino students use to succeed in higher education, empowering them, and reaffirming that the knowledge, skills, and behaviors they bring are valuable, useful, and can help them succeed. Yosso’s model also allows researchers to ask different types of questions, resulting in contributions to the knowledge base and providing answers that can inform new programs or strategies specifically designed with Latino students’ needs and skills in mind. Programs and strategies created to attract, motivate, support, and help increase the persistence of this ethnic group in higher education, and more relevant to this study, in engineering programs.
**Intersectionality Framework**

In order to better understand the phenomenon of persistence of Latina undergraduate engineering students, I also incorporated an intersectionality framework (Crenshaw, 1990; Jones & Abes, 2013). Adding an intersectionality framework complemented Yosso (2005) community cultural wealth model by expanding the data analysis and taking into account the multidimensionality of Latinas. Jones and Wijeyesinghe (2011) wrote: “Intersectionality provides educators with an analytic framework for critically evaluating intersecting dimensions such as race, gender, social class and sexuality in contemporary educational contexts” (p. 12). In essence, intersectionality is considered a strategy for data analysis that allows the study and understanding of human life, human behaviors, and identity since it extends from the experiences of marginalized people, such as Latinos and other minorities (Crenshaw, 1990; Dill & Zambrana, 2009; Jones & Abes, 2013). An intersectionality framework allows a researcher to examine how different constructs impact one another rather than considering their effect separately and without connection (Collins, 1998; Dill & Zambrana, 2009). In other words, intersectionality not only allows the researcher to examine the overlap, the interlocking, or interconnections of diversity constructs or social identities such as race, ethnicity, social class, and gender, among others, but also how these mutually construct one another (Collins, 1998; Crenshaw, 1990; Dill & Zambrana, 2009; Hurtado & Sinha, 2008; Jones & Abes, 2013; Weber, 1998). Moreover, Lord et al. (2009) recognized that women of different ethnic backgrounds may experience engineering education differently. Due to the heterogeneity of the Latino women (Page, 2013; Torres et al., 2003; Vega De Jesús & Sayers, 2007) including an intersectionality framework to this analysis proved a useful tool in further exploring the complexities and emphasizing the diversity amongst Latina undergraduate engineering students, and more relevant to this research study, the diverse
array of their experiences (Jones & Abes, 2013; Weber, 1998). Jones and Wijeyesinghe (2011) presented four core components of intersectionality, these included: (a) centering the experiences of people of color, (b) complicating identity – by highlighting the complexities of lived experiences, (c) unveiling power in interconnected structures of inequality, and (d) promoting social justice. Furthermore, Jones and Abes (2013) wrote that because of the level of analysis intersectionality brings to inquiry, the concept of context, structure, or system becomes a crucial and central element of analysis. The concept of context is incorporated in this study and addressed by the critical systems theory.

**Latinas in the US**

US Census (2016) data showed that 28.3 MM of the 56.87 MM US Latino population in the US is female. Latinas in the US are very diverse (Gándara, 2015), this diversity may stem from the different countries of origin; however, it goes much deeper than that. Gándara (2015) reported that Latina women from Mexico, Puerto Rico, and Central America account for 80 percent of all the Latinas in the US. The largest Latina subgroups comprise of Mexican (64 percent), Puerto Rican (9 percent) and Central American (9 percent), and their geographical distribution also varies. More Latinas of Mexican origin tend to be located in the Southwest; however there are large numbers in the Midwest as well (Gándara, 2015; Motel & Patten, 2012). Moreover, more Latinas of Cuban, and South American origin are located in the Southeast, while Puerto Ricans are concentrated in the Northeast and the Midwest (Gándara, 2015; Motel & Patten, 2012). Besides country of origin, diversity amongst Latinas included immigration or migration patterns to the US, differences in when they came to the US and under what conditions, identifying with other ethnicities, such as White, Black, or mestizo, and having
distinct histories and experiences based on race, class, and culture, including educational experiences (Gándara, 2015; San Miguel & Donato, 2009).

While the educational experiences of Latinas are varied, the overall educational achievement of this group has been described as low and dreary (Romo, 1998), as less than 30 percent graduate from high school (US Census, 2016). Latinas over the age of 25 represent over half of the Latino population for this age group or 16.1M of the 32M (US Census, 2016). Census data showed the attrition rate among Latinas was astonishing, 17.4 percent of Latinas drop out of school before 9th grade, and an additional 12.9 percent leave high school without a diploma between their 9th and 12th grades. Amongst the 16.1M Latinas over the age of 25 years only 29.2 percent obtain a high school diploma (US Census, 2016). Furthermore, 23.1 percent of Latinas go on to having some college courses or receiving an associate’s degree, while 11.6 percent graduate with a bachelor’s degree and 5.8 percent obtain advanced degrees (US Census, 2016).

Comparing overall data of Latinas’ educational attainment to the attainment of White women and women of other races showed that 30.3 percent of Latinas had less than a high school diploma compared to 5.7 percent of White women and 11.3 percent of women of all other races (US Census, 2016). Similarly, 82.6 percent of Latinas had less than a bachelor’s degree, compared to 62.7 percent of White women and 66.3 percent of women of all other races (US Census, 2016). Lastly, 17.4 percent of Latinas had earned a bachelor’s degree or more, compared to 37.3 of White women and 33.7 percent of women of all other races (US Census, 2016).

Overall, Latinas educational achievement is of concern (Cammarota, 2004; Gándara, 2015; Romo, 1998), and reasons for this group’s low academic persistence may include, speaking only Spanish at the beginning of their school careers, preschool attendance gap, low socioeconomic
status, responsibilities within the family, gender roles, stereotypes, a mother’s influence, lack of role models, and marginalization, among others (Gándara, 2015; Gloria et al., 2005; Romo, 1998; Sanchez-Peña, Main, Sambamurthy, Cox, & McGee, 2016).

Several authors wrote that many Latinas understand the value of educational achievement and while the negative trend of their educational history is improving they are still considered to be at a social and educational disadvantage (Cammarota, 2004; Gándara, 2015; Gloria et al., 2005; Romo, 1998). Cammarota (2004) identified Latinas need to balance between the paradox of gender advancement via educational persistence while preserving gendered-based norms of the Latino culture as one of the challenges that Latinas face as they strive for educational success. I discuss each side of this controversy below.

**Gendered-based Norms of the Latino Culture**

The realities and experiences of Latinas in the US are marked not only by their race, or by their ethnicity, but also by their gender (Cammarota, 2004; Kiyama, Harris, & Dache-Gerbino, 2016; Romo, 1998; Sanchez-Peña et al., 2016). Latinas’ identity is not only shaped by gender norms that intersect with the different facets of their being – including socioeconomic status, race, and their ethnicity – but also by their sense of belonging, which is tied to having strong relationships with family members (Espinoza, 2010; Kiyama et al., 2016). Moreover, in addition to racism, Latinas may also experience gender discrimination, pressures, and hierarchies not only in society, but also within their home, where they are expected to fulfill cultural expectations as in their role of “good” daughters, wives, and mothers (Cammarota, 2004; Espinoza, 2010; Kiyama et al., 2016; Romo, 1998; Sanchez-Peña et al., 2016). The expectations of being a good daughter or being a good Latina means that family needs come before any personal goals or wants (Espinoza, 2010; Sanchez-Peña et al., 2016). In all, Latinas’ educational
persistence and success might be substantially hindered by gender oppression and the role Latinas have to maintain within their homes and families (Kouyoumdjian et al., 2015; Núñez & Crisp, 2012; Page, 2013; Rodríguez et al., 2003; Romo, 1998), which may help explain why some Latinas experience conflict and feelings of guilt for aspiring educational persistence (Cammarota, 2004; Espinoza, 2010; Sanchez-Peña et al., 2016).

Furthermore, in relation to the educational trajectory and socialization of Latinas, several authors have written about the stereotypes, myths, and misconceptions of Latinas as being too maternal, too nice, submissive to men, shy, passive, and unambitious (Kiyama et al., 2016; Romo, 1998; Zambrana, 2013). Kiyama et al. (2016) wrote that the concept of femininity in itself suggests that females are not only passive, but also weak. While gender-based norms exist for Latinas, it is important to note that many Latinas negate, contest, and challenge the gendering of females as victims in patriarchal dominant societies by enacting resistance strategies, such as excelling in school and demanding that men acknowledge their worth and value (Cammarota, 2004; Kiyama et al., 2016; Solorzano & Bernal, 2001).

**Gender Advancement via Educational Persistence**

Although this study focused on the persistence of Latinas in undergraduate engineering majors, Latinas in the US have shown persistence in education well before they entered the engineering classroom. In his study of high school Latina/o students, Cammarota (2004) explained how activating her resistance influenced the Latina student’s motivation and goals. Cammarota (2004) added that Latinas resistance influenced their behavior toward asking for help, participating in educational programs, deciding to cut class on a particular day, remaining in school, obtaining a high school diploma, or even going to college. In his study, Cammarota (2004) found that for many Latinas resistance meant graduating high school, and in various cases
being the first person in the family to obtain a high school diploma – a coveted credential that would imply a status change for them at home, the community, and the society. In terms of gender advancement via educational persistence Kiyama et al. (2016) found that Latinas dedication to maintaining and developing their academic identities and creating their own safe spaces by participating in community-based programs as examples of tools used for challenging the system and as proof of resistance. In addition, Latinas’ educational persistence was also linked to their religious beliefs; community-based extracurricular activities, affirmation of ethnic identity, the role their mother’s played in their school and home lives, caring teachers, and membership in multicultural peer groups, among others (Antrop-González, Vélez, & Garrett, 2003).

**Critical Systems Theory (CST)**

In order to better understand the phenomenon of persistence of Latina undergraduate engineering students, I incorporated a critical systems framework as the third lens for data analysis. While Yosso’s (2005) community cultural wealth model and intersectionality (Crenshaw, 1990; Jones & Abes, 2013) frameworks allowed me to focus the inquiry on the Latina student herself, integrating critical systems theory, also referred to as critical systems thinking, expanded the analysis to include the context or system, especially the context of the HSIs in which this study is situated. Through exploring the impact that structures and ideologies of the students’ systems - whether the classroom, the engineering department, or the educational organization itself - I was able to gain a larger perspective or a holistic approach to the complexity surrounding the Latina engineering students’ persistence phenomenon (Flood, 2010; Melzer, 2013; Raymaker, 2016; Reynolds, 2014; Ulrich, 2003). Therefore, incorporating CCW, intersectionality, and CST allowed for the data analysis to be more comprehensive as they
included reflection and connected (Flood, 2010) the phenomenon at three different levels: (a) the individual, (b) the discipline, and (c) the institutional.

Critical systems theory (CST) is complementary to community cultural wealth as CST incorporates tenets from both critical theory and systems theory (Melzer, 2013; Simon, 2009; Watson & Watson, 2011). Melzer (2013) explained that implementing a systems framework for analysis allows for an understanding of how structures and processes, including actors, relate to one another, while critical theory incorporates a stance on inequalities due to race, class, or gender. Hence, CST provides a systems-thinking perspective to evaluate complex educational systems critically and thus adding an emancipatory and social justice approach to the analysis (Melzer, 2013; Watson & Watson, 2011). The three core principles or tenets of CST include: (a) critique, (b) emancipation, and (c) pluralism (Simon, 2009; Ulrich, 2003; Watson & Watson, 2011). The first tenet of CST is critique or critical reflection and it aims to expose inequalities and conflicts (Melzer, 2013). From a research design perspective, this tenet emphasizes the researcher’s need to study, analyze, reflect, and question every aspect of the research, from methodology to theory (Reynolds, 2014; Simon, 2009; Watson & Watson, 2011). By criticizing or questioning every aspect of the research, a researcher is encouraged to move away from hidden assumptions and biases related to traditional approaches (Evans, 2010; Simon, 2009; Watson & Watson, 2011). Moreover, regarding the different interests and relationships within organizations, institutional critique is especially important when dealing with the very complex educational issues related to power dynamics, inequalities, transformation, and emancipation (Evans, 2010; Melzer, 2013; Reynolds, 2014; Simon, 2009; Watson & Watson, 2011).

The emancipatory values of CST play an important critical role in educational systems where relationships of unequal power exist, as do other inequalities in terms of opportunity,
authority, privilege, and control (Evans, 2010; Watson & Watson, 2011). With the emancipatory tenet, CST aims to tackle these problem situations, empower individuals, and promote change of the systems and challenge the practices that oppress them (Evans, 2010; Melzer, 2013; Simon, 2009; Watson & Watson, 2011).

Pluralism is the last tenet of CST, and it refers to the methodologies and methods used in research and the need to have multiple perspectives (Reynolds, 2014; Ulrich, 2003; Watson & Watson, 2011). Instead of following a recipe-like design to their research, pluralism exhorts researchers to expand their research designs and recognize the value that these variations in approach will bring to the knowledge base (Reynolds, 2014; Ulrich, 2003; Watson & Watson, 2011).

**Supplementing Intersectionality with Critical Systems Theory**

While the intersectionality lens provides for a critical analysis of structures, I chose to supplement intersectionality (Crenshaw, 1990; Jones & Abes, 2013) with critical systems theory (Watson & Watson, 2011; CST). As a complementary framework of analysis, CST allowed me to better ground and define the boundaries of this study. In other words, CST acted as a pragmatic tool to better define and structure the analysis as it acted as an organizational tool during the data analysis and data presentation processes. According to Flood (2010), the principle of organization embedded in CST begins by identifying preliminary boundaries of the system. This boundary identification allows for the analysis to move forward, even if the boundaries need to be updated during the analysis (Flood, 2010). Incorporating CST in the analysis provided me with a clarity to think through the data and to best illustrate its content (Watson & Watson, 2011). CST (Watson & Watson, 2011) allowed me, as a researcher, to create a roadmap, to better demonstrate how Latinas perceived their engineering experiences and the boundaries needed to
layout that information. During this process I relied on CST for boundary identification taking into account the interrelatedness of key actors within the students’ experiences (Flood, 2010); and chose to use the intersectionality (Crenshaw, 1990; Jones & Abes, 2013) lens to center the experiences on the Latina students and focus on highlighting the complexity of their own identity within those experiences (Jones & Wijeyesinghe, 2011). Yet, these frameworks still hold gaps in the literature. I summarize each of these below.

**Literature Gaps through the Frameworks**

Research applying the community cultural wealth framework (Yosso, 2005) to Latinos and other people of color is becoming more prevalent. Researchers have established that drawing upon the community cultural wealth model have contributed to student persistence and motivation to succeed in general as well as in undergraduate engineering and STEM programs (Luna & Martinez, 2013; Peralta et al., 2013; Samuelson & Litzler, 2016). Yosso’s model has also been applied to identify resources and challenges in HSIs (Kouyoumdjian et al., 2015) and at different educational levels including the doctoral level (Espino, 2014). Other applications of community cultural wealth model have aided researchers in understanding student school choice and school access (Lu, 2013; Martinez, 2012). However, some researchers have also identified a need for further study to obtain a deeper understanding of the relationships between persistence and community cultural wealth. For example, Samuelson and Litzler (2016) described how limits in their data prevented them from doing a deeper analysis on resistant capital, and were unable to analyze for social and linguistic capital as introduced in Yosso’s (2005) model. As such, there is a need for studies designed specifically using community cultural wealth and persistence to aide in a cohesiveness in design and execution, resulting in primary data being used for analysis (Samuelson & Litzler, 2016). Additionally, research to expand Yosso’s model is needed in order
to identify other forms of cultural capital Latino students use to persist in higher education institutions, such as religious capital (Espino, 2014).

Research applying systems theory is prevalent in the study of organizations as systems and is a key element in developing management and systems sciences, (Reynolds, 2014; Simon, 2009). Several authors built upon systems theory to include a critical perspective, thus creating CST. Critical systems theory has been used to study complex educational issues from the systems or organizational. Authors have applied critical systems theory to further the knowledge base regarding issues in education (Watson & Watson, 2011). More specifically in topics concerning higher education, such as sustainability (Evans, 2010; Porter & Córdoba, 2009), educational program evaluation (Melzer, 2013), and regarding specific communities within the educational organization, such as the Autistic community (Raymaker, 2016), among others. While the application of CST in educational research is vast, there is a need to focus the discourse to further understand the role the system or the educational organization has on the Latina undergraduate engineering student persistence. As presented by evaluation (Melzer, 2013), the application of the CST methodology is useful across institutional systems or contexts, since problems related to educational institutions tend to be context-specific.

In summary, this study aimed to add to the current knowledge base by narrowing its focus and concentrating on furthering the understanding of Latina undergraduate engineering students’ perspectives, while using an asset-based model, such as CCW, in conjunction with an intersectionality framework, and critical systems theory. In chapter three, I discuss the methods I utilized to conduct this study.
CHAPTER THREE: METHODS

In order to further the knowledge base and to attend to some of the gaps in the literature, this qualitative study was guided by the following research questions:

1. How do Latina undergraduate students perceive the experiences that contributed to or detracted from their persistence in engineering programs?
2. How do Latina undergraduate engineering students make meaning of persistence in their lives?
3. How do Latina undergraduate engineering students make use of/enact/implement their community cultural wealth in order to persist in engineering majors?

Methodology

To understand the persistence of Latina engineering college students attending four-year universities and to address the research questions presented above, I conducted a qualitative research study. A qualitative research design stems from the assumption that there is no one truth to explain a phenomenon, but rather multiple realities that are socially constructed and defined (Firestone, 1987). Qualitative research involves in-depth and detailed study of a small number of participants, with a final goal of explaining “how” a phenomenon occurs (Ragin, Nagel, & White, 2004). Qualitative research designs emphasize data collection on naturally occurring experiences (McMillan & Schumacher, 2010). With the goal of strengthening this research design, Appendix B portrays a visual link on how the research questions guided the research methods for this study.

Phenomenology

So as to further the understanding of the persistence of Latina undergraduate engineering students, I used a phenomenological approach as methodology. As described by McMillan and
Schumacher (2010) a phenomenological study is one that focuses on describing the meaning of a lived experience for a group of individuals by getting to the essence of it (Creswell, 2013; McMillan & Schumacher, 2010). Qualitative researchers denoted the essence as the culminating aspect of a phenomenological study, one which incorporates not only what the group of individuals experienced, but also how the group of individuals experienced it from their perspective (Creswell, 2013; McMillan & Schumacher, 2010). To further explore the defining features of phenomenology, the essence of this study came from the educational idea or concept of persistence. Moreover, the study of the phenomenon of persistence was directed towards a specific group of individuals or population – Latina undergraduate engineering students.

**Sampling Strategy**

The sampling techniques used in this study were strategic, purposeful/purposive sampling, which allowed me to deliberately identify a group of participants meeting certain characteristics with an eye toward informing and contributing to the purpose of the study (Creswell, 2013; Maxwell, 2013; McMillan & Schumacher, 2010; Miles et al., 2014). These techniques include site and participant selection, snowball or network sampling, and sampling by typical case type (Creswell, 2013; Maxwell, 2013; McMillan & Schumacher, 2010; Miles et al., 2014), each described in turn next.

**Site Selection**

The site selection assists in not only narrowing down the location of potential participants but also better understanding how the context contributes to the phenomenon being studied (Maxwell, 2013). The higher education institutions chosen met the following criteria: an accredited four-year institution classified as an Hispanic Serving Institution or HSI, having an established engineering department. Since this study focused on Latina engineering students, in
order to ensure there were enough participants to complete the study the institutions selected had a Society of Hispanic Professional Engineers (SHPE) Chapter, in which two or more leadership positions were held by Latinas. In the end, I chose two different HSIs or Hispanic Serving Institutions to best suit the needs for site sampling. These HSIs were located in Florida and Texas. Another aspect considered in this study was the number of locations in which the research was completed. Since Latina persistence in higher education can be heavily impacted by systemic factors, I used a combination of fewer educational institutions, and a larger number of participants per institution (Bean, 1980; Bess & Dee, 2012; Deci & Ryan, 2009; Edman & Brazil, 2009; Kuh et al., 2006; Litzler & Young, 2012; Tierney, 1988; Tinto, 1975). More specifically, weighing in the key role organizational culture and organizational climate play in the experiences of Latina undergraduate engineering students (Blosser, 2017; Chesler & Chesler, 2002; Ismail et al., 2017; Jones et al., 2013; Malicky, 2003; Seymour, 1999), I completed my study at two different institutions and interviewed 10 participants at each location (McMillan & Schumacher, 2010). The interview process concluded once redundancy of data was acquired and additional participants failed to yield new data.

When determining site locations, I first identified the states with the largest concentration of Latinas. According to US Census data (2010), the majority of Latinas in the US or 6.933MM are concentrated in California, while 4.697MM are in Texas, 2.136 MM in Florida, and 1.732 in New York. Furthermore, according to Motel and Patten (2012) subgroups of Hispanic origin residing in the US may differ geographically by region and even by state. For example, the western states are more populated by Mexicans, Salvadorans, and Guatemalans. Hispanics of Cuban, Colombian, Honduran, and Peruvian descent are largely concentrated in the Southern states, whereas Puerto Ricans, Dominicans, and Ecuadorians are concentrated mainly in the
Northeast region of the US (Gándara, 2015; Motel & Patten, 2012).

Therefore, the first educational institution chosen as a site location was located in Texas, based on this being one of the states with the largest concentration of Latinas. The second educational institution chosen was located in Florida in order to include diversity and the heterogeneous characteristics of Latinas in the US. Being able to compare and contrast data from not only different institutions, but also different geographical regions, and participants from different ethnicities strengthened the intersectionality dimension of the analysis and the trustworthiness of the results.

Moreover, the institutional organizations selected had an established SHPE chapter in order ensure there was a strong women participation in the institution’s engineering program; at least two members of the SHPE leadership team were women. This could be any combination of president, vice-president, secretary, treasurer, or any other position.

The site selection criteria implemented in this study included identifying the states with the largest concentration of Latinas, considering the subgroup population within that geographical region, and ensuring these sites included a SHPE chapter in which two or more of the leadership positions were maintained by Latinas was a third criteria for site selection. These factors yielded two Hispanic Serving Institutions (HSIs) as the chosen sites – Site A in Florida and site B in Texas. HSIs have been found to contribute to the success and persistence of Latinos, especially those in engineering majors and other STEM fields (Museus et al., 2011; Perrakis & Hagedorn, 2010). HSIs tend to graduate a large portion of the US Latinos in engineering majors by incorporating a supportive campus environment and climate, where students of color feel a sense of belonging and community with students who experiences are
similar to them (Arbelo-Marrero & Milacci, 2015; Dayton et al., 2004; Deci & Ryan, 2000; Yosso, 2005).

Once these sites were selected, I employed the second sampling strategy to obtain my participants. The second sampling strategy, called participant selection, is also referred in the literature as sampling by case type or typical case. Typical case sampling is described as knowing the distinctive characteristics of the group of participants chosen (McMillan & Schumacher, 2010).

The last sampling strategy I employed in this study was snowball or network sampling. McMillan and Schumacher (2010) defined snowball or network sampling as a participant referral strategy in which a preceding participant names a succeeding participant. Participants are referred based on having a specific set of characteristics or traits (McMillan & Schumacher, 2010). In this case, once I was able to identify and interview one student from a site, I asked the participant to identify other possible participants in their networks.

**Establishing Contact**

Access to the participants was gained through the site’s respective engineering department and the Society of Hispanic Professional Engineers. Once the participants had been identified, an email was sent out explaining the study and asking for the student’s cooperation. A second email was sent, only in a few occasions, where no response was received from the first email. This approach differed from the study proposal, where I suggested sending a series of three emails. Email messages were sent out within a three to five-day interval of each other, wherein this approach differed from the proposed 7 to 10-day interval (see Appendix C). In order to incentivize students to participate, those who completed all the necessary interviews were entered in a raffle for the chance to win one of two $25 Amazon gift cards. Both winners
received their electronic gift cards in December 2019 once the data collection process was concluded.

Once institutional review board (IRB) approval was obtained, I sent an email message to key staff members of the Colleges of Engineering, the SHPE faculty advisor, the leadership members, and any other contact listed in the chapter’s website and social media pages from the two sites selected (see Appendix D). An email was sent out explaining the study and asking the staff members and/or SHPE’s faculty advisor to send the recruitment email directly to students who meet the requirements (see Appendix E). If no response was received, I moved on to another staff member.

**Methods for Data Collection**

The main source of data collection was through one in-depth interview conducted via phone, with one of the interviews conducted through Facetime. This form of data collection deviated from the original proposal to use FaceTime for all of the interviews, as many of the participants did not have the necessary technology to use FaceTime. The length of each interview varied significantly, ranging from 19 to 58 minutes in length. I followed a semi-structured interview guide with a narrative, storytelling format. See Appendix A for the interview question protocol.

**Interview Procedure**

After gathering crucial demographical data, the interview started with the student’s general views on being an engineering student, and then we moved to a more narrowed focus on their experiences and the impact of those experiences on their persistence. The interview questions prompted narratives and examples of lived experiences both positive and negative,
thus ascertaining their perspectives on their persistence. This process provided clues on the tools and techniques the participants employed in order to persist.

Interviews were recorded to ensure accuracy and trustworthiness. In addition, notes were taken during the interviews. See Appendix F for the interview script. During one of the interviews, a technology malfunction was experienced and no recording was produced. However, detailed notes were taken during the interview, so that the data were preserved and used for analysis.

