THE VOICE OF LATINAS PERSISTING IN SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS: A PHENOMENOLOGICAL STUDY

by

Patricia Meulemans

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

Doctor of Education

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ABSTRACT

The purpose of this hermeneutic phenomenological study is to describe the lived experiences of Latinas who persist in a STEM degree in the United States. The central question guiding this research is, what is the essence of the lived experiences of Latinas persisting in STEM education? The sample was composed of 10 Latinas who persisted in a bachelor's degree in STEM. The lived experiences of Latinas who persisted with a degree in STEM was defined as Hispanic females who graduated from a four-year university with a degree in science, technology, engineering or mathematics. The theory guiding this study is Tinto's (2015) model of student motivation and persistence as it provides a framework for examining Latinas' lived experiences persisting in a STEM degree. Data was collected and triangulated using demographic surveys, interviews, focus groups, and letters of advice. The data was analyzed through coding and thematic analysis. It was found that the essence of the experiences of Latinas began with a STEM exposure before entering college, which led to interest in increased curiosity and exploration in their particular STEM field. Following this, either shortly or many years after, they set their goal and worked tirelessly until they graduated. Family support spanned the entirety of their lives, however, peers, professionals or faculty, also provided support by guiding and encouraging them along the way.

Keywords: Hispanics, Latinas, persistence, STEM, graduation rate, achievement gap, LatCrit.

Copyright Page

Dedication

I would like to dedicate this work to the glory of God in Jesus Christ. He gave me the opportunity, ability, and strength to persist through this journey. Next, I also dedicate this to my wonderful and supportive husband, Justin, who pushed me and supported me when I could not keep going on my own, and to Braden, and Isaac. Isaac, you were given to us while I was in the middle of this! You are too young to read this, but one day you will know what an inspiration you both have been to me. I also want to dedicate these efforts to my grandmother, father, and Cousin Patty, all of whom passed away in the short duration of my doctoral journey.

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I am indebted to so many professors at Liberty University. I would not have had the opportunity to even start considering this doctoral journey without Dr. Watson opening the door. So many professors were helpful along the way, including my supervisor, Professor Maria Spaulding, who, as a true servant-leader, prayed for me, mentored me, helped me to persist, and kept me sane. I am humbled by your generosity and if I am in a position of leadership in the future, I hope to be like you! Thank you Dr. Claxton for the talks about your own doctoral experiences and your experiences as a principal. Also, thank you Dr. Swezey for all of your guidance. Thank you, Dr. Ramsey for your strong and cheerful support as we strive for the educational achievement of Latinas. Lastly, thank you Dr. Spaulding for being there – not just as a Chair, but as a friend. I may be the only privileged online student who dropped in several times a week. Being around the office among the wonderful SOE faculty has been a wonderful blessing. I would like to thank all of my friends who encouraged me and believed in me. Thank you Mamá, Catania, and Mom for watching Braden and Isaac – you have my full trust with the boys. Lastly, I would be remiss not to acknowledge my amazing editor and little brother, Danny. How could I not have thought of you? You're the best!

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List of Abbreviations

Advanced Placement (AP)

Beginners' All-Purpose Symbolic Instruction Code (BASIC)

Computer Assisted Instruction (CAI)

Common Business-Oriented Language (COBOL)

Critical Race Theory (CRT)

General Education Diploma (GED)

Grade Point Average (GPA)

International Geophysical Year (IGY)

National Aeronautics and Space Administration (NASA)

National Center for Education Statistics (NCES)

No Child Left Behind (NCLB)

Personal Computer (PC)

Qualitative Data Analysis Software (QDAS)

Social Networking Sites (SNS)

Science, Technology, Engineering, Arts, and Mathematics (STEAM)

Science, Technology, Engineering, and Mathematics (STEM)

Universal Automatic Computer I (UNIVAC I)

CHAPTER ONE: INTRODUCTION

Overview

Hispanic females are underrepresented in science, technology, engineering, and mathematics (STEM) bachelor's degrees (Hernandez, Schultz, Estrada, Woodcock, & Chance, 2013; Landivar, 2013; National Center for Education Statistics [NCES], 2017; Tsui, 2007). The purpose of this hermeneutic phenomenological study was to understand the lived experiences of Latinas who persisted in graduating with a STEM bachelor's degree in the United States. Chapter One introduces the backdrop and context for the present study, including the historical, social, and theoretical contexts surrounding the reasons Latinas are underrepresented in degrees in science, technology, engineering, and mathematics (STEM). Furthermore, Chapter One also contains the problem and purpose statements. Sections containing the situation to self, significance of the study, research questions, and relevant definitions are also presented.