**Sample Size**

Based on McMillan and Schumacher (2010) a qualitative study’s sample size may vary and range between 1 and 40 or more participants, however; this is not usually the case for a phenomenological study. According to McMillan and Schumacher (2010) a phenomenological approach will require fewer participants, and based on the nature of this study I used a sample size of 20 participants. At one interview each, this number of participants generated 20 data points for analysis.

**Participants**

The participants in this study were as diverse as their experiences. The participants’ countries of origin were varied and included eight different countries, comprising of one from each if the following countries Colombia, Cuba, Ecuador, and Puerto Rico. Two participants were from Honduras, Nicaragua, and Venezuela; while 10 were from Mexico. The participants ranged in age from 19 to 24 years old, more specifically six were 19, four were 20, one was 21, five were 22, and three were 24. One student’s age was unknown. Please note to maintain the privacy of each participant, pseudonyms were used throughout this study.
Moreover, three of the participants identified themselves as sophomores, six as juniors, and eleven as seniors graduating between December 2019 and December 2020. Five of the participants were majoring in Biomedical Engineering, nine were majoring in Civil Engineering, and six were in Mechanical Engineering. All of the participants majoring in Biomedical Engineering attended Site A, while participants majoring in Civil Engineering and Mechanical Engineering attended Sites A and B. The participants’ grade point average (GPA) ranged from 2.43 to 4.0; more specifically five participants had GPAs between 2.43-2.9; five participants between 3-3.49, ten of the participants had GPAs from 3.5-4.0. A total of five participants transferred into the Hispanic Serving Institutions in the study, either from community colleges or Predominantly White Institutions (PWIs).

All of the 20 participants considered themselves bilingual in Spanish and English. Six of the participants shared Spanish was their strongest language, while six felt more comfortable with English. The remaining eight participants expressed being equally proficient in both languages. In regards to country of birth, 12 of the 20 participants were born in the United States. Three participants considered themselves international students, while one identified herself as a permanent resident; all four were attending Site A. See Table 1 below for the participants’ full demographic data.
Table 1. Participant’s Full Demographic Data

<table>
<thead>
<tr>
<th>Site *</th>
<th>Pseudonyms</th>
<th>Country of Origin</th>
<th>Country of Birth</th>
<th>Languages †</th>
<th>Major ¥</th>
<th>Expected Graduation date</th>
<th>Year in school</th>
<th>GPA</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Colombia</td>
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<td>BE</td>
<td>2021</td>
<td>junior</td>
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<tr>
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<td>ENG/Spa</td>
<td>ME</td>
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<td>senior</td>
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<td>24</td>
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<tr>
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<td>Honduras</td>
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<td>2020</td>
<td>junior</td>
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<td>Honduras</td>
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<tr>
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<td>ENG/Spa</td>
<td>CE</td>
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<tr>
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<td>ENG/Spa</td>
<td>CE</td>
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<td>ENG/Spa</td>
<td>CE</td>
<td>2021</td>
<td>junior</td>
<td>4</td>
<td>19</td>
</tr>
</tbody>
</table>

*Site A: located in FL; Site B: located in TX
†ENG/Spa: Participant is bilingual, but English predominant; SPA/Eng: Participant is bilingual, but Spanish predominant; Bilingual: Participant speaks both languages equally
¥CE: civil engineering; BE: Biomedical engineering; ME: Mechanical engineering

Participants’ Voices

In order to ensure the preservation of the student’s voices, I chose to write their comments verbatim when using data excerpts to support the findings I report. By using the participants’ quotes verbatim I remained faithful to the intent and spirit of the students and their voices. As such, all grammatical errors, code-switching to Spanish and back to English, as well as pauses are preserved.

Data Analysis

McMillan and Schumacher (2010) wrote, “Qualitative analysis is a relatively systematic process of coding, categorizing, and interpreting data to provide explanations of a single phenomenon of interest” (p. 367). For the data to be collected in this study, I used an inductive
process of data analysis (McMillan & Schumacher, 2010), which included several steps, for instance (a) data organization, (b) transcription process, (c) data coding, (d) description of data, (e) forming categories, and (f) developing patterns.

As qualitative data analysis researchers have suggested, the data analysis process was being completed while the data collection process was in progress (Maxwell, 2013; Miles et al., 2014). Performing data collection and data analysis concurrently allows the researcher to be able to change questions during subsequent interviews to ensure gaps in the data are filled and the data needed is collected. Other strategies I implemented in the data collection and data analysis processes was to listen to the interview recordings prior to transcription, it was suggested that this is also an opportunity for analysis (Maxwell, 2013). The data collected were in the form of words spoken and written—collected from the interviews, as well as the researcher’s field notes, jottings, and reflex journal (Maxwell, 2013; Miles et al., 2014). The different phases of the data analysis process are described below. Figure 1 is a graphical representation of the data analysis process.
Figure 1. Data analysis process

**Phase 1**
- Data collection & Transcription

**Phase 2 - Persistence impacted by:**
- Labels, In vivo, Grouping

- Characteristics, Meaning, Multidimensionality, Skills, Forms of capital
- Faculty, Peers, Other engineers
- Climate in engineering, organizations

**Phase 3 – Identified the elements impacting the experiences**
- Pattern coding, categories
- Connections: Self, Interactions with key player, Effects on climate and the student, Reaction to the interactions

**Theoretical Frameworks Integration**

**Experience**

**Phase 4: Themes**
- Location of experience
- Reaction to experience: CCW
- Meaning to participant
- Factors of the self:
  - Individual factors
  - Intersectionality
- Factors other than the self:
  - Relational
  - Systemic: Climate

**Phase 5**
- Develop meaning
**Phase 1**

In phase 1, I initiated the data collection process via interviews and proceeded to listen to the recordings once the interview had concluded. Notes before and after the interviews were kept in a reflex journal while the recordings were sent to a transcriptionist service to be transcribed. Once I received the transcriptions, I verified them to ensure accuracy. I also rearranged all the demographical data to the top of each document for ease of reference. For the purpose of this study, the qualitative data analysis process was based on coding and thematic analysis of the data collected (Maxwell, 2013; Miles et al., 2014). Authors have described coding as a method of discovery, one that enables the researcher to condense and organize data into topics, rearrange clusters, decipher patterns and categories, make connections, and ultimately develop meaning (Maxwell, 2013; Miles et al., 2014). Furthermore, I used both first cycle coding, to summarize and cluster segments of data; and second cycle coding, in order to group the data into smaller categories.

**Phase 2**

For phase 2, a computer-assisted qualitative data analysis software (CAQDAS) was used to store, maintain, analyze, annotate, and add comments to the data during the analysis process. Data analysis was performed using ATLAS.ti 8 (Maxwell, 2013; Miles et al., 2014). All transcripts were imported into ATLAS.ti 8 - to initiate the coding process. After several iterations of the first cycle of coding attempts, I used descriptive coding – giving the data a label, often times a short noun or phrase, to denote the category or the basic topic of the data. Beside descriptive coding, I used process coding as well, by using gerunds to connote concepts in the data collected (Miles et al., 2014). Examples of codes generated during the first cycle coding included: good-attitude, hard-working, dedicated, bad attitude, anxious, helping others, feeling
support, forms of -ism, connecting via Spanish, type of CCW used, and so on. Labels such as
good-attitude, dedicated, and hard-working were then clustered as characteristics. Clustering of
first cycle codes revealed the following groupings: characteristics, skills, meaning, identity,
climate, activation of capital, faculty, peers, other engineers, and organizations.

**Phase 3**

For phase 3, I used pattern codes in order to denote patterns and categories in the data (Miles et al., 2014). To avoid getting overwhelmed during the analysis process, I used the
conceptual frameworks and research questions as I further defined the categories or themes
included. In this study, I integrated three theoretical frameworks for the analysis of the Latina
undergraduate engineering student experiences, including Yosso’s (2005) community cultural
wealth model, an intersectionality framework (Crenshaw, 1990; Jones & Abes, 2013) and critical
systems theory (Watson & Watson, 2011). In order to analyze each experience using all three
frameworks I filtered each story through the pertaining frameworks and identified what within
each experience impacted the students’ persistence. These further developed the themes
presented in Phase 4.

**Phase 4**

Phase 4 comprised of integrating all three theoretical frameworks to aid in the data
analysis process. Figure 2 (below) is a graphical representation of the integration process.
Integrating all three theoretical frameworks for data analysis meant taking each experience, each
answer shared during the interview process, and one-by-one filtering those stories through the
lenses simultaneously. Using the image of a funnel is an apt way to describe this process. What
emerged from the funnel represents the different factors impacting the students’ experiences.
Deciding how to present the data for this study was not a straightforward process. I struggled with the complexity and the intertwined levels not only of the data as a whole, but also of each experience or story told. This interconnection of elements within a story made it impossible to separate each component, as such I decided to combine methods and chose testimonios as the best way to present these experiences, even though my methodology was phenomenological and I organized my data by themes and categories.

Testimonios was presented as a mode of inquiry used to voice stories from a non-majority perspective (Castillo-Montoya & Torres-Guzmán, 2012; Delgado Bernal, 2002). Testimonios are defined as a counter-storytelling method based on a narrative format used to share the life history of people of color, including Latinos (Delgado Bernal, 2002). As such making use of testimonios allows researchers to present a side of the story that dominant race educators usually do not hear or share (Castillo-Montoya & Torres-Guzmán, 2012; Delgado Bernal, 2002). Choosing
testimonios as a data presentation format allowed for the uniqueness of the messages within the students’ experiences to be presented, heard, and analyzed (Delgado Bernal, 2002).

**Trustworthiness**

The trustworthiness of a qualitative research refers not only to how correct or well written the description presented is, but it also encompasses and judges how credible the explanations, interpretations, and conclusions offered are (Maxwell, 2013; Miles et al., 2014). To enhance the trustworthiness of the data collection I established a multi-method strategy including: rich data, triangulation, and comparison, focusing on discrepant data (Maxwell, 2013; McMillan & Schumacher, 2010), as well as using the participant’s voice. To incorporate the trustworthiness enhancing strategy of rich data, the interviews were mechanically recorded so as to provide a verbatim account of the participant’s stories (Maxwell, 2013; McMillan & Schumacher, 2010). Triangulation was obtained by collecting information from a diverse group of participants. The main purpose of triangulation is to not only obtain convergent data, but also to focus on divergent data as well. For this study the participants attended two different four-year universities in the United States. Another strategy included in this study to enhance trustworthiness was to compare the results obtained (Maxwell, 2013). Participants’ answers were compared to each other within the same institution or site as well as to participants from the other institution or site (Maxwell, 2013). Data comparison allowed me to further study discrepant data, which diverted from emerging patterns or emerging meanings (McMillan & Schumacher, 2010).

Divergent or discrepant data provided another level to the data analysis process in this research study. Discrepant data played a major role in this study since divergent data could potentially lay the foundation in determining that Latinas used additional forms of cultural
capital to persist in engineering majors or extend the understanding of how Latinas used their cultural capital in order to persist.

Moreover, I used a field log and a reflex journal to further enhance the credibility of the data (McMillan & Schumacher, 2010). The field log, a recordkeeping tool, included dates, times, appointments, places, access to sites and participants, participants involved, and other information deemed pertinent at the time. In my field log, I added detailed chronological proof of each data collection process.

Reflexivity plays a key role in establishing credibility in a research study and helps to strengthen its trustworthiness as well (McMillan & Schumacher, 2010). McMillan and Schumacher (2010) defined the concept of reflexivity as a process of rigorous self-examination, or self-scrutiny. From the premise that as the researcher I can’t completely separate myself from the data or become completely neutral and objective, I have taken my subjectivity into account by implementing several strategies (McMillan & Schumacher, 2010). In order to help minimize the trustworthiness threat posed by reflexivity, I used open-ended questions and avoided leading questions during the data collection process as well as making use of reflex journal (Maxwell, 2013; McMillan & Schumacher, 2010). Reflex journals were described by McMillan and Schumacher (2010) as a strategy to enhance reflexivity an defined as a “recording of decisions made during the emergent design.” For my own information and observations, I kept a reflex journal in which I recorded details and other issues occurring during the data collection process that may have impacted the study’s design and rationale. Keeping a reflex journal during the data collection process was an integral part of this study, this journal allowed me to be cognizant at all times of my background as a Latina engineer and as a Spanish speaker, and at the same time ensuring I was allowing the participants’ voice to come through. It was about gathering the truth
of their experience using only the participants’ voice. The data in the reflex journal allowed me to better understand the experiences as well as helped to cross-validate results. Other information included in the journal were feelings and ideas after each data collection event, this triangulation of the data enhanced the trustworthiness of the analysis.

**Researcher’s Perspective**

This research study has been a work in progress since I was a 17-year-old freshman at the University of Massachusetts, even though I was unaware of its development at the time. This study was born as a result of my experiences as a young Latina student as I struggled through my engineering degree. I knew the direction my education would take: I wanted to become a chemical engineer, but I had no idea how I was to accomplish that. My interest in this dissertation’s topic was piqued several decades after I earned my bachelor’s degree as I started pursuing a degree in higher education and learned, through scholarly research, about the underrepresentation of Latinos in higher education. But it was not until I specifically focused my interest on the underrepresentation of Latinas in engineering majors that I knew I would finally be able to put into words my need to understand persistence. All the memories of my journey came back and as I tried to make sense of them, I wondered: *How in the world did I manage to graduate? How did I persist?*

Although there are several racial minorities in the US, I chose to focus on Latinas for this research study. After much consideration, I decided that my personal background, both as a Latina and as a chemical engineer, are an asset for me as the researcher in this inquiry. I am personally motivated to complete this research. First, I want to see more Latinas persist in engineering. Second, it is important to me that young Latina students see that others, just like them, have succeeded. Third, I know how I survived and succeeded in becoming an engineer; I
still remember the situations, conversations, and experiences that touched my journey. Although I was the only Latina in a graduating class of 23, I knew I was not the only one going through it in the US. This comforting conclusion made me question: How did other Latinas succeed? How did they persist? My hope is that the knowledge gathered by this study will help the next group of engineering hopefuls.
CHAPTER FOUR: FINDINGS

This research study was based on the experiences narrated by 20 Latina undergraduate engineering students from two public Hispanic Serving Institutions in the United States. Their experiences, including the highs and lows of being engineering students, came across in their testimonios (Delgado Bernal, 2002). In this chapter I share key findings, as well as two major findings as they relate to how these students perceived and reacted to experiences lived within their engineering spaces in order to persist. Engineering spaces are defined as the different spaces within the participants’ academic world, including engineering classrooms, engineering departments, professional organizations, and conferences. The data analysis process to arrive at the key findings in this study was a difficult one. I struggled with how to best present the complexity and the interconnections of data within each story told. Because of this interconnection I decided to combine methods, I followed a phenomenological methodology and developed themes and categories which then guided the way I chose to arrange these experiences – in a counter-story narrative format better known as testimonios (Delgado Bernal, 2002).

Key findings in this study showed that in order to contribute to their own persistence in engineering majors these Latina students activated their community cultural wealth: (a) not only to resist different forms of oppression, but also to thrive and excel in academic settings, (b) to take control of difficult and challenging experiences, (c) to take/receive knowledge from others, but also to give/share their knowledge (cyclical tendencies of CCW). Other findings included: (d) helping others as the reason many chose to become engineers, (e) major finding #1: the influence of faith on persistence, and (f) major finding #2: overt and covert application of capital.
Creating Meaning: Connecting Key Findings to Student Experiences

This section guides the reader through the analysis by connecting the research questions, the theoretical frameworks used, the students’ testimonios, and this study’s key findings. The following participant experiences highlight the way these key findings were identified from amongst the data and show the different forms of capital these Latina students activated in order to encourage and contribute to their persistence. The first two experiences shared by Anna and Elly are examples of challenging experiences that could have potentially discouraged the students’ persistence had they not activated their CCW.

“I Think It Is Not for You”: Anna’s Experience

Anna is a 22-year-old woman who was born and raised in Venezuela. She attends Site A as a senior biomedical engineer. Anna is expecting to graduate in December 2020 and has a current GPA of 3.33. Anna’s relates how while trying to figure out if biomedical engineering was a good fit for her, Anna had an experience in which an engineering faculty member discouraged her from pursuing that engineering major. Anna shared:

Um, yeah. Once, a professor in the engineering school. So, I was a freshman and went to talk to the biomedical department to see if I did like that, and a professor told me that I think it is not for you.

Anna continued sharing her experience by describing how she felt and what her next steps were. Anna narrated,

Well, I thought about it, and then I knew that engineering was my path. So, I didn't let it bother. Oh, I researched the career, I researched, like what the job, or what the jobs you could have as a biomedical engineer, and I thought, I see myself doing this in the future. And I am sorry I'm trying to think in English. (laugh) Exacto, busque los trabajos, ni
nada, pues me dije que si me veía en ese futuro y seguí con mi carrera, no dejé que una opinión de alguien me frenea lo que yo quería hacer. (Exactly, I looked for the jobs, and then, well I asked myself if I saw myself in that future and so I continued with my (engineering) career, I did not let someone’s opinion derail what I wanted to do).

“Too Pretty to Be an Engineer”: Elly’s Experience

Elly is a 19-year-old woman from Honduras. She attends Site A as a junior biomedical engineer. Elly is expecting to graduate in May 2021 and has a current GPA of 3.70. After describing her overall experience as an engineering student as “good,” Elly added feeling discriminated against for being a woman. Elly explained how this experience came about:

It was my first day at the engineering center. I didn't know anyone there, specifically, at the engineering center. So, there was this group of guys passing by. They were, they looked like they were from the Middle East, because of the accent that they had. They approached me, and they're like oh, are you lost? And the archi-, the fashion design building is not here. And I'm like, excuse me? And they're like, yeah, the fashion design building is not here. This is the engineering center. And, I'm like, I know that. I'm a biomedical engineering major, student here. And they're like oh, but you're too pretty to be an engineer. Besides, you're a girl. One of them said, undertone. And I was really offended by that, because, you know, you're too pretty to be an engineer? What does that even mean? Like, no.

After defining herself as a “really empowered girl,” Elly explained how the comment made her feel and her reaction to it. She shared:

It was an offense. I felt offended, I'm not going to lie. But I had a pretty positive attitude, because if I give them a negative attitude, it's just going to make them do it more. You
They're just going to continue bothering me, like oh yeah, you're a girl. You study engineering. You're too pretty to be an engineer, or stuff like that. Like, no. I'm just going to take it like, oh, you know what, am I too pretty to be an engineer? Okay. I'm just like, I will just ignore his comment and just walk away, because people like that don't even deserve your attention or your energy.

“I Am a Strong Believer in God”: Daniela’s Experience

Daniela is a 19 year-old Mexican woman who was born and raised in the USA. She attends Site B as a senior civil engineer. Daniela is expecting to graduate in December 2020 and has a current GPA of 3.80. Daniela discussed what she did when things at school got too difficult to handle. She said, “I am a very strong believer in God. So, I would pray a lot. I would you know, in my prayers, talk to him a lot.”

“We Believe That We Get Knowledge from Everyone”: Migdalia’s Experience

Migdalia is a 22 year-old Mexican woman who was born and raised in the USA. She attends Site B as a senior mechanical engineer. Migdalia is expecting to graduate in December 2020 and has a current GPA of 3.86. In her story, Migdalia reiterated the key role her peers played in encouraging and supporting her persistence. To that effect, Migdalia shared:

We usually, at the most, we usually study together. We usually study in pretty big groups. Sometimes it's smaller, depending on our classes, but we like to study together more than studying by ourselves. Because we believe that we get knowledge from everyone. So, if I don't get something, maybe the other person gets it, and they can explain it to me. But I can explain to them something else.
“Through Spanish the Bond Is Just Much Stronger”: Pilar’s Experience

Pilar is a 20-year-old Mexican woman who was born and raised in the USA. She attends Site B as a sophomore civil engineer. Pilar is expecting to graduate in May 2022 and has a current GPA of 2.70. Pilar explained that by speaking Spanish she felt a connection, a bond, with other engineering students, which developed into friendships. Pilar related:

But as far as getting to know each other, we start speaking Spanish. Which, I think has helped me a lot, with getting familiar with engineers to a level where I can call, like we consider each other friends. Or even to a point of brotherhood, where we understand each other and we understand where we're coming from. So, just by speaking Spanish, you understand that you kind of come from a similar background. There, the bond is just much stronger.

Arriving at the Key Findings: The Scenic Route

Because of the complexity and the overlapping connections amongst the data within each of these students’ experiences, the road from data collection to key findings was long and difficult, yet beautiful. In this section I guide the reader through that process.

For the most part, each of the stories shared by these Latina students had the following elements influencing each of their experiences: (a) the student herself, (b) interactions with key players – faculty and other engineers, (c) effect of the interactions on climate, (d) effect of the interactions on the student, and (e) actions taken by the student, if any, in reaction to these interactions (activation of CCW). Because of the nature of this phenomenological study, most of these elements coexisted within each narrated story, as such they will be presented together within each story rather than individually. Figure 3 is a graphical representation of a student’s experience within engineering spaces, the elements influencing the experience, and the resulting
effect these interactions had on climate and the students’ persistence. In this section, I share with you some of the *testimonios* where interactions with engineering faculty members and other engineers both encouraged and discouraged persistence. Experiences where the Latina student herself impacted, encouraged and discouraged, her own persistence are also presented.

Figure 3. Elements influencing the Latina students’ experiences in engineering spaces

Interactions with Faculty and their Impact on Students’ Persistence

Encouragement and Support

Encouragement and support to persist came from various places and people for the Latina students in this study. The support and encouragement they felt from engineering faculty members is discussed first.

After Speaking with a Professor, “I Felt Like I Belonged Here”

During her interview, Daniela shared a crucial experience on her first day as an engineering student, one that marked the beginning of her educational journey and reassured her
that she was where she needed to be and encouraged her. This one interaction with a faculty member also had numerous repercussions for Daniela. She recalled:

My first day of school, last year, I came and I talked to one of the professors at [my institution], who was the civil, and talking to him, it felt so, you know, I was very nervous at first. But after I talked to him, it felt so natural and it felt like-You belong here. It made me, it had a very positive experience, because I was like You know what, if he's like this and I hope and pray that all my other professors are like this as well.

Daniela went on to describe how this interaction encouraged her to modify her behavior, resulting in a vast impact to her engineering experience. She said, “Talking to him, it helped me a lot. It helped me to come out of my shell, and to introduce myself to others, and introduce myself to other professors.” She also talked about the benefits she received from taking the initiative to meet other faculty members even before taking their class, she explained:

They know who I am already, because of the fact that I, even if I don't know them, I'll tell them this is my name. Or something. I feel like that has helped me a lot because they, even though I haven't taken their class or it helps to have [phone cuts out] I got to really I guess have a conversation with them, they know me, and they always tend to recommend me for things.

These “things” Daniela was referring to included internships and the professors’ willingness to write her recommendation letters to accompany the applications. She narrated:

Sometimes I'll be sitting down there doing my homework and they'll be like Oh, did you hear about this new internship opportunity? You should apply for it. Or did you hear about this? I'll give you a recommendation letter. Even though I haven't had them for
class. It's just that they can, I guess they can tell how I am or see how I am. I feel like that has led, that has had an impact on me.

When relating to whom she turned to when things get tough, Carmela mentioned her professors. Carmela said:

And, well, the professors here are great. They really, they're not all girl power, but they're, we had one girl in the whole staff for seven years now, for civil engineering. We just recently got another added member to our department, and we're saying oh girls are doing good. We're doing something with our career. And it's like, the professors just really, I think it's more, I think the girls [female profs] discriminate us more than the guys, because the professor guys, they're really supportive with this. They're like, no, even if you're a girl you can do anything. Girls are smart. There's nothing about our job that you girls couldn't handle more. So they, the professors overall are a huge support.

Elena narrated a story in which her interaction with a faculty member made all the difference in the world. She recounted:

My thermodynamics teacher, he would talk about a piston in class. I had no idea what the hell that was. I went to his office, and he said what do you like? I like medicine. And then he kind of explained the pistons like a lung, with the negative, the negative pressure and then the lung can re-expand. And he explained it that way. You know? And he said to me, he's actually a chemical engineer, but anyway, so they make great teachers. And I think that's all the orgo and all the chemicals and all the stuff, that you have to learn how to explain something.

When talking about their interactions with faculty members, a few students mentioned receiving support from them and how having the faculty’s support impacted them. Perceiving
having the support of faculty members also meant feeling comfortable enough to approach them and asking them questions, asking for help, and seeking advice – all indications of a positive climate in engineering spaces and one conducive to sharing knowledge. Several students commented that they saw faculty members not only as educators, but also as mentors. This realization made the difference to those who constantly reached out to them for advice and help. Such as Inés, who professed, “The professors are more accessible, so you can ask questions in class.” Inés, who transferred from another institution, proceeded to explain how having access to faculty members impacted her:

I mean, I've only been one semester here, but I feel like the professors are, they explain things way better, so I just go to class and understand. It takes a work load off for me. Which makes it better. I don't know. I've had a better experience at [this institution]. But it really just depends, I don't know, on the person. Yeah.

Likewise, Ramonita mentioned that one of her strategies for doing well in engineering was to always reach out to the faculty and get to know them, she said: “Yes, and also just to talk to the professors. Get to know them.” Ramonita also explained why she did it:

It helps because you get from, they get to know you better if they know your face. And the fact that you're asking them questions, they'll be like oh, this girl is really, or this person is actually putting some effort.

To this point, Elena said, “I, well I, the biomedical department, I really liked it. The professors were very helpful.” In addition, she described an experience in which a faculty member showed their support and willingness to help and to ensure students were successful. Elena needed help in the machining lab and the professor came in at 6:00AM the next morning to assist her. Elena shared her experience:
I had some expertise in certain classes, and after I took the machine shop class, I loved it. And I asked the professor, hey, I know right now I don't have experience, but I'll come in the morning, I'll come at six in the morning so you can teach me how to use the machines. I would really like to be your teaching assistant (TA). I'd really like to. And he did that.

Elena went on to explain how this experience helped her persist in engineering by boosting her confidence. She related that after becoming proficient in the machining lab the professor made Elena his TA. By becoming a TA not only was she able to help others, but she also gained the respect of her peers since now she had an expertise – which gave her a feeling of accomplishment. Elena related:

And after my first semester, the students walking around, they would see me, Ah, that's my TA. She taught me how to like use this giant ass machine, you know, so I earned a certain level of respect. And it was easier when I interacted with my classmates, because I had an expertise, like they did.

Elly also related a story in which she alluded to having the support and encouragement of a faculty member. Elly related:

I think that for the past, like in summer, I got into my research lab. And this, my, well, what, the doctor, which is the head of the research lab, he told me something really good that has impacted me. He was like if you're, if you wake up thinking about what you're going to do next, with like a project you have, or something else, that's when you're going to know that you're passionate about it. And that impacted me a lot, because when he told me that I was like, wow. I am actually passionate about BME (biomedical engineering). Because I wake up and I'm like oh, let me try this approach to this problem. Or
sometimes I'm studying and I dream about the concepts I was studying, or something like that. And he has told me, don't let anyone discourage you. Because that's, when it's for you, it's for you. And nobody is going to take that away from you.

**Feeling Discouraged**

Conversely, a few of the students in this study also shared experiences in which interactions with some of their engineering faculty members left them feeling discouraged. These experiences were difficult and challenging for these students and, as such, they detracted from the students’ persistence.

**“Some Professors Are Not Used to Our Culture”**

In an encounter with the engineering department chair, Crucita felt ignored, dismissed, and treated with disrespect. Crucita explained that she met with her department chair to request funding in order to present her research at a professional conference. She recounted:

So, when I went to the department chair, I asked him for money. But I didn't say, Hey, where's the money? I was kind of saying, Oh, sir, well, I'm going to this conference and I'm going to present research. Is there any way that you guys can fund my travel expenses or my registration fee? And he's just like, Uh, no. Who are you? And I'm like, because he had a Bluetooth, he had his phone on his hand, and he was looking at his phone the whole time I was talking to him. So he's just like, Uh, no. Who are you? Oh, I'm sorry, I have a meeting. He just left.

Crucita continued describing her experience by explaining how she reacted and what her next steps were. Crucita narrated, “And I was just saying, Okay, whatever. I'm just going to let it slide. It really hurt my feelings but I just said, Okay, I guess that's how it's going to be.” Crucita proceeded to fund her own traveling and registration fee and won first place for her poster
presentation. The first-place win impacted her second interaction with the department’s chair, as he offered to refund her registration fee. This time, Crucita felt really good about the interaction. She recalled:

When I came back, he [engineering department chair] came up to me, and said hey, you're Crucita right? You're the girl that got first place. And, I'm like yes sir. Yes, I am. (laugh) And it was kind of that in your face moment.

Crucita shared a story related to engineering professors having different cultural backgrounds and coming from other countries. She said:

But I would say that a lot of our professors here, they're of Asian, they're from Asia, so they're not used to our culture, I guess. They kind of, when we ask them a question or something, they kind of like look at you like where do you, did you really just ask that question? It's obvious. Because, well, because they're culture STEM is very prominent and you feel like it's kind of just like normal. In our schools, because while our professors, actually, one of my professors, she was kind of explaining how Thailand, or one of those places. She was saying that in her elementary and high school years, they focused a lot, a lot, a lot on STEM. Specifically, science and math. And here, we focus on the social sciences.

In addition, Elena narrated a story in which she was very discouraged from pursuing engineering because she did not know a lot of things about mechanical engineering. She related her experience when asking for help:

At some point it was scary, because I would see classes and they would be talking about pistons and master cylinders and brake fluid and a radiator, and I was here like, what the
hell, you should, I... You know, I had no idea. I mean, I had to go to office hours, and some professors weren't very nice.

Elena proceeded to relate what she felt was a barrier to her educational journey. One she needed to surpass. She related:

I guess it would be earning the respect of certain professors. Certain professors, it's really difficult, or extra challenging, for no reason. And I think you have to prove to them, and nothing was ever good enough. You know? And that was kind of a little bit disheartening, but I guess, like in life, you learn that you can't always please everybody. Or, and that you shouldn't please everybody, but if you did the job well, and then that should be enough.

She continued her story and shared how she was overcoming this challenge, how she pushed through in order to persist. She narrated:

To myself. I had friends that I felt really comfortable with, that you would debrief with. Especially other girls. Other friends that are girls, they know what we go through. And they can kind of relate in a different way. You know?

When discussing experiences in her engineering journey that she wished she could erase or change Isabel revealed one including a professor. She said:

On engineering as a whole, I wish that, honestly, there are some times that some professors are just, they're just really rude. And they look down at you, in like, well, and then they're not even that but some of them just, I don't know. I wish that would change. I wish there would be more of the, I'm here in this program. And even with the guys in engineering, like I'm here in this program. That means I'm just as good as you. You
shouldn't be looking down on me just because I'm a woman here. And that, that would be something I would like to change.

**Identities, Interactions with Peers, and Impact on Students’ Persistence**

**Encouraged and Support**

Beyond their faculty members, students in this study also mentioned feeling encouraged to persist in engineering as a result of interactions with other engineers and their peers. One type of experience that was remarked upon was having their curiosity piqued by an early exposure to the engineering field and beginning to see themselves early on as engineers. In addition, students related experiences in which sections of their identity had a major role in the interactions with peers, including their identities as women, engineering students, Spanish speakers, their race, nationality, ethnicity, or a combination of these.

**“It Kind of Runs in the Family”: Early Exposure to Engineering**

Beginning to see themselves as engineers was an important part of the participants’ identities and, for many of them, this identity development began long before they ever began college. For example, Lourdes shared an experience in which she received encouragement and motivation even before attending her higher education institution. Lourdes referred to how having an early exposure to engineering impacted her choice of engineering and her persistence. Lourdes related how when she was thinking about her future she did not want to become a teacher or a nurse, which were both prominent choices in her area. She decided on engineering, but only after being exposed to it through a software class offered by her high school. Lourdes shared:

My dad worked in a manufacturing company. So, I got involved with trying to do something else, rather than, like in elementary or middle school I always thought I would
be a dance teacher or just a teacher or a doctor or a nurse. Those were the most popular in
the area. But then I changed to engineering when I got to high school because I took a
class that taught AutoCAD and other software.

Moreover, once she decided to go into engineering, Lourdes took advantage of a program
in which she completed an associate’s degree in engineering while attending high school. She
shared doing the program was a big challenge for her, but because of the program she is now a
19-year-old junior.

While she was encouraged to pursue engineering by having early exposure, Lourdes also
found encouragement and support once she got to her higher education institution. Lourdes said
that this feeling of support came as a result of having relationships with her engineering peers,
which she described as “good.” She also shared how her peers were her support system. As
explained by Lourdes:

I think it's kind of motivating knowing that there's others there to support or help
whenever you need them. And to push you forward to, towards the same goal that they're
also trying to achieve. [When I walk into an engineering classroom] I just feel ready for
another day to try and learn with them.

Elena was also exposed to engineering during high school. As she relates it really
encouraged her into pursuing engineering. She said:

I, when I went into high school, they had a biomedical program. I wanted technical
certification, so even when we took our EKG class and to see the machine and learning
about the (name of triangle) triangle, and learning how electrical conduction, works. I'm
like that is cool.
Angelina shared how being exposed to engineering at an early age impacted her decision to become an engineer and encouraged her to pursue the major. Angelina narrated:

Since I was little, my parents always taught me that I was always interested in math and in science. I always saw my dad, he's a mechanical engineer, so it kind of runs in the family, because most of my family members are engineers. But then, I wanted, female, to be in a career that's not as female involved. So, being an engineer, I've always wanted to make an impact on something different.

Isabel was exposed to the world of engineering at an early age not only by her father and brother, but also by her cousins. Isabel said, “My dad is an engineer and my brother is a software engineer. A lot of my cousins on my dad's side. I'm the only girl.” She expressed being surrounded by family members who were in the engineering or tech fields – so engineering was nothing new to her. Isabel continued, “I know with them, they're all in some sort of tech or engineering field. So, I've really been surrounded by engineers. It's not that I never knew what they were.”

Isabel explained how becoming an engineer was a dream for her, she said, “Honestly, becoming an engineer, to me, is, it's a dream. For me. I, it's honestly, something more of a self-actualization for me, because I had always had that science- and math-oriented brain.” She also discussed when growing up surrounded by engineers, and seeing her family member do engineering:

Like oh, I saw my dad and my brother doing engineering, but I never really thought that that was something I could do, until that time, when I went to that one class. And I was like, what? I can do this. And this isn't hard at all. Why have I've been telling myself I can't do this? So, for me, it's self-actualization. It's something that I always thought I
could do, but I never really saw myself doing it. Then, once I realized what it was, I was like wow. Yeah. This is, this is what I want to do. This is me.

Luz was encouraged to pursue and engineering degree not only by her father, but also by participating in an engineering summer camp during her senior year of high school. She shared,

[I was encouraged] mostly my dad, because he's a civil engineer. (laugh) Yeah. And I also, in the summer, going into my first year in college, I took, I went to a camp in, at [institution], and it was for engineering. They also encouraged me a lot. It was for minorities, I guess. Everyone there was ethnic. There, it really encouraged me, because I was debating with business or engineering, and I think that camp really encouraged me to go into engineering. So yeah, it had a lot to do with my dad too.

Daniela, who will receive her engineering degree when she turns 20 years old, also talked about having completed an associate’s degree in engineering while attending high school.

Daniela, considered some benefits for doing this:

Well, it's, (my experience) actually, it's really good so far. I grew up, thought that I would be discriminated, I guess, because that's always, you know, that's a problem nowadays. In school, I, my high school, I did a program where I was able to get my associate's in engineering. Being in that program, I met other Latino/Latina students as well. It felt normal. Like, it felt really, it was awesome to see how everyone thinks and how everyone, you know, how everyone was raised differently. You have some students that were actually raised in Mexico. They came over here for high school. Or you have some students that were like me, that have parents that were raised over there, but came to school here.
“Being Bilingual You Get To Connect With So Many Different People”

Seeing themselves as engineers early in their lives was one way the participants’ identities were connected to their persistence. So too was their language. Spanish became a key way they expressed their identities but also a way they connected with their peers in their HSI environments. Ari described a sense of belonging by connecting to other engineers through speaking Spanish. Ari explained how through speaking Spanish she felt a sense of belonging and felt connected to others. She also alluded to meeting new people thus expanding her engineering network, all by speaking Spanish. She shared,

Being bilingual, you get to connect with so many different people through [professional organization]. People that have the same experiences or the same background as you, and you go, participate in socials, or even the national convention, where you meet people from other schools. And I think that's really great.

Ari shared how after attending a professional convention recently she was impressed with the amount of Hispanics and Spanish speakers in attendance. After describing that experience as “great” she went on to say,

Because usually you're, they say that there aren't, number one, many women in engineering, and there aren't many Hispanics in engineering, so it was pretty cool to go somewhere in Arizona where you usually wouldn't find, well, you do have Spanish speakers there, but this convention, everyone spoke Spanish. So it was neat to see that ev, like such a minority, so strong and present.

Regarding the benefits she perceived receiving from having lived this experience, Ari explained:

It, well, the convention in general just opened up my eyes and made me a little bit more confident going to interviews and talking to different people. I got to hear about different
experiences from different people. And joining, now, graduating and joining the workforce is kind of nerve-wracking for me, so hearing that other people have gone through it and that they've succeeded and have been successful, was beneficial for me.

Another example was presented by Pilar, as she narrated her story and described her experience as an engineering student as a positive one. She reiterated that being able to speak Spanish with other Latinos was key to her positive description. She explained, “It's been a positive experience because a lot of us are Latinos, just tend to get along very easily. Being bilingual already makes us understand each other a lot, and we start talking about other things.”

Pilar went on to describe a typical day amongst Latinos in their engineering spaces:

Then the fact that once we have that bond [through Spanish], we all help each other out. If you saw our building, once we (laugh) a lot of us just start speaking Spanish like crazy, just to like, hey, did you understand this homework? Hey did you do that? Hey, oh my God, this professor gave us this. Did you already take this class last semester? But we start speaking everything in Spanish.

Elena also described a situation as an engineering student, in which she related to others through speaking Spanish. She shared:

When I was doing my internship in [company name], some of the engineers that came from the Costa Rica plant to work with our team, they would put [on a defense] and they were having difficulty speaking, and so I was the, kind of the translator of both sides. Because I speak Spanish and English fluently, so it came in handy and I got a free trip to everywhere they went, because they needed a translator. So, that was pretty nice.

Elena went on to tell another story where she found that speaking Spanish gave her an advantage over other engineers. She related:
Also, when I go to a conference, if I see that the person, like [company name] has plants in Puerto Rico, if they're offering the jobs, and the recruiter is from here, I'll talk to them in Spanish. You know, it's a different level connection with somebody else. Because it opens doors, because in big companies if they have plants in Puerto Rico, Costa Rica, or other plants in South or Central America, who are they going to send? The person that can only speak English, or the person who can speak English and Spanish who has the same qualifications? So, it's nice to have that separate you from the rest. I think that being a woman has a lot of difficulties in engineering. You constantly have to be proving yourself. And that's kind of a one-up that you have against somebody else, that you can speak more than one language.

“He's Either Venezuelan or Colombian or Anything Latino, That I Can Relate To”

Other aspects of the students’ identities and their peers’ identities that were key to their persistence included their race, nationality, and ethnicity. Namely, some of the students also believed that being surrounded by other Hispanics helped them fit in and provided them with a sense of belonging. These students felt being surrounded by other Hispanics in their institutional environment made for a more welcoming climate in engineering spaces. Elizabeth alluded to her institution being mostly Hispanic when she said: “To give a background of [institution’s name], [institution’s name] is mostly Hispanic. The second, the biggest minority is Hispanics.”

Her sentiments resonated with Inés’ when she shared: “Yeah, that's the thing. Here at [this institution] it's mostly Hispanic. You can tell the difference.” Migdalia also sympathized with their assessment. When explaining how she had to learn to expand her network and socialize more, she said “I learned that I had to network, and I had to make friends, and I had to
socialize with other people.” Migdalia explained what had made that experience easier. She narrated:

Yeah. It was a lot easier for me to approach them. Well, I feel because we have something in common, and it's something big. And it's, like, not so different and to kind of, like someone that was not Latino, maybe I would feel like, I don't know, like we wouldn't have anything in common, or it would be harder for us to communicate, and stuff like that.

Feeling a connection through race within other engineering spaces such as a professional conference was brought to life by Olga. Olga mentioned she perceived having a connection with a recruiter at a professional convention after mentioning her country of origin and believing it was his as well. She related:

When I was having the interview at [company] at [conference], for both, for the [company] internship, the recruiter and, like when I started speaking about myself, and the first question, I said I was born in Venezuela. I moved here, as soon as I said I was born in Venezuela, the recruiter smiled at me. And I was like, he's either Venezuelan or Colombian or anything Latino, that I can relate to. And yes, he ended up being Colombian, and he was really happy. He spoke to me about the Hispanic Forum, within the [company name] sites.

During her interview, Inés talked about how she felt at her institution, and the impact of professors and peers alike. She shared:

I mean, first, the people. I mean, the thing is, for me, it might be a little bit different, because I was born and raised in South America. So, I definitely feel, I can relate more to [this institution] people than I could to [different institution] people just because they're
my people, somehow. So, just the people, and how friendly they are. That's one thing. Not only classmates, but professors too. And I feel like [this institution’s] environment is more of ‘if you do good we will all do good.’ Like we have to help each other. While [name of PWI’s] atmosphere was more like ‘you need to be the best ones in order to succeed.’ And it's more like school-oriented, so, like people at [this institution], of course, engineering is what they want to do, it's like what they love to do, but they have a life too. And they're people too, before they're engineers. If that kind of sounds right.

Yeah. Oh my God, I am so happy here. You don't even understand.

“Always Hang Around with the Engineering Crowd”: Networks

When discussing the positive elements of their climates in engineering spaces, students mentioned having the support of other engineers had been crucial to their persistence in their respective majors. Several students identified a few experiences in which they referred to peer support in relation to group membership. Groups included study groups - where students received and gave help to others and professional groups - which contributed to the students’ engineering networks. In many cases asking for help and studying in groups went hand-in-hand in terms of support, as it became a mutually beneficial collaboration amongst students.

To this effect, Anna shared how she was part of a group she relied on when her studying got hard, “Oh, hmm. (sigh) So, I have a group, like it's about six people, all of them are Latinos, and I go to them if I don't understand something or I'm having troubles.” Elly also commented on the importance of her group. Elly said:

Having a good team of people, like a group of friends that are going to help you and, you know, they understand that they have your back when it comes to academic work and personal life too, at the same time.
When sharing some of the strategies that have helped her get to this point in her educational journey, Gracia also mentioned the importance of study groups. She said:

So, definitely to go for that, as well as study groups. You know, like I said, there's many times that classes are going to get hard, so having that study group and being able to have other people that you can ask for help, is definitely the way to go. And so that you're not trying to do it all by yourself.

During her interview, Elizabeth exhorted younger engineering students to become involved in organizations. She discussed getting support through her membership in professional organizations, including receiving advice and expanding her professional network – which she accessed through the chat. She explained:

You have to be involved in professional societies. For example, we have the [professional organization’s acronym], which is the [professional organization] as we call it. In there, is a bunch of engineers, freshmen, sophomores, seniors, probably graduates, that give advice. In that chat. So, it helps us a lot, to communicate within there. Hey, what classes to take? Oh, when is the enrollment open? How can, you know, as counselor, how do you do this? And then it's a bunch, it's about networking. Becoming professional societies. Learning, and attending actual club meetings and stuff like that helps a lot, because you get the network going. Be involved in everything.

Elizabeth brought up some of the benefits her membership in a professional organization provided her with, for example, professional development. To this effect, Elizabeth shared:

For example, [program name], they offered weekly seminars in which they tell you how to write a personal statement, how to find funding for graduate school. It had opportunities for learning how to do public speaking. Things of that nature. Professional
development. There you go. Professional development seminars, which helped me as a
person.

Membership in professional organizations and clubs provided several students with
access to a network of peers and upperclassmen and women – juniors and seniors – of similar
backgrounds and interests. Participants shared that they felt drawn to these spaces because of the
tangible benefits they could receive. Lourdes, for example, explained how her membership in the
engineering organization helped her, “I think socializing more and being more involved and
having teamwork skills, since last year we also had the [professional organization] symposium
being held here.”

When sharing her advice to young Latina engineering hopefuls, Pilar reiterated the
importance of belonging to professional organizations. She said:

You're going to meet people who can give you the advice. Always hang around with the
crowd. So, that was my main advice to them. Then, whenever I was hanging out with the
seniors and juniors, they'd tell me, oh, join this organization, because a lot of the civil
engineers are here. Whenever we have meetings, they come over to the university and
they talk about their firm, they talk about internships.

Membership also offered participants opportunities or access to extracurricular projects
that allowed them to represent their institution in competitions. Among several projects
mentioned was Concrete Canoe, in which a team of engineering students worked together to
design, build, and eventually race their canoe down the river in a competition against other
engineering schools. Luz explained, “Being in the organization I learned so, so much, because
we have a competition and it's called Concrete Canoe. One of the competitions we have is called
Concrete Canoe, and you build a canoe out of concrete.” Luz related her experience full of excitement and very animated. She narrated:

I remember every single day I would stay there, at night, like we would work on it until nighttime, every single day. And those people, like those nights, were the best. Because I learned so much there. So much. I learned how to make concrete. Even though it was before I even took materials, or anything like that, those classes, I learned how to make concrete, right? I'm finding then, well, I don't know, I didn't know basic stuff, and I felt, I think that class gave, or that club or thing gave me the confidence, like, hey, I can do this. I finally know what this is and what that is. I'm not that lost anymore.

Besides talking about the Concrete Canoe experience itself, Luz also how other engineering students helped through tough times. Luz remarked,

Through that club, I also learned, or I also met people that could help me, upperclassmen that could help me, and they're, that they would always be there for me. So, yeah, I would say that's a really, that experience, just being in that club itself, really gave me the connections to, or the connections and the confidence to really continue with my studies, and continue being in that club [professional organization], too.

Furthermore, Luz explained that the members of the organization were more than just students who helped her, but that she considered them her friends. To that effect, Luz shared:

I really, that organization has really made me feel like, I guess, at home. Like I have someone to talk to. I have friends. (laugh) Because I thought I wasn't I was going to make friends at all, and those students are just, my friends there, [professional organization] has really helped my college experience not be so lonely. I think they really helped me also with the stress that comes from college.
When sharing the experiences that contributed to her persistence in engineering, Gracia also mentioned the importance of obtaining membership in professional organizations. Within these professional organizations not only was she able to receive study group benefits, but also participate in special events that she regarded as sources of information. Gracia also alluded to the organizations’ professional events, in which information regarding opportunities like coveted internships, was shared. To this point Gracia narrated:

You should go to the, like I said, the events, because they really do have a lot of information about how you join different organizations and what to do, regarding, like I said, internships. Just because internships are such an important part of, I think, for engineering students, everybody will tell you that you need to have experience before you graduate because it's very important.

In fact, Gracia referred to the engineering department’s events twice during her interview. She recounted:

At the university, probably the … I would say maybe events, since during the year, the civil engineering department will have, will host events for different things. So it would be talking about internships, or talking about class advising, per se, because I mean, as an introvert, I don't know, being able to have those events, outside, has really helped me be able to know what to do next or where to go, or who to talk to. I really enjoy that they do those types of events.

Likewise, for Olga, having peer support meant expanding her engineering network. Olga relied on her peers for advice about which class to choose with the best professor. She mentioned tapping into the juniors’ and seniors’ expertise since they had already taken those classes. She recalled:
I would say it's very, I've made a lot of friends from [organization’s name] and from engineering, because most of them are older, because, I mean most of the freshmen and sophomores don't really get involved as early in the, in their college careers. And but that, I feel like they have always been really good support. They, they've always helped, they've helped me with my classes. They've helped me with questions that I have about professors or like hey, when you're in the future what do you recommend I do? Um, so yeah, I would say a lot of them have become really good friends and people I trust. Yeah. It's fun to have people who are studying the same thing as you go through the things, go through the same things that you do.

When relating an experience about the importance of membership in professional organizations, Ramonita said, “An important experience that I've had here would be just being part of a group, being part of a society.” She proceeded to explain why she considered having membership in a group was crucial to her persistence:

It helps you be more comfortable and be more familiarized with the class, because sometimes you're just really scared to take a class because it's hard. But the fact that you already know someone who took the class, and is willing to help you, or is willing to give you their notes and tutor you, that really helps.

**Feeling Discouraged**

Nevertheless, several participants shared that on occasion they felt discouraged to continue pursuing an engineering degree as a result of their interactions with other engineering students or friends. Feeling discouraged included believing themselves unwanted or unwelcome, sometimes due to the lack of women in engineering majors, and discriminated against within their engineering spaces.
“My Friends Don’t See Me as an Engineer”

For example, Imarys’ testimonio exemplified an engineering climate that highlighted her feelings of being unwelcome. She explained how she perceived other engineering students saw her when she entered an engineering classroom. She believed others saw her and thought to themselves: “Um…who is this girl? Why is she here?” Unfortunately, Imarys’ story was not an isolated incident.

Luz narrated an episode that occurred at a professional organization’s meeting in which the new leadership for her institution’s chapter was to be chosen. While Luz wanted to become secretary, another member of the organization had her heart set on it being someone else. Luz recalled the experience by saying,

I remember I was going to run for secretary, and there was this girl there, and she wanted someone, she was also running for something. For like, vice president. (laugh) And I just remember there was just like girl things, like I hate that this, I hate that this girl in my, well, I guess that's negative, but she started saying, Don't vote for her. She was like, No one knows her. Whatever. She's not going to win, blah, blah, blah. And that really hurt, because I'm not the person that people talk about, I guess. Because I'm super, I'm in my books. I'm a complete nerd. Like, I don't, I'm not, I'm not also very outspoken. I'm very reserved. I'm not shy. I mean, I can talk, (laugh) but I'm very, I'm very reserved. And I'm very chill. I do not talk about, about anyone whatsoever, so when I heard that, I was like what? Like, I hadn't even, all I'd been was nice. So, and that really hurt. It really discouraged me, because the next day we were supposed to do our speeches, and I heard all this stuff and I was like, I can't tell, no, like, they don't even like me. And coming
from not knowing anyone, and I thought they were my friends, and then I hear all of this stuff. And I'm like, oh, I'm all alone. I felt alone, I guess, after that. I felt very alone, very. In order to get through this experience with other engineering students, Luz asked for advice and reassurance. She narrated:

I called my sister, I remember. I was like, (name), my sister, her name's (name), she, I had called her and I was like (name), this happened. And I can't do this. No one likes me. I was just so sad. (laugh) She was like, no, you're going to show her up. You're going to win and she's going to have to put up with you. You're going to do this. You're, she was like this and that, and I was like okay, okay.