Background

Conducting research in order to understand the essence of Latinas' lived experiences relevant to persisting in STEM was an important endeavor. In this study, I refer to Latinas as Hispanic females, Latinos as Hispanic males, and when I refer to both genders, I refer to them as Hispanic. Latinas are an educationally marginalized group (Bittman, Davies, Russell, & Goussakova, 2017; Delgado Bernal, Burciaga, & Flores Carmona, 2012; Villenas, 1996). Thus, researching their lived experiences in light of the male-dominated STEM classroom (NCES, 2017a) is indispensable to scholarly literature. Consequently, it is necessary to convey the historical, social, and theoretical context in order to be acquainted with an appropriate contextual framework for understanding the essence of the lived experiences of Latinas persisting in STEM.

Historical Context

This section contains a discussion of the events surrounding scientific and technological evolution since the advent of computers. One monumental catalyst for investment in mathematics, science, technology, and engineering was the Space Age (Garrett, 2008; Jolly, 2009). Next, I define and explain what STEM is and what it is not. Subsequently, the evolution of the popular STEM acronym, and the reasons why STEM is important are presented. Finally, I discuss the continuous rising demand for STEM education among kindergarten through 12th grade students.

Defining the acronym STEM. STEM is a group of subjects that consists of science courses, technology courses, engineering courses, or mathematics courses (Breiner, Harkness, Johnson, & Koehler, 2012). STEM degrees include Associate's degrees, bachelors' degrees, graduate and postgraduate degrees. The types of occupations that people who have graduated with STEM degrees may hold are marine biologists, aeronautical engineers, mathematicians, programmers, web developers, coders, and other high-skill, high-level employment (Immigration and Customs Enforcement, 2012). For a complete list of STEM degrees, please refer to Appendix A.

In this study, I use the terms STEM and STEM education interchangeably to convey degrees related to science, technology, engineering, and mathematics. In addition, there are a few education-related STEM degrees, such as educational or instructional technology, educational evaluation and research, and educational statistics and research methods (Immigration and Customs Enforcement, 2012). STEM does not include the medical fields, business fields, humanities, or fine arts (Immigration and Customs Enforcement, 2012). Note that although many institutions have promoted the acronym STEAM which stands for science, technology,

engineering, arts, and mathematics, this research study does not include the arts. STEM courses have not always been clustered together. In fact, it is only recently that they have become a common educational acronym (Sanders, 2008).

The catalyst for rapid technological advancement. The launching of Sputnik I in 1957 by the Soviet Union sparked the beginning of the Space Race between the United States and the Soviet Union (Johanningmeier, 2010). Sputnik I was a beach-ball sized satellite that orbited the earth in 98 minutes (Garber, 2007). This alarmed American society since it demonstrated a threateningly superior Soviet Union technology, and it marked the start of the space competition between the United States and the Union of Soviet Socialist Republics (U.S.S.R) (Branscome, 2012; Garber, 2007; Marlin, 1987).

The United States held an International Council of Scientific Unions in 1952. During this council, they announced that 1957 to 1958 would be the International Geophysical Year (IGY) (Garber, 2007; National Academy of Sciences, 2005) since they forecasted a high amount of solar activity (Garber, 2007). Two years later, in 1954, the council resolved to launch artificial satellites to map the earth's surface during IGY (Garber, 2007).

The U.S.S.R.'s launch of Sputnik captured the attention of the world because the Soviet Union demonstrated the technological ability to carry a heavy object into space; Sputnik I weighed 183.9 pounds, and Sputnik II carried an even heavier load into space, namely Laika, a dog (Brown, 2008; Garber, 2007). Launching heavy objects and satellites into space was perceived as dangerous because it signified that the Soviet Union had the ability to launch ballistic missiles carrying nuclear weapons at the United States (Garber, 2007). This is the reason the mass of the satellite alarmed the people of the United States. Eventually, the U.S. finished the race on January 31, 1958, when it launched Explorer I, a satellite that discovered the magnetic

radiation belts encompassing the earth (Garber, 2007). Sputnik also opened the door to the origin of NASA (Garber, 2007; Rosholt, 1966).

In conclusion, these events brought about the beginning of an intense effort in the nation to invest in science, technology, engineering and, mathematics (Garrett, 2008; Jolly, 2009). Some societal changes that the Space Age brought affected the political, military, educational, technological, and scientific arenas (Dolman, 2002; Garber, 2007). In fact, the seminal report *A Nation at Risk* made it clear that the United States fell behind other nations in technology, mathematics, engineering, and science (Gardner, Larsen, Baker, Campbell, & Crosby, 1983). Although the following decades brought many inventions and societal changes, including frozen orange juice, vacuum tubes, and microchips, the most notable for the purpose of this study is the change it brought to the classroom (Garrett, 2008).