Luz was very glad she asked for advice and stuck with her plan to run for secretary. To this effect she shared: “Yeah, the next day I did the speech. I did win, I (laugh) yeah, I became secretary. Yeah. I know, but she also was like vice president, so you learn how to work with people (laugh).”

Elena also shared an anecdote where she alluded to feeling discouraged especially when asking men engineering students for help. Elena compared how she felt when asking a friend for help versus asking other engineering students:

And then I would ask my friends that I felt comfortable with, that they weren't like those typical guys that would be like agghhh. They would kind of be very dismissive when you asked questions. A very good friend of mine, he's actually a mechanic. And he would explain to me, theory, and I was, I felt comfortable with asking him questions that, for others, were deemed to be stupid or that you sounded ignorant, or, et cetera. So, he was, I was, I never wanted to get a little comment like that. I didn't like comments like that. You know? So that's what I would do.
Elena also talked about having seen how women engineers get dismissed at conferences. Her father did not believe the mistreatment of women so she took him to the conference and he saw it firsthand. She related, “I'm like, no, Dad. It took him until he went to a conference, he saw the women aviation engineer be, get dismissed on when everybody was talking. And he understood.”

Angelina related an experience with a few of her men friends after she told them her goal was to study biomedical engineering. She recounted:

Maybe some of my male friends, they were a little like, mmm, I feel like you're going to change major whenever you transfer and do your biomedical courses. Or I don't see you as an engineer. But that discouraged me a little, for a moment, but then I was like, no, Angelina, like you can do it. You can do it. Not, because you see all these girls going into architecture, business, international relations, it doesn't mean that you can't be an engineer. If you want to do that and that's your passion, you're going to be able to. So I never, I, it discouraged me a little, but I don't, I try not to let stuff and people discourage me. So, that has helped me, also, continue with my biomedical engineering career.

“So Many Men, Men Everywhere”

Inasmuch as the students’ gender and identities as women were discussed by the participants, the male-dominated spaces of their departments were also. A few students also confessed feeling unwelcome within the men-dominated spaces of engineering. Delia put this into words when she described her experience as, “Hard - so many men. Men everywhere. There are some women, and some Latinas, but men everywhere. Even at the conferences - more men there. Very male-dominated field.” Delia went on to say that although it was hard, she had to work around it in order to succeed and described how she learned to cope with that reality:
I try to relate to them (the men). Hang out with them, since we like the same things it’s easy. I also has to make friends with girls, not that many in the major. I have a lot of common with the guys. It’s also important to make those friendships, we will work together in projects and eventually will be colleagues.

Carmela mentioned that one of the biggest challenges she has faced in her educational journey had been dealing with the men in engineering. She explained:

Oh, I'm always trying to prove the guys wrong, because they think that it's more of a man-dominated field. And a lot of them when, now, here in Civil (engineering) we actually have the greatest amount of girls. I think we're number 3 or 2 in the nation, where we have the most girls in civil engineering. So, since that's been happening, they're kind of like, it's a girl career. That's why it's happening. You know, it's just kind of like, well, no, there are still guys, like obviously the guys still, like there are still more guys than girls, but we have a large amount of girls. It's just a hassle having to deal with.

Carmela continued her story and explained how she handled these type of interactions.

She recalled:

Oh, just proving them wrong, I guess, because they kind of expect us to 'wuss' out I guess, after a while. But then, they see that we handle more sometimes than they do. So they're kind of like, oh, I'm sorry. I didn't realize, or I didn't mean it that way. And I'm like well, now you know. (laugh)

For her part, Luz talked about been discouraged from the lack of women in engineering.

While describing her experience in the major she said:

I think it has its pros and its cons, honestly. So, cons, there aren't that many women in engineering, especially in civil. Well, I mean, no. No, that's wrong. Actually, in my
school, in civil, there's more girls than in any other engineering major. So, that's good, for one. But even that, there aren't that many girls in my classes. So, let's say I'm taking, I don't know, materials. And out of all the classes there's 5 girls out of like 14, 20 guys. So, yeah. That's hard, I mean, because then it discourages you a lot.

After explaining how the lack of women in engineering was discouraging to her, Luz explained how she managed the situation and still pushed through her engineering studies. She related:

Honestly, knowing… I think knowing that you're as smart as, because I'm, I don't consider myself smart. I consider myself hardworking. I know that no one, no other person, especially a guy, no other person is going to be more hardworking than me. And I know what I can bring to the table, knowing what I have to offer. It really helps me a lot with not being discouraged. I would say it gives me the confidence to keep going. To know that I am… I am, like I have, how do you say, I have just the right to be here than the other guys that are here. You know? Yeah, I think knowing you're better and being confident in what you do.

During her interview Elena talked about how happy she was to be a TA at the machinist lab. She went on to discuss the benefits being a TA gave her:

And it was easier when I interacted with my classmates, because I had an expertise, like they did. Like my friend that was a mechanic, like my friend that was an aviation mechanic, or the gearhead in my class that loves cars and talked about his Mustang and how fast it goes, or whatever they do to the thing in the back of the car. And that was interesting. So, I kind of felt like I had a home, or I had a value to add.

However, even as a TA in the machinist lab Elena had to constantly prove her abilities to men engineering students, she explained:
So it's an interrogation, to prove your qualifications. That wasn't very nice. Or even when the machine shop, now, opens its doors, yeah, I'm your TA, I'm your teaching assistant. Do you know how to really work these things? Are you sure? Yes. I'm going to teach you how to work this machine. Oh, okay. It was just always a constant having to show yourself.

While other students used the phrase men dominated field, Elena described her institution’s engineering spaces a “boys’ club.” Elena continued to expand her story to explain why. She related:

When you start off in the low-level requirements, you see a lot of women. Then you get to the third year, and it's like okay, well, why is it a? Where are all the women now? And I think it's that. It's like it turns into a boys' club and then some women, you don't have thick skin to defend yourself every time. It kind of hurts. And sometimes you don't get exposure to the different cultures, and different areas, the way that they speak and communicate to a female (is) disheartening. So I think it's, a lot of things have to change. I think universities have to have programs for women who come, to kind of beat that stigma out. You know? And it hurts in a, I think in a level that not a lot of women like to get hurt in. Just the feeling that they can't do it. And that's not nice. I don't think anybody likes to be treated that way.

When describing her overall experience as an engineering student Elizabeth mentioned, “Okay, one of the other things that came into my mind was it's not common to find a lot of women in engineering. That is for sure.” She went on to explain the impact this had on her:

And in some sort of aspect it could, not to say it's a bad thing, but it's lonely, because you find mostly the, in the industry, it's mostly men. So, we have to work harder than usual.
We have to prove ourselves. We have to have one of the best resumes, or have a characteristic that the men didn't have. For example, one thing that I do possess, and not a lot of people do, is the ability to communicate. To be, how do you say it, in interpersonal relationships. So, it's very easy for me to connect with people. Very easy to talk. If I don't know that person, I'll create the conversation and I would learn to network. Or I'm easy for public speaking. So, it's not hard. And that's something that men usually don't like, and they'll give me that job. (laugh)

Elizabeth continued her story and explained how she handled these experiences. She recalled learning to overcome this through her membership to an organization specifically tailored for women in transportation engineering that provided her the guidance of a woman engineer mentor. She related: “One society I belong to is the [Acronym], it's called [professional organization’s name], which is mostly engineering women, coming together and basically mentoring each other.” Elizabeth went on to relate her experience within that engineering space:

Two semesters ago, so give it about the beginning of January, something like that I was part of a mentorship program from [organization]. It was, again, basically another woman. Not a Latina, it was mostly an American woman that has helped me translate myself from the school environment to the engineering professional world. It was very helpful to see that from a woman's point of view. And she would explain to me, her examples, her story of how she overcame it, and how she became a professional all the way.

The men-dominated characteristic of the field of engineering does not end at the higher education institution’s door. Pilar found out engineering was not only a men-dominated field as a major and within the boundaries of her engineering spaces, but also as an industry when she
started her first internship. Pilar related: “And then when I got the internship, and of course the boss is a man, and then my professors are mostly men.”

“It Took For Me to Butchering a Pig: Feelings of Gender Discrimination”

It is not surprising, then, that after discussing their gender identities and the male-dominated spaces in which they found themselves that the participants would also discuss experiences of discrimination. However, gender was not the only area in which students experienced discrimination in their programs. More than a few students declared having some challenging interactions regarding age, gender, and race as well. These perceptions of discrimination while in engineering spaces detracted from their persistence in engineering. A few participants stressed their desire to fight the stigma that came along with being a Latina.

To this Daniela added, “Mmm, one of the biggest challenges. I think, honestly, it would have to be what we were talking about earlier, was about feeling discriminated against. Feeling like I'm lesser than. You know, especially when it comes to the field of engineering” During her interview, Daniela mentioned the phrase feeling lesser than more than once. The first time was while describing her experience as an engineering student, the second was while giving advice to young Latinas. She narrated:

Actually, yes. Sometimes I do think that they think less of me, for one, you know, since I came here with my associate's, in my classes I'm younger than mostly everyone. (laugh) Everyone, since I'm taking the higher classes already, everyone is at least 20, 21 or older. And I am 19. So, when I came in I felt like people just saw me as like oh, she's a kid or she's a child. Then it doesn't help, you know, that in this, in engineering, in general, you're surrounded by guys, and so most guys have a habit of thinking they're superior.
Sometimes I feel like they're like, Oh, it's a girl. Like oh, she's probably not that smart. Or this little, this girl, she's a kid. Or something.

The second time Daniela used the phrase *lesser than* in was in regards to giving advice to high school Latina women who wanted to go into engineering. She advised:

My advice to them would be to not give up. It would be to try their hardest, and you know what, people might think of them as being *lesser than*. Or people might think that they won't be able to do it. Because I feel like some races have, if they're a typical mindset towards Latinos/Latinas, and they think that we are *lesser than* them, you know, just because of where we're from or where we were born. And I know that it can get hard, because I've seen it personally. I've felt it sometimes. I've seen my friends go through it. I've seen my family go through it.

While describing how she felt walking into an engineering classroom Elly said, “I feel really confident. I can tell you that I feel like my peers turn at me and they look at me as a person who knows her stuff. And who is smart and really loves what she does.” Elly proceeded to discuss how her confidence impacted her in engineering, she said:

I'm pretty sure that if I go to a state that's more, that has more Americans, so, um, yeah, Americans, it's going to make me, so being confident, well, like I said, being a minority, it can take you down really easily if you don't know your worth or if you don't believe in yourself. So, you know that scenario that I encountered, they're like oh, you're a girl. Or, you know, actually. I recall sometimes people saying that Latino people are really lazy. Or like oh, you're from Honduras. So, are you like a drug dealer or something like that? Have you, do you know drug dealers? I'm like, no. My cultural background doesn't mean that I'm part of the bad part of my country. Because my country has had bad aspects. But
that doesn't mean that I'm part of that bad aspect. So, me being confident, and me knowing myself, makes me push away those negative thoughts and that negative energy that people bring into you whenever you're an engineer.

When Elly described a significant challenge she had to overcome as an engineering student, she referred to the way one of her study partners (a man) made her feel. She recounted, “Sometimes maybe this might not be the best example, but proving myself to others, sometimes it's necessary for them to respect me as an engineer. And as a Latina. And as a woman.”

While describing herself, Luz touched upon race and how she perceived others viewed Latinas and how she is determined to overcome that racial stigma – the standard. She said:

I think having a purpose, I guess. Because I know what, I mean, let me think about this a second. More, I know, for sure, having a purpose. Because I know where I'm coming from and I know I am a minority. I know I have a lot of disadvantage most of the time. And being able to overcome those things, and having that drive to want to surpass those, that standard, for people who are Latina, is why, is what gives me the drive and the dedication and the strength to keep going and to try to be the best I could be. Trying, and having this opportunity to actually get an education here, in the United States, I'm really trying to get the most out of that. Yeah, it has to be, it really has to do a lot with the purpose and what I'm doing this for. And I often consider myself as a multitasker. That's really helped me stay on top of school.

Daniela narrated an experience she had while attending a professional symposium. She recalled:

A lot of jobs, I remember there was a job that I had really wanted and I was looking into an internship with them, but I remember that they had said that they were only looking
more for guys because guys are the ones that should be doing the outside work, and girls should be the ones doing the inside work.”

Daniela proceeded to state how hearing the abovementioned comment made her feel. She shared:

That, to me, it didn't hurt me. It just got me a little bit mad because I was kind of like, well, I can do just what you can do, and, if not better. That, to me, is one of the biggest challenges I feel like I have faced and that I think girls in engineering face, in general. Guys tend, maybe not so much now, or where I'm from, but especially from other schools. When we had gone to the [organization] symposium, most of the people there were boys, or guys. And there was hardly any girls. I remember a guy had made a comment and he was like how are there so many girls? Why are there so many girls? Girls should be working inside. And you guys know that you're going to have to work outside, right, as a civil engineer? It's just stuff like that, that we're, we have to overcome.

Daniela explained how she handled herself in this situation and helped her women friends handle it as well. She remembered:

Well, I remember when one of the guys had said that, one of my friends had gotten very mad. And she was about to go off with him, and I looked at her and I just told her, I was like, it's okay. It's fine. We're not going to give into that. For all we know, they're just trying to provoke us, to make us angry. I feel like boys have a, or guys, in general, have a stereotypical picture of women. In general, it's kind of like oh, every woman is the same. I feel like boys think the same as that, and they think oh, every woman is the same. They get mad easily. They get, they overreact easily. And I felt like that's what they were trying to do, was to provoke us, and wanted us to say something. So, I was like you know
what, we'll just prove it one day. One day we'll, we just have to trust in ourselves and trust that we'll do better than they will. And one day, they won't be saying that.

When asked to describe her engineering experience, Elena said it was “I think very nice. You know, I have the skill set to be able to solve a problem and analyze it.” However, Elena was very vocal about how her experienced changed her. She recalled:

   But it has changed me as a person, because I never wanted to believe that because you're female, somebody's going to think twice. And I've actually experienced it. I think that that's something that's going to take some time, for people to take you seriously. I've met girls who are absolutely brilliant in their field, and they know what they're talking about, but yet they prepare twice, three times, and more, because they know that they're going to get a ton more questions.

Elena elaborated on an experience related to women not being taken seriously. She narrated:

   So, I was running a meeting for a design on a mold. And everybody had told everyone, hey, I want to for the meeting, and everyone can come up with their own design. And I think that's better. And I get there, and I'm like. You know this is not going to work. It's not going to work. Like, problem with this design, and the guy is like, you know what, how do you know what you're talking about? And I'm like well, I do machining. He goes, well machining, is just knowing how to work a part. I'm like, I know I work in a power tool, I worked with a mill and a lathe before, and your tolerances don't make sense. And then he's like, no. No, no, no. They do make sense. You don't know what you're talking about. And I'm like, I do know what I'm talking about. I have machine shop experience. And I have a certification, and I've done molds before. So, it took for me to -butchering a
pig- before he finally gave up. And it's hard. Or, what sort of machine shop experience do you have? So it's an interrogation, to prove your qualifications.

An example showing a challenging climate for women in engineering was also shared by Crucita. She told the story of when she first realized her gender was used to define her in engineering:

I always thought, okay, I'm just an engineering student. Right? I didn't see myself first like oh, a Latina woman in STEM. I always saw myself as well, I'm an engineering student and I'm here to pursue an engineering degree, just like everyone else. I tried to see myself, and I tried to go into college with that mentality, of like, oh, you know, it's, being Latina does not define anything. It doesn't change anything for me. But it actually has. Actually, not too long ago, there was this, because I'm in the [professional organization], and we had a meeting, and civil engineering is, it's primarily male in my school. But we had a meeting and there were a couple of us, females, and a number of males. And there was [leader] he was talking and he said something that was really inappropriate. He probably could have said it a little bit differently, but he was just like, Oh, to get sponsors, we would like to have more women come with us because women know how to talk to men.

Crucita reacted to the remark made regarding the women’s role in engineering. She continued:

That just made me feel like, okay, just because I'm a woman, you're saying I can use my, like me being a woman, to flirt with men, to get money? Then I'm just like, right away I was saying okay, now, I think what you mean is that we want to make the group more diverse. And we want to promote diversity. We want to promote diversity, that there's men and women pursuing STEM. Right? Is that what you meant? And then he was like,
oh yeah, I totally didn't mean, like don't take it the wrong way, whatever. And I just said, okay, well, next time just try to be conscious about what you're talking about, because we're in 2019, where anyone can be whatever they want to be. (laugh)

**Sense of Self: Sense of Agency**

To overcome the negative experiences and interactions they discussed, the students in this study described themselves using characteristics they deemed to be their strengths and helped them persist in engineering. Amongst these characteristics were confidence, resilience, determination, good attitude, and being a hard worker. Also, several students alluded to their desire to help others as much as they could and the influence of faith. Because they had the power to impact their own persistence, at the very center of Figure 3 (below), we have the Latina student herself.

Figure 3. Elements influencing the Latina students' experiences in engineering spaces
“I Set My Mind to It and I Work Hard, I Can Do It. And Nothing Can Stop Me”:

**Contributing to Their Own Persistence**

For example, completing projects and receiving good grades became a way of proving to themselves, and to others, that they could do it. One example of this was Isabel, who was working on getting several papers published before finishing her degree. The confidence boost she received from having her papers accepted was key, she expressed seeing them published was proof she could do this. Isabel related:

> It is a literal hard copy thing, that I can do this. Like it's a physical, tangible thing. Saying I can do this, and it also puts it out into the world, to the world that says hey, this annoying girl, who kind of messed up a little bit, has been able to bounce back and now be at the top of her game. Like, it's a lot, and it's kind of shown me that I know, no matter what I do, if I set my mind to it and I work hard, I can do it. And nothing can stop me.

> The only one that can stop me is me.

During her experience as an engineering student Daniela said it all comes down to having a positive attitude. She shared:

> Just to be positive, have a, try to look forward. Try to see, if I fail this exam, am I going to be sad about it in five years when I'm working and I have a job? Or am I going to be sad about it when I'm successful and I'm accomplishing what I wanted to do? It's just, I feel like it's, for this field in general, for engineering, I feel like it's all about a person's mindset. I feel like it's all about how they handle things. No one ever said engineering was going to be a piece of cake. If it was, everyone would do it. (laugh)

> I feel like, yes, it gets hard, but we wouldn’t be here if we couldn't do it.
Migdalia explained how she felt when walking into an engineering classroom. She said, “First of all, I feel proud. I feel proud that I'm here, and mostly because in my classes, it's usually like five girls and everyone else is a male. So, I feel really proud about that, that I’m there.” Migdalia proceeded to explain how feeling proud pushed her to keep going:

Oh, it makes me feel, when I feel proud, it makes me want to work even harder and prove to myself that I can do it. And that I can achieve anything that I set myself to. Yeah, I think that's pretty much it. I just feel like I've got this. I can make this work. Stuff like that.

Determination and resilience were key characteristics when things got tough, even when some wanted to quit they decided against it, as Ari explained, “I think about it, and I'm like not many people can do this, but I'm here. I'm doing it. There might be some times that I'm struggling, but I'm going to push through.”

During interview Elizabeth related an example where pure determination was what got her through. Elizabeth shared a difficult situation in which she took a class three times before she passed it. She related:

Okay, so I was taking mechanics and materials, and that's something that all civil engineers have to do. But, unfortunately, I wasn't doing well. Ni la primera, ni la segunda. Pero en la tercera vez tenía que pasarlo. (Neither the first, nor the second, but the third time I had to pass the class). So when, I've noticed that my study habit was mostly by myself, learning to do that. However, by the time I failed it the first time, I said no, you know what, I've got to start asking questions. Opening up. So, I started networking. So, again, that's where the openness comes in. I asked different kinds of people, hey, do you understand this? Do you understand that? Some people knew better
than others, so I just took the best of what I had and learned to study. Unfortunately, the second time, I did not pass. But the third time, I knew that by asking questions, learning how to study, through the advice that my friends had given me, that made me pass the third time. So. (laugh) Learning power.

During her interview, Olga related the experience on how she got her first internship during her sophomore year. Olga described:

When I was at the [professional organization] national convention, last year, I was, like I was trying my best to find an internship. I knew it was going to be hard, as a freshman, because I didn't have the typical experience and I had read, I don't have any engineering related projects. But I still went, and I would still talk to companies. I spoke with [company name], which was one of the companies that I knew hired young people. So, they were my main focus throughout the whole conference, and I would, I went to their workshops. I had two interviews with two different recruiters. I was there. I was always there. I went to the career fair and I spoke with [name of company]. I spoke with different recruiters, just about, like hey, I had an interview, but I wanted to ask you more about how the company is like, or what can you tell me about why you like working at [name of company]. And I think that's one of the parts that I was resilient, very resilient.

Similarly, Crucita shared that while she was completing her summer internship at a school that was geographically far away from home, there were times that she questioned whether engineering was right for her. She explained,

Going home to nobody, and having a really rough day and not having anyone to talk to about it. So, I questioned myself a lot. Like, am I even good enough to pursue this? I'm struggling so much just in the nine-week program. Imagine me actually doing graduate
school. Imagine me actually pursuing an engineering discipline where you work 40 plus hours a week. It was just like, I kept having those questions over and over and over again. But I always went back to like, no, okay, my mom didn’t raise a quitter. I'm just going to keep going because I can either just cry about it for nine weeks or I can do something about it, and at least say I left with the satisfaction that I did something about it. Just persisted and persisted until I finally got the results I wanted. And now my professor loves me. (laugh) He even wanted me to stay there to finish my degree at [summer internship institution] and continue research with him as a graduate student. It was like a whole 360 turn at the end of the day. (laugh) It was like really, really good.

“God, You Told Me That, I'm Going to Stick with It”: The Influence of Faith

During this study a few of the students also shared how their faith in God was what got them through difficult times. They shared how through prayer they found guidance and answers to questions related to their engineering journey in higher education. For the most part students activated their faith when narrating difficult situations in which their resilience was pushed to the limit. Elizabeth stated that when things got tough, “The first thing I do is pray.”

Elizabeth experienced a tough semester after transferring from a local community college to her institution’s engineering program. She narrated:

I became overwhelmed to the point where I couldn't take it. I wanted to cry. So you would see me in my room, crying all the time, like this is so hard. I have no one to help me. And not that I didn't know how to receive help, but I had this habit of studying by myself. But lately, like for example, that's another thing about me, I am very, I'm a Christian, so I have a strong relationship with God. During that time, I was thinking a lot, okay, what is my purpose? What, what does it have to do with engineering? So, within
the years afterwards, I've learned that I want to pursue engineering because I do want to impact young women in STEM through education.

Elizabeth proceeded to share how her relationship with God impacted her as a Latina engineering student. She related her story:

*En, cuando comencé la profesión no sabia lo que quería hacer. Literalmente,* (When I started studying I did not know what I wanted to study. Literally) oh I'll also use it in English, maybe it's better. But when I decided to pursue my engineering degree, that wasn't my first choice. It was accounting. So, when I got there, I'm like you know, this is not for me. I literally took a pamphlet that said "civil engineering". I looked at it and I'm like, guess what, I'm going to study this. So I literally picked it out of random. That was not good, but I was already too deep into the career. I wasn't going to drop it. So, I talked to God, and I said, what I'm I going to do? Because this is not something that I see myself doing. And the one thing that I kept reading, besides verses and praying, is stay faithful to the process. Remain in there because eventually you're going to find out what you're meant to do. And as I did, again, I'm getting revelations of, man, you're studying this to become a doctorate in teaching. You have to do this.

Once again, Elizabeth was presented with making a choice during her fourth year in engineering.

This is how she approached that experience:

So then I had the option in my 4th year in college, to pick whether to go to industry immediately or go straight to research. Another time. So, within that part I was praying, and I said to God, look, I don't know what to do anymore. You have to tell me what to do, and I will expect your answer, to, I mean it was to, how do you say it, I was too arrogant on my behalf, but I was desperate. So, I'm not going to lie, at 12pm I received a
phone call in the middle of the highway that said, hey Elizabeth I really want you to meet this professor. She wants you to do research, and I think you're really going to like her. And I gave it a chance, and to make a long story short, I stayed with it. And I'm like God, you told me that, I'm going to stick with it. So, now that I'm out of research, now that I'm starting in industry (internship), I got, I have gotten to know that my purpose is to stay faithful to what I am doing, and do the best I can, because eventually, with time, you're going to find your purpose. And I think I found it. I'm just patient enough to go through life, step by step, learning, doing my best. Then once I start reaching my purpose, I'm going to look back and say, look, I did it. I've trusted in the process. I have remained faithful in God. So, and he talked to me. Always talked to me. It's maintaining a close relationship.

Nevertheless, when sharing her advice to Latina high school students who wanted to become engineers, Elizabeth said, “Be open to new exposure. Find the passion that, well, I can't mention God to them, but finding your passion, finding your craft, learn to excel in that area.”

For her part, Elly also mentioned the impact her relationship with God had in her persistence in engineering. She narrated:

Definitely, my faith in God is one of the biggest things in my life. God comes first for me, overall. Every time I am doing something, so, for example, for my [organization] conference, I was like listen, I was praying to him, I was like I know this is for me. I know you're going to open this door for me. And I've been at his own time. I just turn to him for almost everything. Every time something is bothering me, not only as an engineer, but also as a person, I turn in to God.
Elly also talked about a specific experience in which she turned to God and explained how relationship with God impacted her engineering journey. She narrated:

I'm like please, because being an international student, sometimes it's hard because there's a lot of obstacles in the way. For like getting a job, for getting an internship. There's a lot of paperwork, and people sometimes just don't want to do it. Companies, universities, they're not, are just not willing to take that extra step for you. So, I turn to God, to that aspect, telling him please, touch their hearts and just open a door. Because if it's for me, I know you're going to give it to me. If it's not, then it's not for me.

Daniela mentioned how when things got tough in engineering, she always turned to God. She also alluded to having a relationship with God before entering higher education. To this effect, she commented:

When I was in high school and I was doing bad on my grades and on my exams, I had kind of felt like, God, why did you put me here? You can't get me through this, or I can't even get myself through this. Why am I here? I'm feeling like a failure and feeling like I'm dumb. What am I doing here? I would pray a lot, I would talk (to God) a lot, and I think that week at church, I had, the sermon or the service was about how we just have to trust. We have to trust in God and how he will give a sign to us. That everything will be okay and if he put us there, it's for a reason. And we have to trust that it's a good reason. So, I realized that I didn't trust him so much when it came to school. I felt like that was the sign that I needed, was to trust him and to work hard and that everything would just go as planned. After that, after that service, I started doing better on my grades, and I ended up with all As that semester.
“I'm Very Introverted, so Having to Put Myself Out There Is Definitely Something That I've Struggled with”: Discouraged by Challenging Characteristics

On the other hand, the students did not always see themselves positively or described challenges that they felt they needed to overcome. A few students in this study described themselves using characteristics they considered created additional barriers to their persistence in engineering, thus potentially discouraging their persistence. Amongst these characteristics included having mental health issues, feeling underprepared, a negative self-image, and feeling disadvantaged.

During her interview, Crucita made a comparison between the secondary education she received in the USA to that offered in Asian countries. She explained:

Because their (Asian professors’) culture STEM is very prominent and you feel like it's kind of just like normal. In our schools, because while our professors, actually, one of my (?) professors, she was kind of explaining how (Thailand, or one of those places). She was saying that in her elementary and high school years, they focused a lot, a lot, a lot on STEM. Specifically science and math. And here, we focus on the social sciences. Versus here, in USA at least, we focus a lot on social sciences. And we kind of try to as much as we can, but because of that, our science and mathematics, like when we graduate from science and mathematics, we're not as strong as they would be. That's only something I noticed because a lot of our cities here, our high schools, are not very, we don't have the highest, I guess we're not very, like when we graduate high school, we don't have the skills necessary to be able to succeed in really big schools. Or okay, I don't, I mean I guess you could say that. Yes. So, yeah. And we also don't have, we don't come from, because it's easier for someone who is surrounded by an environment of engineers and
PhDs and master's students, versus people that have parents that have an elementary education.

Delia also shared what she considered her biggest challenge to be as an engineering student. She related:

Trying to stand out from all the guys. Males have more technical knowledge, they know more ‘bout electronics. They get to be exposed to things like that, but not girls. Girls have to follow the mom and clean with the mom, while boys are learning technical things, we are cleaning.

She went on to explain how she overcame constantly trying to stand out. She shared:

“Dedication. Not a lot of them guys has dedication. They get tired, they get lazy, they stop trying. They don't want to strive to keep going. I can see the line its stops at dedication.”

During the interviews a few students mentioned characteristics that created additional challenges to their pursuit of engineering. While Migdalia shared some of the strategies she had implemented during her educational journey she mentioned some characteristics that had made it challenging. She said:

Mmm. … I think that one of them was networking and socializing, because when I first got into [my institution], I didn't, I was very shy. I was very reserved. I didn't like to talk to many people, so at the beginning I was just staying with my group of friends. But none of them were studying engineering, so when I had a problem with one of my classes, or with something involving engineering, I had no one to go with but my brother. But none of my classmates that were in my same classes, because I was very shy. But then towards like, later on in time, I learned that I had to network, and I had to make friends, and I had to socialize with other people in my, in the same classes as me, because they were the
ones that could help me. They were the ones that could tell me if I'm missing something, or we could study together and stuff like that.

While describing herself Pilar said, “Even though my two friends, they're very, very shy. I'm shy, but they're very, very shy. (laugh)” However, she did something about it to help herself and her friends:

They would not, yeah, they wouldn't talk to a lot of people at all. But I would always, once I made friends in civil engineering, I'd be like oh, come to the civil engineering building and I'll introduce you and I'll show the labs and I'll show you everything. And I would tell them, look, (Name), this is this person. This is this person. Oh, let me show you my best friend. And then that, I would force them to talk to people. Then they went and made friends and they'd force me to go talk to them. So we just all just pulled each other all over the place. It's like a tug of war all the time.

Additionally, Gracia described herself, “As an introvert.” As such, she explained a few challenges she encountered. She narrated:

For me, probably it's my anxiety when it comes to putting myself out there. And being, in engineering, nothing is really handed to you. You have to go out and, for example, put yourself in group organizations that are in the school or in, even internships, you know, you have to go out and look for them. You have to interview for them. It's definitely, I'm not a very social person. (laugh) Like, I'm very introverted, so having to put myself out there is definitely something that I've struggled with.

Gracia continued her story and explained how she handled these types of experiences. She recalled:
I just, honestly I just, I don't know, I try to, like I just remind myself that it's not going to be handed to me. You know? I think I have things that I want to do, like recently I know that this group started for this [professional organization] competition, and the first meeting, even just going to that, for me, was really nerve-wracking because I didn't know who else was going to be there, or how hard the competition was going to be, or how many people were going to be able to participate in it. So I think it's understanding, again, that it's something that I really wanted to do, but I had to go there. You know? The professor wasn't going to come up to me and tell me, specifically, out of the blue. They're not going to come specifically to me. You know?

Gracia also mentioned other experiences which were made more challenging due to her anxiety and stress. She shared:

Mmm, no. I think for me … maybe not necessarily negative, but more challenging, would be when I have to do presentations for different classes. I know, I mean as an engineer, there's many times when I'm going to have to present a project. So, I think those experiences are needed. But during those times, every time I know that I have to present for a class, I get very anxious. And stressed about that. So, I think those are not my favorite.

Gracia continued explaining how, although difficult, she managed to get through presentations. She shared:

I think, well, one is my determination to get a good grade. I don't want to fail just because of this. And also, presentations are usually in groups, so I think of my group members. I don't want to, again, drag others down, just because, I don't know, I was very nervous or anxious about doing stuff. Because I know how hard that they worked on it as well.
Furthermore, when Imarys narrated her story she confessed not identifying herself as a success story, although her graduation date was only a few months away. Imarys explained:

But when it comes to successful, I feel like I'm not good at what I'm doing. So, I don't think I'm successful in my mind. I have a, I see success as finding a sweet spot, which is basically being good at something that you like and that is also helping others.

Imarys went into more detail to describe her experience as soon to be graduate from engineering. She recalled:

I think my biggest struggle was my mental health. I'm still struggling with, until today, and I've gotten better, but, I mean, it's the combination of depression and my personality. Like the whole isolation aspect can be part of the depression. The whole being unmotivated, and whatnot, can lead to, you really lose the importance of what you're doing. You become very careless. So that affected me negatively, academically. But I mean, yes, I struggled with academics, and I don't know if I had studied anything else, would it be a different me, would I not be in this state of mind. I honestly don't know, but it's a constant feeling of I am not good enough. And I think that kind of (sigh) has been my whole engineering experience.

Imarys continued her story and explained how she handled these type of mental health issues in order to persist and be eligible for graduation in a few months. She recalled:

As an engineer, you kind of do the math, to be like, what is well enough to let go. What is enough to get you through? Sometimes I didn't even do the math, and I would just kind of, I would just stop showing up to class. That's how I started failing some courses. But for the courses I did pass, I think the best way was finding other people to study with. And also, financially, that's what keeps me going, because I know I need (laugh) to, a
salary to live off, by, and I can't keep getting into debt. And I can't, yeah, I can't keep living off loans, basically. I think that's what pushes me the most, which is not the best driver. (laugh) But it's what I have going so far.

**Meaning of Becoming an Engineer**

Having a clear understanding of what becoming an engineer meant to them and knowing the direction they wanted their lives to take contributed to the persistence of these Latina engineering students. The students explained what it meant to them to become engineers—having a meaning or a purpose helped them focus on their dreams and pushed their persistence forward. Even though many used the term *graduate*, several used the term of wanting to *earn* their title.

When asked what becoming an engineer meant to her Elena quickly responded with the following experience. She said:

When I'm watching the surgery, I'm paying attention to the procedure, but mostly paying attention to how the physician holds the tools. Because that's what I'm interested in. I, you know, it's nice to make something a little bit nicer for somebody who's operating for 13 hours and they haven't slept in 48 hours and they haven't eaten or seen their family in three days. So, but that's something I've picked up along the way.

During her interview Carmela explained why becoming an engineer had become so important to her. She replied:

Well, it means that I can help out people that don't have the ability to help out their surroundings, and then like foreign countries, not just foreign countries but here in the [county] where I live, it's very, not, it's susceptible to flooding. So, it's kind of like I want to focus on water resources only so I can prevent that from happening. Because, I mean,
there's not, we don't have the greatest economy, but we're not poor either. We're just there, so I want to be able to help the people with their issues.

Inés, for her part, shared what she found most rewarding about her chosen engineering major. She recounted:

All the engineering majors, I feel like we, engineers, have the power to actually, not, I mean, not only change the world, but yeah, do something for our community. So that, yeah, that power, that's what keeps me going.

When asked if there was anything else she perceived had impacted or pushed her to persist in her engineering major. She added:

Um … I mean, I feel like personally, it does depend on the person. For me, I wanted, like I wanted to, I'm really, really interested in medicine and helping out people. So, I know that's what I'm meant to be. And that's what I'm meant to be doing. Because I couldn't find myself in any other major. I thought about, is this even worth it? I'm going to switch to business or like, just joking around. But for me, I know my passion is biomedical engineering. So, that keeps me going. But yeah, it does depend on, on every person, like what you want to do in the future.

When relating an important experience she had during her educational journey, Ari mentioned:

Um. … So, this is also a part of [professional organization], but doing outreach events. We did a, an event where a bunch of schools went to [name of institution] and we showed them about engineering, and we did a bunch of projects and activities with them. That was a big, a big one for me. It just, I mean it hasn't impacted my studies, being able to
give back, and teach kids about what I'm doing, and maybe that experience leads them to walk in my same path, I think is nice.

While mentioning what her advice would be too young Latina students who wanted to pursue engineering, Crucita recalled her summer internship experience at a Predominantly White Institution (PWI) where the lack of Latinas was evident. She mentioned:

Yes, definitely. Definitely, and when I went to [PWI], that's also something I saw. I saw it was primarily white males, or Asian males, or white women. We would never, I never saw Latina or, it was just like, it was very different. It kind of motivated me, like, okay you know what? I need to, I need to be a mentor, I need to give back to my community and help them pursue PhDs or go into STEM, because we are the future. (laugh)

Furthermore, quite a few of the students expressed a desire to advance their career and revealed future plans. Some examples of these future goals, which helped put their persistence into focus, including obtaining a PhD. To this effect, Crucita said:

So, me, as an engineer, I would be helping my community, I would be coming back to my community, after I get my PhD and I become a professional engineer, I would be coming back to my community and helping them by mitigating natural disasters. Or minimizing the damage as much as possible. Promoting resilience in cities.

When asked what was pushing her to persist in her engineering major, Delia mentioned her future goals. She shared:

I want to do my PhD, I am not satisfied with my BS. I feel I don't know enough. I can’t go to work, the company is going to pay me for my knowledge and I don't know much - I am not ready! I need to take more classes to be where my professors are. They took different
classes, better classes and I respect them a lot. I highly respect my professors they are more prepared than me. I need to keep going. All I know is that a BS is not enough.

Olga also talked about her dreams of going into aerospace engineering. She said, “Yeah, aerospace too, but I want to go more towards space things.” Additionally, when describing her experience as an engineering student, Olga said:

Mmm, it's been great. It's been, I think, as a Latina, you have a diverse, different perspective on education. You realize how important it is. Not saying that not-Latino students don't appreciate it, but I think it's more like hey, like I moved from Venezuela and now to me, for example, NASA could be something that I could get to. But if I was living in Venezuela, that would be something that I would not be able to achieve, or think, even think about. It would be a lot harder. I guess I really like that part of having more, like you get to have more opportunities, if you really look for them, as a Latino engineering student.

**Summary of Findings**

In summary, this study focused on understanding the persistence of 20 Latina undergraduate engineering students enrolled at two public four-year Hispanic Serving Institutions. Key findings in this study showed that in order to contribute to their own persistence in engineering majors these Latina students activated their community cultural wealth: (a) not only to resist different forms of oppression, but also to thrive and excel in academic settings, (b) to take control of difficult and challenging experiences, (c) to take/receive knowledge from others, but also to give/share their knowledge (cyclical tendencies of CCW), (d) as well as revealing that helping others was the reason many chose to become engineers. Two major findings of this study regarding Latina undergraduate engineering student persistence included: (e) the influence of faith on Latina student persistence, and (f) overt and covert applications of
In chapter five, I expand the discussion on these findings by providing a deeper analysis guided by three frameworks. These frameworks included Yosso’s (2005) community cultural wealth model, an intersectionality lens (Crenshaw, 1990; Jones & Abes, 2013), and critical systems theory (Melzer, 2013; Simon, 2009; Watson & Watson, 2011).
CHAPTER FIVE: DISCUSSION, IMPLICATIONS, AND FUTURE RESEARCH

The purpose of this study was to further the knowledge base regarding the underrepresentation of Latinas in engineering fields. More specifically, I aimed to understand the persistence of Latina undergraduate students in engineering majors through examining the following research questions: (1) How do Latina undergraduate students perceive the experiences that contribute to or detract from their persistence in engineering programs? (2) How do Latina undergraduate engineering students make meaning of persistence in their lives? and (3) How do Latina undergraduate engineering students make use of/enact/implement/cultivate their community cultural wealth in order to persist in engineering majors?

In this chapter, I discuss and interpret the experiences presented in chapter four and connect them to extant literature in order to further the knowledge base regarding the underrepresentation of Latinas in engineering fields. Through their stories, these participants narrated their experiences in engineering spaces. Critical systems theory (Watson & Watson, 2011), the community cultural wealth model (Yosso, 2005), and an intersectionality lens (Crenshaw, 1990; Jones & Abes, 2013) guided this discussion and my interpretation of the findings. Findings in chapter four revealed how students perceived and reacted to the experiences lived within their engineering spaces, and how by activating their community cultural wealth students contributed to their own persistence in engineering majors (a) not only to resist different forms of oppression, but also to thrive and excel in academic settings, (b) to take control of difficult and challenging experiences, (c) to take/receive knowledge from others, but also to give/share their knowledge (cyclical tendencies of CCW), (d) as well as revealing that helping others was the reason many chose to become engineers. Two major findings of this study
regarding Latina undergraduate engineering student persistence included: (e) the influence of faith on Latina student persistence, and (f) overt and covert applications of capital.

These findings also identified the elements interacting within each experience, including: (1) the student herself, (2) interactions with key players – faculty and other engineers, (3) effect of the interactions on climate, (4) effect of the interactions on the student, and (5) actions taken by the student, if any, in reaction to these interactions (activating CCW). In the next section, I expand the discussion and interpretation of these elements, how they came to be, and how they coexist and intersect with one another – thus impacting the students’ persistence.

Moreover, several persistence researchers have identified a need for further study to explore the relationships between persistence and community cultural wealth (Espino, 2014; Samuelson & Litzler, 2016). Especially including in the analysis not only the heterogeneity of Latina identity (Dill & Zambrana, 2009; Torres et al., 2003), but also the role the educational organization or system has on these students. This study assists in filling those gaps.

In this study, many of the experiences the students shared encouraged and contributed to the Latina students’ persistence, while other experiences tended to discourage or detract from their persistence. Several factors within each experience were deemed to impact such outcomes. Table 2 below depicts the factors that impacted the students’ persistence. It is important to note that each story had several of these factors that interlaced and occurred simultaneously. The factors presented in Table 2 link several aspects of this study including the theoretical frameworks, the research questions, how these are used in the analysis of the data generated by the interview process and presented as testimonios.
Table 2. Factors Impacting Persistence and Theme Classification of Factors

<table>
<thead>
<tr>
<th>Factors impacting persistence</th>
<th>Encouraged</th>
<th>Discouraged</th>
<th>Themes</th>
</tr>
</thead>
<tbody>
<tr>
<td>a the students’ identities: gender, race, ethnicities, Spanish, and so on</td>
<td>X</td>
<td>X</td>
<td>self</td>
</tr>
<tr>
<td>b characteristics/skills of the self</td>
<td>X</td>
<td>X</td>
<td>self</td>
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<td>c other engineers</td>
<td>X</td>
<td>X</td>
<td>others</td>
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<td>d engineering faculty members</td>
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<td>X</td>
<td>others</td>
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<tr>
<td>e professional organizations</td>
<td>X</td>
<td>X</td>
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<tr>
<td>f engineering classroom</td>
<td>X</td>
<td>X</td>
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<td>g engineering departments</td>
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<td>h reason for becoming engineers</td>
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<td>i faith/God</td>
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<tr>
<td>j activating forms of capital</td>
<td>X</td>
<td>-</td>
<td>CCW</td>
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</tbody>
</table>

Rearranging the 10 factors presented on Table 2 above showed that, for the most part, each of the experiences shared by the students had some concurrent themes within each story. These themes are listed on the far-right column of Table 2 for ease of reference. Each story took placed at a specific location, factors affecting the experience included the student herself and her interactions with others. These interactions with others impacted the student and also the way the student perceived the climate of the space. However, the student herself also impacted her own experience, as she brought in some characteristics and skills that helped her through, as well as by choosing to activate her community cultural wealth in order to contribute to her own persistence. Following that line of analysis, the reason or meaning why the students became engineers also contributed to their persistence. These themes are presented on Figure 4, below.
Figure 4. Themes in a student’s experience

<table>
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<th>Phase 4: Themes</th>
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<td>• Location of experience</td>
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<td>• Reaction to experience: CCW</td>
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<td>• Meaning to participant</td>
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<td>• Factors of the self:</td>
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<td>• Individual factors</td>
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<td>• Intersectionality</td>
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<td>• Factors other than the self:</td>
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<td>• Relational</td>
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<td>• Systemic: Climate</td>
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Further analysis of the themes presented on Figure 4 above, gives way to what I classified as the elements of an experience. These elements summarize what is happening during each story shared. Figure 3 below is a graphical representation of a student’s experience within engineering spaces, the elements influencing the experience, and the resulting effect these interactions had on their perception of climate and the students’ persistence. The five elements are: (1) the student herself, (2) interactions with key players – faculty and other engineers, (3) effect of the interactions on the student’s perception of climate, (4) effect of the interactions on the student herself, and (5) actions taken by the student, if any, in reaction to these interactions (activation of CCW).
Once the elements interacting within the students’ experiences taking place in their engineering spaces were identified, then I was able to deepen the analysis around the research questions. Focusing on the element of the resulting effect these interactions had on the student and her reaction to these interactions gives way to the key findings of this study.

I organized this chapter by discussing the (a) Interactions with Faculty and their Impact on Students’ Persistence, (b) Identities, Interactions with Peers, and Impact on Students’ Persistence, (c) Sense of Self, (d) Community Cultural Wealth, (e) Analysis using CST, CCW, and intersectionality lenses, where applicable. I conclude this chapter with a short summary, I describe the limitations and strengths of this study, and include a few recommendations for future research and implications to policy and practice.
Interactions with Faculty and their Impact on Students’ Persistence

Encouragement/Support

The students in this study shared numerous interactions with many of their engineering faculty members in which they felt encouragement from their words, their actions, and the way they made the students feel. Feeling encouraged by these key players translated into making students feel welcome and feel they belonged in their engineering spaces. The engineering faculty members students interacted with were of different racial and ethnic backgrounds, however, both sites had some men Latino faculty members as part of their staff, with one of the sites having two Latina faculty members. These examples touch upon the importance of having an engineering faculty that represents the racial composition of the student body, a key element that rings true especially for Latino students (Laden, 1999).

By offering encouragement and support, these faculty members also showed students they cared and that they were invested in the students’ success. Examples of support provided by faculty members included being accessible, willing, and able to offer students additional help when needed, and by acting as mentors. Such actions from these particular faculty members’ part inspired, empowered, and nurtured confidence and cultural fit in the students. Such encouraging interactions described a welcoming climate during those experiences and for the specific student. These experiences touch upon the different roles Latino and Latina professors tend to take on in order to foster college student persistence in students of similar racial backgrounds – these roles include mentors, advisors, and role models (Chesler & Chesler, 2002; Dayton et al., 2004; Hu & Ma, 2010; Museus et al., 2011; Núñez & Murakami-Ramalho, 2012). Students tend to feel supported and understood by many of these Latino faculty members because they share a bond through similar experiences and by overcoming similar barriers in order to persist, thus fostering
a positive climate (Dayton et al., 2004; Museus et al., 2011). Further interpretation of the students’ experiences in this study revealed that these supporting interactions with faculty members positively impacted the student’s persistence, thereby upholding the literature.

**Discouraged**

Several students in this study also shared some instances when they felt discouraged to continue studying engineering as a result of their interactions with some other faculty members and engineering students or friends, thereby revealing the impact these key players have on the students’ persistence. Challenging interactions with these less-than-supportive faculty members included being told engineering was not for them, being treated with disrespect, being ignored, being treated rudely, and being looked down upon by faculty when they did not understand the concepts being taught. These types of experiences touched upon the antiquated and highly criticized teacher pedagogies, such as the banking system (Baldwin, 2009; Freire, 2014), often still implemented in many engineering classrooms, particularly as many faculty members are not trained to teach (Baldwin, 2009; Considine et al., 2014; Peralta et al., 2013). Baldwin (2009) connected the faculty’s pedagogical strategies to climate in engineering classrooms, writing, “Overall, the climate in many colleges and universities and in the academic profession as a whole does not seem conducive to enhancing undergraduate education in STEM” (p. 13). Further interpretation of the students’ experiences in this study revealed that these interactions with faculty members negatively impacted the students’ persistence, thereby confirming the literature.
Identities, Interactions with Peers, and Impact on Students’ Persistence

Encouragement/Support

Students in this study revealed how interactions with other engineers impacted their experience in engineering and therefore their persistence. A few of the students shared experiences whereby being exposed to engineering at an early age had piqued their curiosity and desire to learn more about the field. Some students were exposed to engineering as young children by a parent or a family member, others through programs in middle school and high school. These experiences of early exposure impacted their choice of engineering as well as their persistence by connecting their early identities and sense of self to engineers. These examples of capturing a child’s mind and feeding their engineering curiosity follows the current need for future American talent in engineering and other STEM fields (Camacho & Lord, 2011; Peralta et al., 2013), and as such the need to expose American children to STEM through early programs, summer camps, or after school programs (Bagiati et al., 2010; DeJarnette, 2012). Bagiati et al. (2010) connected early exposure to sparking interest in children by writing, “Early exposure to engineering may spark interest in and increase preparation to undertake engineering as a career” (p. 1).

Additional experiences of encouragement from other engineers included obtaining membership in groups, such as social networks, professional organizations, and study groups. This type of communal behavior, such as social networks and groups, relates and describes how communities of color, such as Latinos share knowledge, skills, abilities, and values – a concept captured in Yosso’s CCW model (Gonzales, 2012; Yosso & García, 2007; Yosso & Solorzano, 2005), which I discuss in detail later.
Students in this study related that studying in groups and feeling the support of other engineers and friends made them feel they were part of the group, which provided them with a sense of fit. These types of experiences relate to the concept of cultural fit presented in the literature as a factor impacting the persistence of Latino students (Cerezo & Chang, 2013; Gloria et al., 2005; Gloria & Ho, 2003; Rodríguez et al., 2003). Furthermore, Latino student achievement has been linked to students having support from other ethnic minority peers, such as a Latino community, minority organizations, and friends (Cerezo & Chang, 2013; Gloria et al., 2005; Gloria & Ho, 2003; Rodríguez et al., 2003), which explains why these ethnic groups tend to be drawn to each other.

Other examples of situations where students felt encouragement and support from their peers reflected feeling welcome within those spaces, examples of fitting in resulted from being around other Latinos, bonding by speaking Spanish to one another, and by acquiring membership into professional social networks. These bonding experiences through the Spanish language have been related to the link among language, identity, and culture (Pérez, 2014; Perez, Cromley, & Kaplan, 2014). But the importance of Speaking Spanish in an English-predominant country can also be seen as an act of resistance, since Latinos may draw on their Spanish language skills in order to minimize the negative effects of racial microaggressions (Perez et al., 2014; Vidal-Ortiz, 2004). Vidal-Ortiz (2004) also presented that Puerto Ricans speak Spanish as a way to move beyond the superiority of one language over another, thus relating language, culture, and power. In general, the way Latinos use language represents an important source of capital (Vidal-Ortiz, 2004; Yosso, 2005) and an act of rebellion. Further interpretation of the students’ experiences in this study revealed that these interactions with other engineers and friends positively impacted the student’s persistence, thereby upholding the literature.
Discouraged

At the same time, a common thread during the conversations in this study included other, more negative interactions with other engineers that discouraged the Latina engineering students’ persistence. Students remarked about the large amount of men, as well as the lack of women in engineering, which were evident not only in engineering classrooms, but also in other engineering spaces such as conferences, professional organizations, and the engineering workplace. These types of revelations have similarities to current issues in engineering presented in extant literature where engineering in the US is considered a profession for men (Bucak & Kadirgan, 2011; Faulkner, 2009) and, as such, men are considered the norm and women the exception to that norm.

Several of the participants highlighted the relevance of gender and how being a woman impacted their experience as engineering students. Some students shared how they felt unwelcomed as women and were not taken seriously in engineering as their engineering knowledge and skills were constantly questioned by other engineers. These experiences touch upon how women in engineering have reported feeling unwelcome and outnumbered (Baldwin, 2009; Bean, 1980; Blosser, 2017; Chesler & Chesler, 2002; Gloria et al., 2005; Gusa, 2010; Miller, 2014; Morris & Daniel, 2008; Ryan & Deci, 2000; Seymour, 1999; Tinto, 1997; Tinto & Cullen, 1973; Vaccaro, 2014), revealing a membership issue for women in engineering fields (Faulkner, 2009).

In fact, several of the women in this study felt that they had to prove their worth and skills to other engineers in order to attain membership to the groups, or to engineering itself, to the point that the women anticipated the enhanced questioning and prepared for it during class presentations and interviews.
In fact, many times the students perceived having to work harder than their men counterparts. These types of experiences mirror the current research explaining how, at the university level, men may tend to see women as women but not as engineers. In this way, men may be surprised when women students start getting good grades and the men start going to the women for help (Faulkner, 2009). These kinds of experiences presented in this study were examples of how Latinas, Latinos, and women in engineering majors are adversely impacted by the negative cultures, chilly climates, lack of role models, and stereotypes (Blosser, 2017; Chesler & Chesler, 2002; Ismail et al., 2017; Jones et al., 2013; Malicky, 2003; Seymour, 1999). Further interpretation of the students’ experiences revealed that some of the experiences negatively impacted these students’ persistence, echoing the literature.

**Sense of Self**

The intersection and interjection of the self was a key element to this study, since the students themselves also affected their own experiences and impacted their persistence. During their experiences with other engineers and faculty, each student brought parts of herself to life, which impacted the outcome of each interaction. The way each student influenced her experiences depended on the skills and characteristics each recognized as having, and which came through during the interviews. The students in this study showed several characteristics that enabled them to continue in their engineering journey despite difficult situations and barriers. Students described or portrayed themselves as being confident, determined, resilient, as having a good attitude, and being hard workers. Students also talked about having great time management skills and future goals that kept them motivated. These declarations revealed a link to extant literature where individual factors are linked with student persistence (Espino, 2014; Gonzalez, 2015). Individual factors have to do with the student herself and the characteristics or
skills she brings with her to higher education. Where the characteristics these students described as their strengths – resilience and confidence, amongst others – have been found to have a positive link to college student persistence (Edman & Brazil, 2009; Garza et al., 2014; Gloria et al., 2005; Gloria & Ho, 2003; Kouyoumdjian et al., 2015; Kuh et al., 2006; Lechuga, 2012; National Academy of Sciences, 2011; Nora, 2003; Swail et al., 2005; Tsui, 2007).

Students in this study mentioned being hard workers as one of the characteristics they felt was responsible for their success thus far. These comments were underscored by Cavazos, Cavazos, Hinojosa, and Silva (2009), who wrote, “It appears that hard work, effort, and family support may be more important than perceived ability level” (p. 8). Further interpretation of the students’ characteristics of confidence, determination, resilience, and hardworking, amongst others, showed their positive impact to the students’ persistence, thereby affirming the literature.

These positive traits or characteristics cannot exist in a vacuum, however. The importance of a positive climate in engineering spaces is further declared by the relationship between confidence, self-efficacy, and cultural fit, which highlights the need for students to feel they belong further impacting the students’ motivation to persist and to graduate (Deci & Ryan, 2009; Gloria et al., 2005; Ryan & Deci, 2000).

**Challenging Characteristics**

A few of the students in this study also shared that a few characteristics detracted from their persistence in engineering, such as mental health issues, depression, anxiety, and stress. These challenging characteristics portrayed students having to push through not only established systemic barriers in order to persist in engineering majors, but individual barriers as well. These types of characteristics impacted their day-to-day experiences as engineering students and added yet another layer of complexity to their fight, making it even harder for them to persist and
graduate (Hartley, 2011; Torres & Solberg, 2001).

Other challenging characteristics included feeling underprepared, having a negative self-image, questioning themselves, and feeling unprivileged and disadvantaged. This finding touches upon the disconnect between the need to increase the representation of students in engineering and other STEM fields and number of Latino and other minority students who are not prepared for the rigorous math and science curriculum of higher education STEM fields in higher education (Arcidiacono et al., 2013; Downs et al., 2008; Garza et al., 2014; Irizarry, 2012; Kuh et al., 2006; Museus et al., 2011; National Academy of Sciences, 2011; Núñez & Crisp, 2012; Page, 2013; Walsh, 1998). The concept of under-preparedness amongst Latino students is an historical one, as Latinos tend to attend schools that employ less qualified teachers than those found in schools for White children (San Miguel & Donato, 2009).

While several students in this study alluded to engineers as a whole as being smart and intelligent and described engineering as one of the most difficult majors, interestingly only one student described herself as “smart.” Their reluctance to identify themselves as “intelligent,” or use any synonyms, was striking. Instead, students described themselves as “hard working,” “dedicated,” and being “able to do things better than a man could,” among others. However, the characteristic of being smart was attached to them as part of a group, as a collective – as in “engineers are smart.” Gracia said, “Here, everybody seems so smart […], as soon as you tell them that you're an engineer, they automatically think you're just the smartest person ever. But […] like I said, it takes a lot of work. It's not that easy.”

These experiences touch upon feelings of self-doubt, of not belonging, and wondering if a mistake was made in letting them into these programs. These feelings are described by the concept of impostor syndrome (Villwock et al., 2016) as the legacy that years of oppression have
had on women of color and that it shines bright when these women have an accomplishment (Solorzano & Yosso, 2001). Solorzano and Yosso (2001) expressed the root of impostor syndrome, writing, “The legacy of racism and sexism often comes packaged in self-doubt” (p. 485).

Further interpretation of the students’ challenging characteristics both affirmed and negated existing literature. Existing literature was affirmed by stating that the students’ challenging characteristics added a layer of difficulty to the students, and as such they detracted from the students’ persistence. However, the findings indicating these students did not self-identify as smart or intelligent, disagrees with Samuelson and Litzler (2016) who found that Latina students described their high levels of achievement and capacity by showing academic confidence and indicating their strength as student, instead of describing themselves as hard working.

**Community Cultural Wealth**

Key findings in this study showed that in order to contribute to their own persistence in engineering majors these Latina students activated their community cultural wealth: (a) not only to resist different forms of oppression, but also to thrive and excel in academic settings, (b) to take control of difficult and challenging experiences, (c) to take/receive knowledge from others, but also to give/share their knowledge (cyclical tendencies of CCW), (d) as well as revealing that helping others was the reason many chose to become engineers. Two major findings of this study regarding Latina undergraduate engineering student persistence included: (e) the influence of faith on Latina student persistence, and (f) overt and covert applications of capital.

In this study, the relationship between persistence and Yosso’s (2005) model was outlined by students’ characteristics such as confidence, resilience, and determination. Within the
CCW model, Yosso explained that communal knowledge is transferred and shared within communities of color through several forms of capital, including: (1) aspirational, (2) familial, (3) social, (4) navigational, (5) resistant, and (6) linguistic (Espino, 2014; Gonzales, 2012; Kouyoumdjian et al., 2015; Peralta et al., 2013; Samuelson & Litzler, 2016; Yosso & García, 2007; Yosso & Solorzano, 2005).

One of the most significant findings in this study referred to the students being able to impact their own persistence by activating their CCW and relying on characteristics such as confidence, determination, and resilience in order to succeed in their engineering majors. However, it was not enough for students to have capital at their disposal. In order to reap its benefits, students needed to make a decision to take action and tap into these forms of capital. In essence, CCW did not just happen; it was made happen by the student. Furthermore, in many instances, more than one form of capital was activated during an experience. This realization is not uncommon; as stated in the literature where one experience can reflect the activation of multiple forms of capital (Burciaga & Erbstein, 2013; Espino, 2014).

In addition, students made use of their multiple forms of capital while living different experiences that encouraged and discouraged their persistence in engineering. In experiences that encouraged the students’ persistence, students activated their CCW in order to access its benefits. This finding relates to the point that Latino students tend to activate their CCW to resist forms of oppression (Samuelson & Litzler, 2016; Yosso, 2005; Yosso & García, 2007; Yosso & Solorzano, 2005) and to excel in academic settings (Luna & Martinez, 2013).

In experiences that discouraged their persistence, on the other hand, students tended to activate their CCW in order to push through barriers and deter negative situations from affecting them. By activating their CCW students were able to manipulate challenging interactions and
“flip” them to ensure they too contributed to their persistence. In essence, making use of their CCW was how students took control of difficult experiences. Making use of these forms of capital in order to stand up to different forms of oppression aligns with the emancipatory tenet embedded in both the CCW model (Yosso, 2005) and the Critical Systems Theory model, since taking action promotes change and challenges current practices of oppression (Evans, 2010; Melzer, 2013; Reynolds, 2014; Simon, 2009; Watson & Watson, 2011).

**You Could Almost Hear the Click: Activating CCW**

The concept of activation or activating forms of capital resembled the action of turning on a light switch – you could almost hear the “click.” During the sharing of a story, there would be a key moment in the narration when things would change. It was then when students decided to push back and question the experience. In many cases you could hear the moment they decided to make use of their capital because what they were feeling came through in their voice. Their tone reflected their power, their anger, their attitude, or their joy and was very indicative of what would come next, when they activated their capital. It was, in many ways, an active reaction, an action taken, one that needed to be explained by using a strong and active verb, such as activating, instead of a passive verb phrase. While activating their CCW refers to the action taken, how students chose to take that action is one of the major findings of this study and covered next.

**Yelling it out or Keeping it Quiet: Overt and Covert Activation of Capital**

A major finding in this study centered around how students activated or implemented their different forms of capital – overtly or covertly – terms that I chose. In some instances, students were overt with their CCW and voiced their resistance and displeasure of a challenging situation or welcomed a beneficial experience right on the spot while the experience was being
lived, whichever was the case. It was very public and the activation could be witnessed and shared by others.

A covert activation of capital refers to when students activated their CCW quietly in a more private way, where they were the only witnesses. In situations of covert use of capital students started by leaving the scene, removing themselves from the situation or experience and waiting to be alone so they could take time to analyze the experience. The term covert, therefore, does not describe an unconscious activation of capital. Students were very much aware of using their capital. They just decided to use it publicly, or overtly, so others could see it or share it, or privately, or covertly, just for their own benefit.

However, there were some instances during this study when students were confronted by difficult interactions and chose not to activate any of their forms of capital, or they chose not to push through the experiences. Some of these situations included men authority figures, such as faculty members, the engineering chair, or when students were feeling intimidated by being surrounded by so many men engineering peers. In other words, situations in which the power differences between the genders and where the patriarchy in the men-dominated field of engineering was felt by these Latina students. It is important to note that choosing not to activate any form of capital is also considered a form of agency. A decision not to activate CCW could potentially be rooted on the way communities of color, such as Latinos, share and transfer knowledge. From this perspective, then, messages from community members could persuade or impact these women, not only how to push through these circumstances, but when and under which circumstances.

CCW-related research determining how students choose to activate their forms of capital - covertly or overtly – is not abundant. As such, these interpretations of the students’ experiences
in choosing to activate their forms of capital contributes to the existing literature. An analysis on how students activated each form of capital described in Yosso’s (2005) CCW model is discussed below in turn.

**Navigational Capital**

In Yosso’s (2005) CCW model navigational capital represents qualities and competencies students used to be successful in higher education settings, including the strategies used to succeed in racially hostile institutions (Samuelson & Litzler, 2016; Yosso, 2005; Yosso & García, 2007; Yosso & Solorzano, 2005). By sharing their navigational capital, these participants shared the strategies they put into practice in order to successfully navigate in engineering. All of the participants had experiences in which they activated their navigational capital that contributed to their persistence in engineering. In this study, students’ strategies to persist in engineering included: asking for help, studying in groups, obtaining membership in professional and social networks and groups. These strategies relate to the community-oriented behavior of Latinos and communities of color and their need to belong as it relates to the concepts of cultural fit and persistence (Cerezo & Chang, 2013; Gloria et al., 2005; Gloria & Ho, 2003; Rodriguez et al., 2003).

**Social Capital**

The concept of social capital in Yosso’s (2005) CCW model recognizes the value of social contacts and networks within communities of color as resources of information and skills. These social contacts are also a source of moral and emotional support in higher education upon which students rely (Yosso & García, 2007; Yosso & Solorzano, 2005). All of the participants in this study had experiences in which they activated their social capital that contributed to their persistence in engineering. In this study, participants activated the social capital by relying on
other engineering students for help in their homework, and as a channel to network with other key players, such as senior engineers who had taken the same classes in years past. During these interactions of studying in groups, the cyclical characteristics of CCW came to light, as students not only received knowledge from their peers, but also shared their knowledge with them. These mutually beneficial activations of capital are not uncommon in Latino communities where the desire to help others and serve their community has been shown to predominate (Perez et al., 2014).

Many of the participants discussed how they relied upon and thrived just by knowing they had their friends’ support. Some of them also learned social cues from their peers, especially as a few of the participants identified themselves as shy and introverted. Peers were their connection to other engineers and students in general. As expanding one's social network may lead to feelings of well-being and belonging (Yosso, 2005; Yosso & García, 2007; Yosso, social capital is a key aspect in ensuring the student finds their engineering program a good fit for them, thus contributing to their persistence family (Cerezo & Chang, 2013; Gloria et al., 2005; Gloria & Ho, 2003; Rodríguez et al., 2003). Similar to navigational capital, students activated their social capital to gain/share benefits from groups and communal experiences. These strategies relate to the community-oriented behavior of Latinos and their need to fit in and their effect on persistence (Cerezo & Chang, 2013; Gloria et al., 2005; Gloria & Ho, 2003; Rodríguez et al., 2003).

**Aspirational Capital**

As presented in Yosso’s (2005) CCW model, the concept of aspirational capital refers to the ability to maintain future hopes and dreams, even when faced with barriers and obstacles: or an example of resilience (Martinez, 2012; Peralta et al., 2013; Samuelson & Litzler, 2016;
Aspirational capital was activated by every student in this study, as a way of motivating themselves and ensuring their persistence.

Students described many instances where they had to activate aspirational capital. In other words, they described many barriers and obstacles they had to overcome and had to be resilient, including feeling the lack of support of engineering professors, being ignored by a department chair during a conversation, made to feel stupid by a fellow engineering student only because it took them longer to understand a new math concept, and feeling frustrated by situations within engineering but outside their control. Aspirational capital was activated as a way to push back barriers or obstacles that get in the way of a participant’s dream of becoming an engineer. Moreover, aspirational capital was activated most in “flipped” experiences that could have detracted from the students’ persistence had they not flipped it by activating their CCW. This finding made sense since students are faced with barriers that could potentially detract from their persistence, but instead they pushed through them in order to achieve their goal of becoming engineers. In other words, participants activated their aspirational capital more often while in flipped experiences, but aspirational capital was activated less often in encouraging or positive experiences.

**Familial Capital**

The concept of familial capital presented in Yosso’s (2005) CCW model stretches the meaning of family so that it includes aunts, uncles, grandparents, and close friends. Because this study is focused on the student’s engineering spaces, family members include only close friends and close engineering peers. Nevertheless, some students did talk about how their family impacted their experiences, especially early in life when they had early exposure to engineering.
The connection amongst family members, and close friends helps carve a sense of community, history, and promotes the students’ well-being (Delgado Bernal, 2002; Samuelson & Litzler, 2016; Yosso, 2005; Yosso & García, 2007; Yosso & Solorzano, 2005). Instances where participants activated their familial capital revolved mostly around positive and encouraging experiences in which feeling supported and understood their engineering peers or friends was crucial. Some students also referred to their engineering peers as family or as a brotherhood. The importance of the concept of family, as close friends, relates to the Latino culture where family members, extended family, close friends, and community members are crucial. Familial capital also relates to the concept of relational factors influencing Latino student persistence, which have identified as family members, friends, and members of the community (Gonzalez, 2015).

**Linguistic Capital**

With the concept of linguistic capital, Yosso’s (2005) acknowledged that students in communities of color have multiple language and communication skills considered important within the community. These forms of knowledge are transferred and shared in Latino communities through storytelling, *cuentos* (or stories), translation skills, and cross-cultural awareness, to name a few (Chang & Kanno, 2010; Gonzales, 2012; Yosso, 2005; Yosso & García, 2007; Yosso & Solorzano, 2005). Most of the participants in this study had experiences in which they activated their linguistic capital that contributed to their persistence in engineering. Instances where participants activated their linguistic capital included those when speaking Spanish gave them a sense of fit and belonging, such as those cases when students mentioned how Spanish provided them with a strong bond they would not otherwise have. In addition, students used their linguistic capital to help others by studying in Spanish. Through their linguistic capital, participants recognized the value of Spanish, and the benefits they gained


by being able to communicate in Spanish in engineering spaces. These experiences strengthen
the arguments made in the existing literature about the strong relationship between language,
identity, and culture (Francis, Archer, & Mau, 2009; Pérez, 2014; Perez et al., 2014).

Although no linguistic capital was activated while the participants found themselves
living discouraging experiences, students tapped into their language skills during encouraging
and “flipped” experiences. These relate to the core of encouraging experiences that were
cemented in feelings of well-being and acceptance and instances when the students were able to
help one another were often described as such. This line of reasoning also follows the purposeful
activation of capital in order to share one’s knowledge, rooted in the concept of the CCW model
(Yosso, 2005).

Indeed, the importance and benefits of Spanish were observed in the students’
descriptions impacting their persistence. For some of these participants, Spanish was so much a
part of their identity that they often code-switched during the interview. Code switching is
defined as the act of inserting, transferring, alternating, borrowing, and mixing two or more
different languages within the same conversation (Duran, 1994; Gumperaz et al., 1999; Milroy &
Muysken, 1995; Montes-Alcalá, 2005; Reyes, 2004). While code-switching moments in this
study did not follow a specific theme or a specific question, in many cases participants just could
not express what they were feeling using the English language or could not find the right words
to express the weight of their argument. This application of linguistic capital overlaps with the
activation of navigational capital as code-switching is considered a strategy used by bilinguals
and is a crucial communicative function (Duran, 1994; Gumperaz et al., 1999; Hussein, 1999;
Montes-Alcalá, 2005; Reyes, 2004). Latinas in the study also code-switched to share idioms, as
Elizabeth cheerfully explained she was usually not available to do things outside homework and
school related work, but that I had lucked out, since it was a miracle she was available on the day of her interview. Elizabeth said, “Me sacaste de chiripaso,” which translates as “You lucked out you got me.” The act of code-switching also strengthened the students’ identity and culture by emphasizing that being Latino and being bilingual are their norm (Francis et al., 2009; Pérez, 2014; Perez et al., 2014).

Resistant Capital

The next concept in Yosso’s (2005) CCW model is resistant capital. Resistant capital includes the behaviors and attitudes that push back and refute stereotypes and other forms of oppression (Peralta et al., 2013; Samuelson & Litzler, 2016; Yosso, 2005; Yosso & García, 2007; Yosso & Solorzano, 2005).

Several participants had experiences in which they activated their resistant capital to contribute to their persistence in engineering. Moreover, instances in which participants activated their resistant capital revolved mostly around “flipped” experiences. Resistant capital was activated by a participant when she felt the need to push back and deny forms of oppression in order to continue persisting in engineering. These forms of oppression ranged from discrimination by gender, race, age, to being discouraged from pursuing their engineering dream in general. These types of experiences of discrimination and racism touch upon the unwelcoming and negative cultures and climate women and Latinos alike perceive in engineering spaces (Brown et al., 2005; Crisp et al., 2009; Griffith, 2010; Gusa, 2010; Harper & Hurtado, 2007; Hurtado, 1992; Hurtado et al., 1996; Miller, 2014; Vaccaro, 2012, 2014), but that goes unseen or undetected by the predominant race, or gender in the case of the Latinas in this study, since they tend to experience events differently (Alvesson & Sveningsson, 2015; Bess & Dee, 2012; Castillo et al., 2006). Furthermore, the activation of resistant capital encompasses the tenets of

**The Influence of Faith**

In addition to the six forms of capital presented by Yosso’s (2005) CCW model in this study, a few of the students connected their persistence in engineering to their religious beliefs/faith. These few students’ faith was at the center of their *testimonios*, as they believed and shared that God and their faith carried them through. From these stories and the passion with which they were told, these few students believed things got better, their problems were solved, and destinies were made clearer because God made it happen. These experiences touch upon the fact that religion tends to be ingrained in the Latino culture and Latino communities (Hodge, Marsiglia, & Nieri, 2011), as such the relationship between Latina persistence and religious beliefs has already been established (Antrop-González et al., 2003; Espino, 2014).

Although the students who shared about their faith in God spoke openly and enthusiastically about their relationship with God and how their faith in him guided them through many of the situations encountered as engineering students, their experiences had a private undercurrent to them as they only involved the participants themselves. None of the participants discussed how or if she portrayed her faith openly and publicly or even if she shared it with other engineering students. This behavior completely contradicted how these students activated other forms of capital, such as linguistic, social, or navigational. In those instances, their interactions with others was necessary and a key part of the experience. Regarding social, linguistic, and navigational, the sharing of ideas and capital felt open, public, and most importantly welcomed by others. This feeling of taboo surrounding their faith was brought to life during one of the
interviews. When Elizabeth shared her advice to Latina high school students who wanted to become engineers, she said, “Be open to new exposure. Find the passion that, well, I can’t mention God to them, but finding your passion, finding your craft, learn to excel in that area.” The comment, “I can’t mention God to them,” was nonconforming since most of Elizabeth’s decisions regarding her engineering education involved her faith and relationship with God. However, this comment was not surprising. The decrease of Latino men in religious practices combined with the men dominated climate of engineering spaces could shed some light on the apprehension of these participants to share their faith as a form of capital in order to persist in engineering majors (Navarro-Rivera, Kosmin, & Keysar, 2010). This current religious polarization looked at the intersection gender and raced where men are moving away from religion as Latina women are becoming more conservative (Navarro-Rivera et al., 2010).

**Meaning to Become Engineers: Cyclical Tendencies of CCW**

The cyclical tendencies of CCW were prominent in the experiences lived by this group of Latinas. Their motivation to persist and graduate from engineering did not only include tapping into their own CCW, but also sharing their knowledge in order to impact another’s persistence. This process of giving and taking – or sharing – CCW amongst other Latina engineers was observed in all forms of capital, but was most prominent in navigational, social, and aspirational capital. This realization ties in with the participants’ desire to help others in their communities, which was described by many as their main reason and meaning for becoming engineers. In other words, looking at this from a larger perspective – a macro view – the students’ characteristics of determination and resilience were fueled by their need to graduate and their desire to be of service to others and to their communities. Being able to help others and their communities gave meaning to and value to their persistence. These experiences tie in with the
core of Yosso’s (2005) CCW model, which acknowledges that communities of color share and transfer their knowledge to others (Espino, 2014; Gonzales, 2012; Kouyoumdjian et al., 2015; Peralta et al., 2013; Samelson & Litzler, 2016; Yosso & García, 2007; Yosso & Solorzano, 2005).

In a smaller perspective – a micro view – sharing their knowledge with other engineering students allowed these Latinas to contribute, coexist, and thrive in their engineering spaces. Sharing their knowledge allowed them some respect and a certain level of acceptance amongst their peers. While these experiences refer to the fact that Latina students equate success with the ability to help others (Perez et al., 2014), it also ties in with the culture and climate in engineering where Latinas perceive having to work harder than men to earn membership in engineering spaces, thereby helping other engineers succeed might be a way to show and prove their value and earn respect.

**Summary of CCW Analysis**

Looking at these findings through Yosso’s (2005) CCW model showed that students not only activated their CCW in difficult situations, but also in experiences that contributed to their persistence. In these cases, students activated different forms of capital in order to receive or absorb the benefits of these experiences. The forms of capital activated during interactions that encouraged these students’ persistence in engineering included navigational, aspirational, familial, social, linguistic capital, and their faith. Activating forms of capital during encouraging experiences is an important element to CCW since, as stated in current literature, communities of color draw upon different forms of capital in order to survive and resist racism and similar forms of oppression (Gonzales, 2012; Yosso & García, 2007; Yosso & Solorzano, 2005). Based on this study’s findings, communities of color also rely on these forms of capital in order to thrive, excel
in academic settings, and absorb the benefits these experiences offer them as well as to resist different forms of oppression (Luna & Martinez, 2013).

In summary, in this study Latina students activated their community cultural wealth in order to contribute to their own persistence in engineering majors (a) not only to resist different forms of oppression, but also to thrive and excel in academic settings, (b) to take control of difficult and challenging experiences, (c) to take/receive knowledge from others, but also to give/share their knowledge (cyclical tendencies of CCW), (d) as well as revealing that helping others was the reason many chose to become engineers. Two major findings of this study regarding Latina undergraduate engineering student persistence included: (e) major finding #1: the influence of faith on Latina student persistence, and (f) major finding #2: overt and covert applications of community cultural wealth.

**Analysis: Critical Systems Theory**

Beyond the CCW model, critical systems theory also helps make sense of the findings of this study. The women in this study described many experiences that positively impacted their persistence in engineering, but also experiences that discouraged them from persisting. Critical systems theory (CST) allows for the impact the context of the engineering spaces have in the persistence of these students to be integrated into the analysis. Engineering spaces in this study were defined as the different spaces within the students’ academic world, including engineering classrooms, engineering departments, professional organizations, and conferences. Analyzing the interactions of the Latina engineering students in this study with engineering faculty members and other engineers through a CST lens lent itself to the analysis of organizational environment in engineering spaces. The impact of pedagogical techniques and the effect of the men-dominated culture and climate had on these students will be discussed in turn.
Pedagogy

This analysis considers Latina students being discouraged from engineering majors due to having difficulties understanding the concepts professors were explaining and not receiving the help they needed from their faculty members. These experiences touch upon several issues plaguing Latinos in higher education. First, the under-preparedness of Latino students, which affects persistence and academic readiness (Arcidiacono et al., 2013; Downs et al., 2008; Garza et al., 2014; Irizarry, 2012; Kuh et al., 2006; Museus et al., 2011; National Academy of Sciences, 2011; Núñez & Crisp, 2012; Page, 2013; Swail et al., 2005; Walsh, 1998). The concept of under-preparedness amongst Latino students is an historical one, as Latinos tend to attend less rigorous schools that employ less qualified teachers than those found in schools for White children (San Miguel & Donato, 2009).

Second, from the engineering faculty perspective, the Latina experiences are impacted by the lack of pedagogical experiences engineering faculty tend to have (Baldwin, 2009; Considine et al., 2014; Peralta et al., 2013), compounded by the fact that many faculty members are more focused on research than teaching assistants (Astin & Astin, 1992), the continuous use of the banking system in the engineering classroom (Baldwin, 2009; Freire, 2014), the lack of training to teach and the unawareness of how communities of color learn (Baldwin, 2009; Considine et al., 2014; Peralta et al., 2013), and the lack of Latino and Latina faculty (Ek et al., 2010; Núñez & Murakami-Ramalho, 2012), all of which have the potential to impact the persistence of Latina undergraduate engineering students. A CST perspective provides a perspective on the organizational climate and the culture of the engineering places and the way behaviors, practices, and policies affect the Latina persistence (Castillo et al., 2006; Museus et al., 2011).
In addition, there is an urgent need for updated pedagogical strategies that will reach communities of colors for knowledge to be shared effectively. There is a plethora of research suggesting changes to the strategies engineering faculty members continue to utilize in the classroom. Among them, researchers have suggested integrating STEM education to the student experience by employing techniques such as problem based learning, cooperative learning, and research-based learning in the classroom (Astin & Astin, 1992; Considine et al., 2014; Coppola, 2009; Freire, 2014; Kuh et al., 2006; Museus et al., 2011; Ramaley, 2009; Smith et al., 2009).

Men-Dominated Field

In this study, students mentioned having to adapt to the reality that engineering is a men-dominated field. The fact that men were everywhere made some of the women feel uncomfortable, but mainly it was the men’s behavior toward the women that was the problem. With their actions, some men made some of the Latina engineering students feel that they did not belong in those engineering spaces, or that they were unwanted. These beliefs that men are the only ones that deserve membership to engineering spaces may negatively impact the persistence and motivation of Latinas in the major. During their interview these students complained having to do twice as much work and prepare more than the men in order to prove themselves worthy. This unequal treatment and practice in engineering spaces resembles a price of admission mentality. This mentality negatively affects the non-predominant gender currently in engineering majors, as well as having the potential to discourage other young Latina engineering hopefuls. Both the men-dominated spaces of engineering and the pedagogical practices in engineering touches upon the organizational environment – namely, the culture and climate – of engineering spaces, as they are both a by-product of years of behaviors, policies, and practices that have gone
unchanged and unchallenged for many years, mainly by the people in positions of power who may be unaware of or unaffected by these conditions (Castillo et al., 2006; Museus et al., 2011).

The Impact of Hispanic Serving Institutions

HSIs tend to not only enroll a large percentage of Latino undergraduate students, specifically 66 percent in the academic year 2017-18 (HACU, 2019), but HSIs also contribute to the persistence of Latinos in engineering and STEM related fields (Museus et al., 2011; Perrakis & Hagedorn, 2010). As such, this study included two public four-year Hispanic Serving Institutions located in the Southeast and Southwest regions of the US, respectively. The experiences of these were greatly impacted by the type of institutions in which they enrolled. In this section I take a closer look and analyze the data from an HSI-system perspective.

In this study students shared certain experiences that both encouraged their persistence and were a result of their HSI enrollment. Some of these included feelings of cultural fit and belonging, being surrounded by Hispanics, the racial similarities between the students, the commonality of Spanish as an accepted language, and knowing others knew what they were going through because they were also Latinos. I discuss each below.

The racial component of HSIs played a key part in these students’ experiences. Several students mentioned that being surrounded by students who were also Hispanic helped them feel welcomed, made them feel that they fit in, and gave them a sense of belonging they would not have had otherwise. This finding relates to current scholarly research that explains that students of color, such as Latinos, feel a sense of belonging and community with students who experiences are similar to them (Arbelo-Marrero & Milacci, 2015; Dayton et al., 2004; Deci & Ryan, 2000; Yosso, 2005). Other forms of cultural fit, associated with being enrolled in HSIs, included the value of speaking a second language and the acceptance of Spanish amongst the
students. Some students mentioned feeling connected to each other due to being able to speak Spanish with one another, and how they had to speak Spanish to get into certain engineering spaces.

Students also mentioned the large number of tutors their universities provided them with—free of cost, and their accessibility to those tutors and faculty was also mentioned. Students felt that being part of an HSI exposed them to experiences they would not otherwise have. These experiences included engineering competitions, special engineering projects, outreach events, being able to mentor high schoolers, access to research laboratory, minority student research being funded by an industry, access to engineering events at the school, and to clubs. These engineering events exposed students to professionals in the industry and presented panels of engineers in the workplace sharing their experiences and offering guidance. The easy access to minority professional organizations was also mentioned, as well as the way these organizations exposed the students to opportunities such as interviews and internships.

One of the many issues impacting Latino student persistence is low-socio-economic status (Irizarry, 2012). In many instances, Latino students may have to choose between helping support their family or getting an education in order to get a better paying job. Several of the students mentioned the lower cost of their HSIs. These lower-cost institutions allowed them to attend and being able to eat regular food not just “ramen noodles,” as Elena put it. Overall, these students’ experiences corroborated current research that HSIs tend to incorporate a supportive campus environment and climate making Latinos feel welcome and giving them a sense of fit (Arbelo-Marrero & Milacci, 2015; Dayton et al., 2004; Deci & Ryan, 2000; Yosso, 2005).
“Where Are All the Women Now?”: Interrogating Engineering Spaces in HSIs

While the Latina engineering students in this study shared many experiences in which attending an HSI positively impacted their persistence, there were also plenty of testimonios to counter that statement. Some of the students in this study shared how the engineering spaces within their HSI in fact negatively impacted their persistence. This was highlighted by Elena who said, “When you start off in the low-level requirements, you see a lot of women. Then you get to the third year, and it's like okay, well, why is it a? Where are all the women now?”

Looking at this aspect of HSIs and their impact on Latina persistence is important for several reasons. First, these higher education institutions enroll 66 percent of all Latino undergraduate students (HACU, 2019). Second, as the Latino population continues to increase, the demand for HSIs will increase accordingly, which means that many racially White institutions will transition into being HSIs as the need arises (Dayton et al., 2004; García, 2019; Macdonald et al., 2007; O’Brien & Zudak, 1998), bringing with them their White pedagogies and cultures. As stated by García (2019):

HSIs are also criticized for operating like white institutions, meaning they teach a white curriculum, employ white faculty and administrators, and foster racism and discrimination in similar ways as racially white institutions. Yet these criticisms are inherently tied to a system that values all things white. (p. 16)

Therefore, it is important to identify the pitfalls and instances where HSIs can improve to better serve this demographic for current students and future generations.

In this study several challenging aspects of HSIs came to light, including the pedagogical techniques used in the engineering departments, the few Latino engineering faculty members, the almost non-existent Latina engineering faculty member, the large amount of faculty with
minimal amounts of Latino cultural knowledge, encounters with difficult and extra challenging professors, feeling dismissed by faculty, and being talked down to.

Moreover, from the student body’s perspective, there were also some challenges, including the unchecked behavior of some of the men engineering students towards the Latina women, making them feel that they do not belong in engineering spaces, or in engineering majors. Not to mention, making the Latina women feeling intimidated by vast amounts of men in the field, the constant need for the Latina students to prove themselves worthy of being in those spaces, feeling sexualized, as well as feeling they need to work harder than men, and having their intelligence questioned.

HSIs have made great strides based on their commitment to the education of Latino students as they improve access, provide cultural fit, and help remove some barriers for this demographic (Dayton et al., 2004); however, because of the way many institutions become HSIs, they continue to be embedded in whiteness (García, 2019). Therefore, as evidenced in this study, HSIs have more work to do for Latinos in general, and especially for Latinas pursuing an undergraduate engineering degree.

**Analysis: Intersectionality Lens**

A final lens is also helpful in understanding the findings of this study, that of intersectionality. Through the interview process these participants identified themselves as women, as women of Latino race, by country of origin, as engineering students, friends, daughters, granddaughters, sisters, cousins, nieces, musicians, role models, mentors, leaders, teachers, translators, and Spanish speakers who were part of a larger community outside their student personae. Looking at the encouraging and supporting experiences these students shared with faculty members brings in several aspects of their identities. Many of these interactions took
place at the intersection of engineering student, woman, engineering peer/friend, and Latina.
Where being Latina and sharing that racial similarity with a few professors and peers created a
sense of understanding.

**Discrimination**

Several of the women in this study expressed having lived experiences in which their
gender was an issue for others, presenting how the intersectionality of the women’s identity was
a key element in these experiences. Latinas, or women in general, are not the norm in
engineering spaces (Faulkner, 2009). A few of the students commented about the disappearing
Latina by year three. High attrition rates found in engineering majors could be explained by the
engineering departments’ practices to weed out those whom the faculty believe will not succeed
(Baldwin, 2009), such as minorities, women, and Latinas. As behaviors and practices remain
unchanged, higher education institutions utilize the STEM introductory classes as filters in order
to weed out the less desirable students (Baldwin, 2009). Latinas tend to attend schools with
teachers and staff who may be less qualified than those employed at schools for White children
(San Miguel & Donato, 2009). As such, the practice of weeding out students during their first
year may mainly affect students from lower socioeconomic status that grew up in poorer
neighborhoods and attended less rigorous school systems, such as Latinas. This practice in
engineering departments may have the potential to exclude students from underrepresented
minorities, which contradicts the current need in the US to integrate racial and gender diversity
in engineering design and the engineering workplace.

One student’s experience helps to illustrate this point. Crucita narrated her experience
during a meeting in which one of the men student leaders mentioned needing more women to
help raise money since women knew *how to talk to men*. First, this statement assumes that only
men have money to be given, putting men in a more powerful position than women, which follows the patriarchal mentality. In addition, this statement assumes that women’s contributions to engineering are only due to their “sex appeal” or other feminine skills to raise money. This sexualized statement toward Latina engineering students undermines the value of the women’s minds and their future contributions to the engineering field. Not only was the sexual comment towards Latina engineers inappropriate, the reaction of the other members was equally wrong—since the comment was taken as a joke – they laughed. When comments like this are told and go unchecked, not only do they promulgate a negative climate and a chilly space for women in engineering, but if nothing is said then it becomes an accepted comment and the norm. Such behavior also propagates the patriarchy within the men-dominated engineering culture, where the lack of respect in such comments touch upon the fact that women in engineering spaces are tolerated, but unwelcome and not seen as equals (Faulkner, 2009).

While another one of the students shared that she stood up to the engineering student who made a sexually charged comment during a professional organization’s meeting, other students in similar circumstances felt they could not and should not stand up for themselves. Some students in similar situations chose to simply ignore the negative comments hoping they would stop for a lack of reaction. Women in these experiences felt sexualized, mistreated, and humiliated by their men counterparts. These types of experiences touch upon the lack of Latina students in engineering as well as the lack of Latina faculty in engineering, and the lack of role-models, mentors, and advisors for these students (Dayton et al., 2004; Museus et al., 2011; Sanchez-Peña et al., 2016).

In a way, Latinas in this study challenged the expected roles Latinas have in society – often as homemakers, mothers, and wives. At the intersection of race and gender, these women
are therefore breaking barriers and taboos to further identify themselves as engineers, which is therefore fostering resistance (Cammarota, 2004), even sometimes at the expense of having to negotiate facets of their identity between being a woman and being an engineering student (without the identification of gender) or being just one of the guys. Because engineering is a men-dominated field, many of the women had to adjust and find common ground with the men in order to build their professional networks and persist. This finding touches upon research presented by Kiyama et al. (2016), where the authors stated: “Latinas are resisting subjectivity as emasculated females and are taking on traditional male traits of strength, courage, and honor through physical violence” (p. 5). Kiyama et al. (2016) discussed the term respect “respeto” as it applies to Latinas, where respect plays a large part in how Latinas perceive peer relationships, educational experiences, and negotiate identity. As Latinas introduce themselves to the men-dominated spaces of engineering they negotiate parts of their identity to receive membership and respect, where respect does not mean demanding obedience, but demanding acknowledgement of their worth and value (Cammarota, 2004; Kiyama et al., 2016).

The women in this study also demonstrated intersectionality of identity in the type of engineering they chose to study. The students were part of biomedical engineering, civil engineering, and mechanical engineering programs at two sites. While all three majors were still described as men-dominated, several of the women studying civil engineering mentioned the great efforts their school was doing to bring more women in. However, for this very reason some of the men started to call civil engineering a “girly major.” This behavior is offensive as it diminishes engineering as a whole. These experiences touched upon the new trend of classifying engineering as hard or soft, based solely on the numbers of women in the major (Blosser, 2017; Brawner et al., 2012; Ismail et al., 2017).
In terms of ethnicity, the women in this study came from several different countries including Colombia, Cuba, Ecuador, Honduras, Mexico, Nicaragua, Puerto Rico, and Venezuela. The women from Nicaragua shared experiences describing negative climate more often, while positive climate experiences were described more often by the student from Colombia. These 20 students shared similar experiences, but their perceptions and reactions varied greatly. Reactions to difficult situations included activating some forms of capital and fighting back, to ignoring the experience and going away. The different way women reacted to similar situations attests to the heterogeneity of Latinas and that the differences amongst Latinas including not only differences in race, but also to ethnic subgroups, and socioeconomic status (Dill & Zambrana, 2009) can impact the way experiences are perceived and what actions are taken to push back barriers and continue to persist in engineering Torres, et al., (2003).

**Other Salient Identities**

Besides race, ethnicity, gender, and age, other salient identities that came through in the participants’ experiences included generation status related to education. For example, some of the participants were the first in their family to attend college while others had family members who either worked with engineers or were engineers themselves. These second- or third-generation students benefited from being exposed to engineering at an early age and becoming familiar or used to conversations between engineers. As older siblings also studied engineering, some of the participants were able to gauge how hard their major was going to be and went into it knowing, to some degree, what to expect more so than students with no prior contact to engineers. Moreover, in their stories a few students revealed the importance of having an engineering sibling in terms of encouragement, motivation, and help with projects and homework – this aspect of their experience relates to familial capital. The benefit of having
family members with an engineering background within the same household relates to the benefit of early exposure to the field (DeJarnette, 2012), since through conversations and discussions young students may be exposed to technical concepts and terminology. This early exposure to the field and its terminology may also make the subjects of math and science be less taboo in the home and the student feel better prepared and less overwhelmed when they start their engineering degree (Perrin, 2004).

Another aspect of the students’ identity that came through in the conversations was socio-economic status. While this was not a topic explicitly covered in the interview questions, it did come up on several occasions. Several of the students lived in neighborhoods they described as poor, neighborhoods that are susceptible to flooding, and others where the living conditions were not the best. However, while they described their surroundings as poor, the students did not describe themselves or their families as such, instead they were grateful to have had everything they needed. The students who described themselves as living in poorer neighborhoods attended higher education institution that were geographically close to their home. This finding relates to issues of access, guidance, and college choice for lower socioeconomic students (Bergerson, 2009a), issues that communities of color, such as Latinos, tend to grapple with on a regular basis. Factors relating to Latino families and Latino student persistence include low socio-economic status, lack of parental education, having diverse citizenship status, various immigration or migration patterns, colonial identities, and multiple positionalities may affect Latinos’ persistence negatively (Arcidiacono et al., 2013; Downs et al., 2008; Garza et al., 2014; Irizarry, 2012; Kuh et al., 2006; Museus et al., 2011; National Academy of Sciences, 2011; Núñez & Crisp, 2012; Page, 2013; Walsh, 1998).
Stemming from a low-socio-economic status identity, many of the Latina students in this study had to supplement their income while completing their engineering degree. A few mentioned they worked so many hours that their studies had been affected. This observation falls in line with extant research stating that low-socioeconomic Hispanic students tend to have jobs while attending school (Benitez & DeAro, 2004; Dayton et al., 2004; De los Santos & Cuamea, 2010; Perrakis & Hagedorn, 2010).

**Conclusion**

This study fulfilled two goals: First, it created new knowledge regarding the way Latina undergraduate engineering students implement or activate their CCW - overtly or covertly and it extends the conversation on the influence of faith on the students’ persistence. Second, this study’s results filled some gaps in the existing knowledge base by addressing the underrepresentation of Latina undergraduate engineering students through the positive perspective of persistence. For this analysis I integrated three theoretical frameworks, including Yosso’s (2005) community cultural wealth (CCW) model, alongside an intersectionality framework (Crenshaw, 1990), and critical systems theory (Watson & Watson, 2011). As specified above, there was a need to relate persistence to community cultural wealth as well as examining all tenets of Yosso’s (2005) model. Focusing the analysis through these three frameworks produced invaluable primary data, such as the influence of faith in persistence and the covert and overt application of forms of capital, that helped further the conversation surrounding the persistence of Latina undergraduates in engineering. This study provided a new look at the tools Latinas are using to push barriers in two engineering sites, while at the same time provided further understanding of some of these barriers.
As evidenced from these interviews, Latina undergraduate engineering students made use of distinct forms of capital described by Yosso’s (2005) community cultural wealth model to thrive and succeed as well as to resist forms of oppression and ultimately persist in higher education. The connection between persistence and community cultural wealth was seen in the actions taken by these participants during their experiences. One of the most important findings in this study was that by choosing to activate their community cultural wealth, participants had the power to change the impact challenging experiences had on their persistence, and as such they activated forms of capital to take control of those experiences. Not only did the participants activate every form of capital described by Yosso’s (2005) model – navigational, social, aspirational, familial, linguistic, and resistant – but also a few of the women referred to their faith in God in order to survive difficult experiences. Moreover, the cyclical tendencies of community cultural wealth and the way participants chose to activate those forms of capital – overtly or covertly were also observed.

As I conclude my interpretation of findings and my analysis of engineering spaces, I am happy to report that the Latina undergraduate engineering students in this study had the power and the courage to change the impact their experiences had on their persistence; that, in itself, is an empowering statement. However, looking at these experiences in a more critical manner made me wonder: Why do women continue to be treated like they don’t deserve to be in engineering spaces? The this is the price of admission mentality embedded in the men-dominated engineering climates cannot continue to be so. As I stated in the purpose of my study, the goal is to increase the number of Latina engineering students who graduate. If that purpose holds true, it seems unfair to expect that it is up to the women in these engineering spaces to overcome these challenges on their own, especially when in truth these challenges should not even exist. As
presented by these women the answer is not many do, because not many can, and more importantly no one should.

**Limitations and Strengths**

**Limitations**

This study’s design exhibited some limitations, the context in which this study took place could be considered a limitation, since only experiences within the students’ engineering spaces were analyzed, thus limiting analysis to include only perceptions of interactions that took place in the engineering department, classroom, or professional organizations, and professional organizations conferences and meetings. As a result, interactions and experiences lived at the home and with family members were not included in the protocol or analysis.

Another factor to consider was the participant selection process. It is possible that participants who chose to take part in the study wanted to do so because of having exceedingly negative or positive experiences, thus introducing bias. Ensuring the interview questions were open-ended and focused both in positive and negative experiences helped minimize this bias.

In addition, no questions about faith or religion were included in the interview protocol. This decision was made since faith is not part of the six forms of capital included in Yosso’s (2005) community cultural wealth model.

**Strengths**

The strengths of this study first include its timing. This study is very timely, as the issue regarding the underrepresentation of Latinos in engineering fields has been identified as of crucial importance and needs addressing. Another strength of this study included the cohesiveness of design. Incorporating three different, but complementary, frameworks allowed a more holistic approach for analysis, which included exploring the students’ persistence at the
individual, the discipline, and the system’s level simultaneously. Applying Yosso’s (2005) community cultural wealth model changed the inquiry perspective and the rhetoric by moving the conversation forward and away from deficit-based models which follow a blame the student mentality into an asset-based research framework. Including an intersectionality lens (Crenshaw, 1990; Jones & Abes, 2013) allowed for the multidimensionality, the diversity, and complexities of the Latina student to be furthered explored. Furthermore, incorporating CST expanded the data analysis to include the impact that structures and ideologies have on the students’ persistence.

As qualitative designs do not have generalization as an end goal, the results of this study will not reflect the truth for all Latina students who meet the participants’ characteristics; however, results from this study can be applicable or transferable to similar situations as it was based on thick and rich descriptions and narratives (Denzin & Lincoln, 2000; Firestone, 1987). This study could be applied to other STEM majors, other types of institutions including Primarily White Institutions, and institutions at different geographical locations. Furthermore, both of the higher education institutions I chose were classified as Hispanic Serving Institutions. This expands the conversation as a large part of STEM focused research is based on Primarily White Institutions. Next, I discuss some recommendations for future research and implications for policy and practice.
**Recommendations for Future Research**

**Recommendation 1 - Overt and Covert Applications of CCW**

Results from this study showed that students activated their CCW in different ways. In some instances, students were overt with their CCW and loudly voiced either their resistance or displeasure of a challenging situation or welcomed a beneficial experience. In other experiences, students activated their CCW quietly in a more covert manner, when they were alone and had time to analyze the experience. In these instances, students would have an inner dialog and through those dialogs activate their CCW. While other CCW scholars have presented students activating their CCW, this observation of overt and covert applications of CCW provides a new critical perspective or element to the literature of Latina persistence. Further research is needed to further develop this new element of the CCW.

**Recommendation 2 – CCW as a Choice**

During this study, there were situations in which students were confronted by difficult interactions and chose not to activate any of their forms of capital. Future research should focus on better understanding how students choose to use their CCW.

**Recommendation 3 – Expanding this Study**

I designed this study’s settings to be two, public four-year Hispanic Serving Institutions and at specific geographical locations. Based on those design features the following recommendations are proposed for future research:

(a). What are the experiences of Latina undergraduate engineering students at non-HSIs?, (b). What are the experiences of Latina undergraduate engineering students at different geographical locations in the US?, and (c). How do these students’ experiences differ by location and type of institution?
Recommendation 4 – Faith

This study did not overtly include interview questions geared towards faith, spiritual, or religious capital as they are not part of Yosso’s (2005) CCW model; however, a few students brought up their faith and explained how it contributed to their persistence. In order to further develop the relationship between faith and persistence, and possibly expanding Yosso’s Community Cultural Wealth Model (Antrop-González et al., 2003; Espino, 2014), this line of inquiry should be addressed in the design phase of a future study.

Implications for Policy and Practice

Implication 1 – Early Exposure

Some students in this study mentioned their interest in engineering was piqued in middle school because of program they had a chance to participate in. Accessing these students at an earlier age will help them prepare in high school for the engineering requirements of math and sciences. Creating partnerships across all levels of education (P-16) amongst schools, community colleges, universities, industry, and local businesses so that there is a clear path to follow for students from underrepresented communities. This partnership can foster STEM or engineering-focused after-school programs, summer camps for students in grades P-12 (DeJarnette, 2012), and offer internships for students ages 13-16. Also, middle schools and high school should pair with industry and have expositions, or job fairs directed specifically to the different types of engineering. For this to happen, however, there is a need of additional teacher training (DeJarnette, 2012).

Implication 2 – Associate’s Degree in Engineering while Completing High School

Census data shows a high attrition rate among Latinas (US Census, 2016). Reasons for this group’s low academic persistence may include speaking only Spanish at the beginning of
their school careers, preschool attendance gaps, low socioeconomic status, responsibilities within the family, gender roles, stereotypes, a mother’s influence, lack of role models, and marginalization, among others (Gándara, 2015; Gloria et al., 2005; Romo, 1998; Sanchez-Peña et al., 2016). Therefore, expanding bridge programs between high schools, community colleges, and higher education institutions with engineering programs may be helpful. These programs would allow Latinas to complete an associate’s degree in engineering while attending high school, and upon graduation these Latinas could be guaranteed admission to a local engineering school. This kind of program would provide a smoother transition and might eliminate some of the barriers Latina students face in higher education, such as access, admissions, application, and so on.

Several students in this study also received an associate’s degree in engineering while completing their high school education. This singularity brought them into the higher education institution as third-year students. Cutting the cost of college and the time it takes them to graduate in half could be a strong incentive to attract more Latinas not only to higher education, but also to engineering fields. This suggestion is strengthened by extant research stating that the cost of college and limited financial aid are potential factors impacting the access and persistence of Latinos in higher education (Bergerson, 2009a, 2009b; Downs et al., 2008; Kouyoumdjian et al., 2015; Museus et al., 2011).

**Implication 3 – STEM or Engineering Magnet School**

In order to even off the starting point, states should create – free of cost – STEM-focused magnets high schools for underrepresented minorities. These schools could provide high school students with the necessary mathematical and scientific base knowledge to be better prepared for undergraduate degrees in the STEM fields. These magnets schools could partner with a local
higher education institution in order to ensure admission to students who graduate from the magnet school. Creating a partnership will ease the transition from high school to college, help with paperwork, financial aid, and the like. These programs and partnerships would ensure students’ preparedness for higher education and STEM careers, provide access, and support during the admission process, including financial aid and other types of help that first- and second-year students require.

This concept is not new. An example is CROEM, Centro Residencial Oportunidades Educativas Mayaguez, located in Mayaguez, Puerto Rico, established in 1967 (Rosario, McGee, López, Quintero, & Hernández, 2015). CROEM is a public – free of cost - magnet high school for high achieving Puerto Rican children, in grades 9-12, who have shown an interest in the STEM fields. The school offers Puerto Rican students, from any socio-economic level, and from both public and private high schools in the island, the opportunity to get a stronger base in advanced math and science courses as well as meeting the necessary graduation requirements established by the Department of Education. Students in this program take at least nine different courses per semester. If a student takes all the mathematics courses offered at CROEM, they are then eligible to take additional mathematics courses at the nearby campus of the University of Puerto Rico (UPR). Courses taken at UPR become part of the student’s transcript once they move on to their higher education career.

**Implication 4 – Entry Level Engineering Course**

Higher education departments should bridge the gap between the engineering classroom and the engineering workplace by teaching students how the work completed in the classroom relates to the world after graduation by exposing students to the different types of engineering during their first semester. A few of the students in this study mentioned not liking their chosen
major, but that it was too late to switch to a different type of engineering since they were almost ready to graduate. Some students from underrepresented minorities may not have had any early exposure to the field of engineering prior to their first year. As such, their engineering knowledge may be limited to the selection offered at their institution and, even then, they may not be sure what each engineering field entails and represents. For that reason, engineering departments should have a required first-year course focused on the different types of engineering majors and what they represent. Instruction would show the type of engineering, have students complete a short laboratory exercise, and have a field trip to a related company or job site showing the students the types of work that each type of engineering covers. If a field trip is not reasonable, industry leaders could come and talk to the students, bring the products they make, or tools of the trade. This option could feed the students’ curiosity and keep them excited about their chosen field. With approximately 15 weeks per semester, higher education institutions could go into depth and study the different branches of engineering and show how the work completed in the classroom relates to the world after graduation.

**Implication 5 – Update the Pedagogy in Engineering**

Institutions of higher education that place a higher value on research than teaching tend to have engineering faculty members focus less on teaching and sharing their knowledge with students and focus more on their own research studies (Astin & Astin, 1992; Baldwin, 2009; Brainard, 2007; Ramaley, 2009). In addition, several researchers have voiced concerns regarding not only the quality of the teaching (Litzinger et al., 2009), but also the techniques being used (Brainard, 2007; Ramaley, 2009; Smith et al., 2009), such as the highly criticized banking system of teaching (Freire, 2014). Therefore, more inclusive pedagogical changes might include a broad approach of integrating STEM education and development with the overall student
experience (Ramaley, 2009). Other researchers have also addressed the need for instructor development workshops to improve teaching strategies and become aware of the different way students learn in their instruction (Baldwin, 2009; Considine et al., 2014; Peralta et al., 2013).

As a large percentage of engineering school educators and faculty members are not Hispanic, engineering faculty, or faculty in general, should be part of a cultural training where CCW is presented and explained in order to further their understanding of the tools students from different backgrounds use in order to succeed. Understanding how these students succeed is not enough if the importance of their knowledge and capital is not valued and respected. Educating the educators is a first step in accepting these different forms of capital. Moreover, education in the classroom should be more practical and hands-on, where higher education departments aim to bridge the gap between the engineering classroom and the engineering workplace and teaching students how the work completed in the classroom relates to the world after graduation. Other researchers have also addressed the need for instructor development workshops to improve teaching strategies and become aware of the different way students learn in their instruction (Baldwin, 2009; Considine et al., 2014; Peralta et al., 2013).

**Implication 6 – Normalize Women in Engineering Spaces**

There is plenty of research addressing women’s negative perception of the social environment in men-dominated engineering spaces (Blosser, 2017; Chesler & Chesler, 2002; Seymour, 1999). Higher education institutions should make changes to policy and practice through education of faculty and engineering body to ensure women in engineering are no longer viewed as out of the norm. This education could come in the form of programs and workshop sessions for faculty as well as the student body. The focus of these programs should include implicit bias training to ensure their current behavior is in line with the goal of increasing women
and Latinas in engineering majors instead of deterring them.

Institutions could create a program to support Latina engineers in these situations, provide them with safe spaces in order to discuss these issues, such as having coffee talks where like-minded women come together to discuss their experiences and help each other bond and push each other through. Talking to each other will allow Latinas, and women in general, to be better informed, to identify aggressive behaviors, and develop the tools to push back.

In addition, more role models for Latinas in engineering are needed (Dayton, Gonzalez-Vasquez, & Martinez, 2004; Museus et al., 2011). Institutions of higher education should be proactive in making sure their faculty reflects their student population. Latina faculty can act as mentors and guide these young Latinas through their engineering journey.

**Implication 7 – Membership**

Students in this study mentioned the importance of networking and expanding their professional groups had in their persistence. Many explained the benefits of going to conferences and the exposure these events gave them as engineering students – from going through interviews, and simply talking to other professionals of the field, to being able to obtain internships. However, due to funding issues, not every student was able to take advantage of these events. In some instances, a school could only send two students to a conference. Because of the benefits mentioned, higher education institutions should start a funding program in order to help cover the costs for more third- and fourth-year student members to attend professional organization conferences.

**Implication 8 – Future Goals**

Latinas in the US are currently underrepresented in undergraduate engineering programs, and are even more so at the graduate and doctoral levels. Amongst the 16.1M Latinas only 5.8
percent obtain advanced degrees (US Census, 2016). Overall, Latinas educational achievement is of concern (Cammarota, 2004; Gándara, 2015; Romo, 1998). There is a need for higher education institutions to implement programs that provide access, recruitment, assistance, and facilitate these transitions. These programs should not be limited to the higher education institution the student is currently attending, but to groups of institutions that work together to offer better access and to better place and guide these students. Guiding more Latinas to graduate schools will allow more women to have a place at the table where key conversations are taking place, where ideas are being shared, and policies are being made, thereby ensuring Latinas’ needs are being considered. Programs like this will ensure the Latina pipeline gets stronger with time.


Antrop-González, R., Vélez, W., & Garrett, T. s. (2003). Where are the academically successful Puerto Rican students? Five success factors of high achieving Puerto Rican high school students.


## APPENDIX A. INTERVIEW QUESTIONS

### I. Warm-up questions

Tell me about yourself.
- Where is your family from?
- Where were you born?
- Where did you grow up?
- Which languages do you speak?
- Type of engineering?
- Expected grad year?
- What is your GPA?

### II. Interview Questions

<table>
<thead>
<tr>
<th>Interview Question</th>
<th>Categories</th>
<th>RQ addressed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What does becoming an engineer mean to you?</td>
<td>Individual factor/CCW Aspirational capital</td>
<td>2</td>
</tr>
<tr>
<td>2. List some of the characteristics/strengths that have helped you get here. Follow up: Talk to me about a situation in which these came in handy.</td>
<td>Individual factor/ CCW Social, Navigational, Familial, Resistant, Aspirational, and Linguistic</td>
<td>1, 2, 3</td>
</tr>
<tr>
<td>3. You mentioned you were bilingual, please describe a situation as an engineering student in which being bilingual impacted you in some way.</td>
<td>Individual and Systemic Factor/ CCW Linguistic Capital</td>
<td>3</td>
</tr>
<tr>
<td>4. Tell me your experience as a Latina engineering student. Probe: Positive answer: How did having that experience helped you get where you are today?; Negative answer: How did you overcome it to get this far?</td>
<td>Individual, Systemic Factor/ CCW Social, Navigational, Familial, Resistant, Aspirational, and Linguistic</td>
<td>1</td>
</tr>
<tr>
<td>5. Describe a situation in which you felt encouraged to study engineering? Probe: By whom? Or what? How did having that experience help you get where you are today?</td>
<td>Systemic, Relational, and Individual Factors / CCW Social, Navigational, Familial, Resistant, Aspirational, and Linguistic</td>
<td>1</td>
</tr>
<tr>
<td>6. Let's talk about the other side of that coin, talk to me about a situation when you felt discouraged from studying engineering? Probe: What was that situation like? How did you overcome it to get this far?</td>
<td>Systemic, Relational, and Individual Factors / CCW Social, Navigational, Familial,</td>
<td>1</td>
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<tr>
<td>7</td>
<td>What is one of the biggest challenges you have had to overcome as a Latina engineering student? Probe: What did you do to survive it?</td>
<td>Systemic, Relational, and Individual Factors / CCW Social, Navigational, Familial, Resistant, Aspirational, and Linguistic</td>
</tr>
<tr>
<td>8</td>
<td>Besides yourself and answer in #6 in what or whom else do you rely on/count on to help you through in engineering? (or When things get tough, who do you turn to for advice or help?) Follow-up: Give me an example of a situation and how they/it helped? i.e.: get through a hw, exam, pass a class, a semester. Anyone else? Any organization?</td>
<td>Systemic and Relational Factors/ CCW Social, Navigational, and Familial</td>
</tr>
<tr>
<td>9</td>
<td>Describe how you feel when you are in an engineering classroom surrounded by your peers. Probe: What makes you feel that way? Positive answer: How does feeling like that help you achieve your engineering goals?; Negative answer: How do you overcome this feeling and still get the job done? Back up: Describe your relationship with your peers.</td>
<td>Systemic, Individual Factors/ CCW Resistant, Social, and Navigational</td>
</tr>
<tr>
<td>10</td>
<td>Describe an important experience you've had at this university. Probe: When, Where, How, Consequences. Positive answer: How did having that experience helped you get where you are today?; Negative answer: How did you overcome it to get this far?</td>
<td>Systemic Factor / CCW Resistant</td>
</tr>
<tr>
<td>11</td>
<td>Scenario: You meet a group of Latina high school students who want to be engineers. Question: What is your advice to them? Any other tips or tricks?</td>
<td>Individual Factor/ CCW Navigational</td>
</tr>
<tr>
<td>12</td>
<td>Hindsight is 20/20, regarding your experiences as a Latina engineer what would you change? How did you survive?</td>
<td>Systemic Factor/ CCW Navigational</td>
</tr>
<tr>
<td>13</td>
<td>LAST: Is there anything else I didn’t ask about your own journey as a Latina engineer?</td>
<td></td>
</tr>
</tbody>
</table>
### APPENDIX B. QUESTIONS AND METHODS MATRIX: LINKING RESEARCH QUESTIONS AND RESEARCH METHODS

<table>
<thead>
<tr>
<th>Research Questions: What do I need to know?</th>
<th>Why do I need to know it?</th>
<th>Sampling decisions: Where do I find these data?</th>
<th>Data collection methods: What kind of data will answer this RQ?</th>
<th>Data acquisition: How do I gain access?</th>
<th>Data analysis: What kinds of analyses?</th>
</tr>
</thead>
<tbody>
<tr>
<td>RQ 1. How do Latina undergraduate students perceive the experiences that contribute to or detract from their persistence in engineering programs?</td>
<td>Lack of Latina representation in engineering fields. Still some persist regardless of barriers faced. Latinas perspectives on how they persist plays a key role in understand this phenomenon.</td>
<td>Latina engineering students or recent graduates. Found in: Engineering departments, Society of Hispanic Professional Engineers.</td>
<td>Participants: Interviews. Interviewer: field notes, jottings</td>
<td>Engineering Department - contact person SHPE chapters - Faculty advisor and student president, vice-president, secretary, treasurer.</td>
<td>Spoken words: Audio taping of interviews, transcription, coding, matrix.</td>
</tr>
<tr>
<td>RQ 2. How do Latina undergraduate engineering students make meaning of persistence in their lives?</td>
<td>To further understand how this group perceives their own persistence.</td>
<td>Latina engineering students or recent graduates</td>
<td>Participants: Interviews.</td>
<td>Engineering Departments, SHPE Chapter</td>
<td>Spoken words: Audio taping of interviews, transcription, coding, matrix.</td>
</tr>
<tr>
<td>RQ 3. How do Latina undergraduate engineering students make use of/ enact/ implement their community cultural wealth in order to persist in engineering majors?</td>
<td>To further understand the role community cultural wealth as presented by Yosso (Yosso, 2005) plays in the persistence of Latinas in engineering fields.</td>
<td>Latina engineering students or recent graduates</td>
<td>Participants: Interviews.</td>
<td>Engineering Departments, SHPE Chapter</td>
<td>Spoken words: Audio taping of interviews, transcription, coding, matrix.</td>
</tr>
</tbody>
</table>
APPENDIX C. PARTICIPANT INVITATION EMAIL AND INFORMED CONSENT

Dear Latina engineering student,

Hello, I am Yarissa Ortiz-Vidal, a PhD candidate in Higher Education at the University of Maine. I am inviting you to participate in a research project designed to better understand what Latina undergraduate students do in order to succeed and graduate from engineering majors.

I will be conducting this project as part of my doctoral research and to be included you must meet all three of the following criteria:
- Self-identify as Latina
- Engineering student in your junior or senior year, or a recent engineering graduate
- Be between 19-24 years old

Did I just describe you? Great, read on! If you agree to participate - and I hope you do - here are the details:
- Your time commitment is 1 hour – that’s it!
- I will conduct your 1 hour interview via Skype/FaceTime
- I will record and take notes during the interview
- Your information will be kept confidential and your participation is voluntary
- What’s in it for you? - A chance to win one $25 Amazon gift card (raffle)

Would you like to participate? Contact me at yarissa.ortizvidal@maine.edu or text/call (207) 831-7975. For any lingering questions and additional information about this study, please refer to the included informed consent form.

From one Latina engineer to another, I really look forward to hearing from you soon and learning from your experiences. I thank you in advance for your help and I wish you a great semester. Remember, the interview will only take 1 hour. To be part of my project, please contact me at (207) 831-7975 or via email yarissa.ortizvidal@maine.edu

With appreciation,

Yarissa I. Ortiz-Vidal, ChE, MBA
PhD Candidate in Higher Education
College of Education and Human Development
University of Maine, Orono, ME
yarissa.ortizvidal@maine.edu
cell phone: (207) 831-7975

ATTACHMENT: Informed Consent
Informed Consent

You are invited to participate in a research project designed to better understand what Latina undergraduate students do to succeed and graduate from engineering majors.

This project is being conducted by Yarissa Ortiz-Vidal, a PhD candidate in Higher Education at the University of Maine. Yarissa’s advisor is Dr. Susan K. Gardner, Director of Women's, Gender, and Sexuality Studies & The Rising Tide Center at the University of Maine. You must meet the following criteria to be included in this study:

- Self-identify as Latina
- Engineering student in your junior or senior year, or a recent graduate
- Be between 19-24 years old

What will you be asked to do?
If you decide to participate, you will be asked to complete a one-60 minute interview. This interview will be conducted via Skype/FaceTime depending on your location. The interview will be recorded. I have included some of questions below:

- List some of the characteristics that help you achieve your goals as an engineering student.
- Describe the most impactful experience you've had so far at this university.

Risks:
- Except for your time and inconvenience, there are no risks to you from participating in this study.

Benefits:
There will be no direct benefits to you as a participant. Overall research benefits: The overall research benefit of this study is linked to the stark underrepresentation of Latinas in engineering degrees (National Science Foundation, 2017). This study will allow me to obtain a deeper understanding of the experiences that contribute and detract Latinas from persisting in engineering programs; thus expanding the current knowledge base and research on this topic.

Moreover, increasing the number of Latinas in engineering fields could act as a bridge between three major issues currently facing US engineering: (a) the underrepresentation of Latinos in engineering fields (Camacho & Lord, 2011; Castellanos & Jones, 2003; Chang et al., 2014; National Action Council for Minorities in Engineering, 2013; National Action Council for Minorities in Engineering & Smith, 2014), (b) future engineering employment projections (Camacho & Lord, 2011; Peralta et al., 2013; Santiago & Soliz, 2012; Tsui, 2007), and (c) continuing to include diversity in engineering design (Camacho & Lord, 2011; Chubin et al., 2005; Guenther et al., 2015; Tsui, 2007).

Compensation:
- You will be able to enter a raffle for the chance to win one $25 Amazon gift card.
- Please note that not completing the interview, in other words stopping the interview before the last question, will make you ineligible for the raffle.
**Confidentiality:**

Your name will not be on any of the data. A pseudonym will be used to protect your identity. A printed key linking your name to the data will be kept separate from the data in a locked cabinet in the primary investigator’s office and destroyed by December 2022. The interview will be recorded and the file will be downloaded onto an external drive. The external drive will be placed in a safe and destroyed by December 2022. The recorded interviews will be transcribed by a transcription service. The transcribed interviews will be saved in a password protected computer as well as in an external drive in a safe and kept indefinitely. Notes taken during the interview will be scanned and saved electronically onto an external drive and saved indefinitely. Original notes taken during the interviews will be kept in a safe and destroyed by December 2022. These data may be used for future research. My faculty advisor – Dr. Susan K. Gardner may have access to the data. Your name or other identifying information will not be reported in any publications.

**Voluntary:**

Your participation is voluntary and really appreciated. If you choose to take part in this study, you may stop at any time. Please note that during the interview process you may skip any questions you do not wish to answer.

**Contact information:**

If you have any questions about this study, please contact me, Yarissa Ortiz-Vidal by email at: yarissa.ortizvidal@maine.edu or via text/call (207) 831-7975. You may also reach my faculty sponsor, Dr. Susan K. Gardner, PhD at susan.k.gardner@maine.edu or by calling (207) 581-3122. If you have any questions about your rights as a research participant, please contact the Office of Research Compliance, University of Maine, (207) 581-2657 (or e-mail umric@maine.edu).
APPENDIX D. IRB APPROVAL

APPLICATION COVER PAGE

• KEEP THIS PAGE AS ONE PAGE – DO NOT CHANGE MARGINS/FONTS!!!!!!
• PLEASE SUBMIT THIS PAGE AS WORD DOCUMENT

APPLICATION FOR APPROVAL OF RESEARCH WITH HUMAN SUBJECTS
Protection of Human Subjects Review Board, 400 Corbett Hall

(Type inside gray areas)
PRINCIPAL INVESTIGATOR: Yarissa L Ortiz-Vidal EMAIL: yarissa.ortizvidal@maine.edu
CO-INVESTIGATOR:
EMAIL:
CO-INVESTIGATOR:
EMAIL:
FACULTY SPONSOR: Dr. Susan K. Gardner, PhD EMAIL: susan.k.gardner@maine.edu
(Required if PI is a student):

TITLE OF PROJECT: Latina undergraduate engineering student persistence
START DATE: June 2019 PI DEPARTMENT: Higher Education

STATUS OF PI: FACULTY/STAFF/GRADUATE/UNDERGRADUATE G (F,S,G,U)

If PI is a student, is this research to be performed:
☐ for an honors thesis/senior thesis/capstone? ☐ for a master’s thesis?
☒ for a doctoral dissertation? ☐ for a course project?
☐ other (specify)

Submitting the application indicates the principal investigator’s agreement to abide by the responsibilities outlined in Section I.E. of the Policies and Procedures for the Protection of Human Subjects.

Faculty Sponsors are responsible for oversight of research conducted by their students. The Faculty Sponsor ensures that he/she has read the application and that the conduct of such research will be in accordance with the University of Maine’s Policies and Procedures for the Protection of Human Subjects of Research. REMINDERS: if the principal investigator is an undergraduate student, the Faculty Sponsor MUST submit the application to the IRB.

Email this cover page and complete application to UMRIC@maine.edu

******************************************************************************
FOR IRB USE ONLY Application # 2019-04-20 Review (F/E): E Expedited Category:
ACTION TAKEN:
☒ Judged Exempt; category 2 Modifications required? Yes Accepted (date) 5/15/2019
☐ Approved as submitted. Date of next review: by Degree of Risk:
☐ Approved pending modifications. Date of next review: by Degree of Risk:
Modifications accepted (date):
☐ Not approved (see attached statement)
☐ Judged not research with human subjects

FINAL APPROVAL TO BEGIN 5/15/2019
Date

10/2018
APPENDIX E. EMAIL MESSAGE FOR COLLEGE OF ENGINEERING
STAFF MEMBERS AND/OR SHPE FACULTY ADVISOR

Dear College of Engineering staff member,

Dear SHPE Faculty Advisor,

Hello, I am Yarissa Ortiz-Vidal, a Ph.D. candidate in Higher Education at the University of Maine. I am requesting your assistance to find potential participants for an amazing research project designed to better understand what Latina undergraduate students do in order to persist and graduate from engineering majors. I will be conducting this project as part of my doctoral research.

As fewer Latinas choose engineering as a majoring field, your help in gaining access to this group is imperative. Do you have any students who meet the following criteria?

- Self-identify as Latina
- Engineering student in their junior or senior year, or a recent engineering graduate
- Are between 19-24 years old

If a few names came to mind, I am asking for your help. I have attached an invitation letter for the potential Latina engineering students you have identified. I am requesting you to forward the invitation letter to them. I hope that a good number is interested and they reply to me directly.

I would greatly appreciate the opportunity to interview some of your institution’s Latina undergraduate engineering students and discuss their experiences in greater depth. I thank you in advance for your role and assistance in helping me complete my doctoral dissertation.

With appreciation,

Yarissa I. Ortiz-Vidal, ChE, MBA
PhD Candidate in Higher Education
College of Education and Human Development
University of Maine, Orono, ME
yarissa.ortizvidal@maine.edu
cell phone: (207) 831-7975
APPENDIX F. INTERVIEW SCRIPT

Dear participant,

Thank you for taking the time to meet with me today. As I explained in the consent email I sent you earlier, my goal is to better understand how Latina engineering students succeed and make it to graduation, and since you are both a Latina and a successful engineer, your participation is very important. This interview will last 60 minutes. This interview will be recorded for accuracy and I will be taking notes while we talk, do I have your consent?

(Pause and wait for spoken response)

I will start by asking some questions about yourself, about how you see yourself as a Latina engineering student. Then we can go through some of the experiences (good and bad) you have lived that have had an effect on your goal to graduate. Before we conclude this interview, I will give you the opportunity to offer any additional thoughts on your experiences. Please note this interview is confidential, voluntary and you can skip questions. Do you have any questions for me before we start?

All in all, this interview is about you and your experiences as a Latina engineer. So let’s get started!
BIOGRAPHY OF THE AUTHOR

Yarissa Ivette Ortiz-Vidal was born in 1972 in Caguas, Puerto Rico. Yarissa was raised in Caguas and graduated from the Centro Residencial Oportunidades Educativas Mayaguez, (CROEM) a STEM magnet high school in Puerto Rico in 1989. Upon finishing high school, Yarissa came to the United States to pursue her undergraduate studies. In 1994, Yarissa completed a Bachelor of Science in Chemical Engineering degree with a minor in Chemistry at the University of Massachusetts, Amherst, MA. Upon graduation, Yarissa moved to Rockland, Maine for her first engineering job. After marriage in 1995, Yarissa and her husband moved to Puerto Rico for four years where they welcomed their first child in 1999; their second child was born in 2006 in Maine. Yarissa received a Master’s degree in Business Administration from the University of Maine in 2003. During her professional career, Yarissa has held positions in both Maine and Puerto Rico as Process/Project Engineer and Environmental Engineering Manager. Yarissa also taught Introductory and Intermediate Spanish for the University of Maine System from 2007-2018. In 2012, Yarissa received a Graduate Certificate in Classroom Technology Integrationist from the University of Maine and in 2013 she was admitted to the Doctoral Program in Higher Education at the University of Maine. Since 2017, Yarissa has held the position of Environmental Compliance Manager and Assistant Director at the Rockland Pollution Control Facility. Yarissa is a candidate for the Doctor of Philosophy degree in Higher Education from the University of Maine in May 2020.