Science and mathematics. Since the beginning of the Space Race, when the Soviet Union launched Sputnik, science curriculums changed (Jenlink, 2013). Science curriculums began including laboratory time and project-based activities (Garrett, 2008). In fact, one of the biggest changes in science, technology, engineering, and mathematics (STEM) education historically has been also been one of its biggest challenges, namely employing highly qualified teachers (Garrett, 2008; Polizzi, Jaggernauth, Ray, Callahan, & Rushton, 2015).

In an effort to address this problem, the Bush administration re-authorized the Elementary and Secondary Education Act of 1965 as the No Child Left Behind Act (NCLB) in 2001 (Taylor, Pearson, Peterson, & Rodriguez, 2003). NCLB affirmed that states were required to establish high standards for student achievement and to set a criteria for hiring highly qualified teachers. Under this act, 35 states increased their graduation requirements to include three years of science (Garrett, 2008).

Mathematics curriculums also changed (DeJarnette, 2012, Garrett, 2008). Mathematics courses now included set theory, problem-based learning, and engineering components (DeJarnette, 2012). In the 1980s and 1990s, computers for student use also began making their way into the classroom (Garrett, 2008). NCLB also changed the mathematics requirements for student graduation. Under NCLB, 38 states established a graduation standard that required at least three years of mathematics (Garrett, 2008).

Technology and engineering. First generation computers began flooding the market around the world in the 1940s ("Production begins," 2013). Certain universities in the United States helped develop computers, and the military began utilizing this new technology in war (Murdock, 2014). Starting in the 1950s and continuing through the end of the century, computer usage evolved from mainframe computers taking up entire rooms and being practical only for staff use, to becoming personalized, handheld, and widely-used (Fransman, 1995). Performing many of the perfunctory and personal tasks that were done on a personal computer (PC) are now easily accomplished on a smart phone (Bonnington, 2015).

Evolution of STEM education. People who lived through the Space Age have witnessed a fast change of pace in technology that continues today. Currently, there is a high demand in the global market for technology and innovation (Atkinson & Mayo, 201; Branscome, 2012; Garber, 2007; Marlin, 1987). Innovation is defined as "the improvement of existing or the creation of entirely new products, processes, services, and business or organizational models—drives long-run economic growth, competitiveness, and quality-of life improvements" (Atkinson & Mayo, 2010, p. 20). This demand for innovation in the global market suggests that those who delve into STEM will be compensated with greater financial wages, upward mobility, and more options

than those who do not earn any credentials at all (Beede, Julian, Langdon, McKittrick, & Khan, 2011).

American society did not generally group STEM education courses until the year 2005, when Congressman Vernon Ehlers and Congressman Mark Udall launched the STEM caucus for members of Congress, which still exists today (STEM Education Caucus, 2017). The STEM Education Caucus was created to raise awareness of STEM in education, and to prepare students to become knowledgeable of software, hardware, critical thinking, and problem solving skills, as well as literacy in scientific and mathematical principles (Bybee, 2013; STEM Education Caucus, 2017).

Social Context

In the STEM classroom, there is a disproportionate representation of race and gender. There is an underrepresentation of minorities in general. In fact, among all male recipients of STEM degrees, 65% of them are awarded to White males (NCES, 2017a). Although a higher percentage of women than men earn bachelor's degrees (57% versus 43%), only 35% of women and 65% of males persist in earning STEM degrees (NCES, 2017a). Thus, being a minority and being a female gives Latinas double minority status (Hill, Upadhyay, & Beekun, 2015).

The female representation in STEM is scarce. There may be social and cultural reasons why women historically have not pursued STEM (Shapiro & Williams, 2012). Thus, this section introduces information about female representation in STEM, factors that may impact the underrepresentation of Latinas in STEM, and lastly, the societal repercussions of the underrepresentation of Latinas in STEM.

Female representation in STEM. There exists a historic underrepresentation of women teaching STEM, and females earning STEM bachelor's degrees. In 1975, only 9% of faculty in

science, math, and engineering were female, yet by 2005, the number had increased to 33% (Bakian & Sullivan, 2010). The rate of persistence in STEM education degrees among women has remained at a constant 30% since 2008 (NCES, 2015).

Nevertheless, women outnumber men in undergraduate degree attainment. In fact, women earned 57% of all bachelor's degrees conferred (McFarland et al., 2017; NCES, 2016a); however only 38% of those degrees were in STEM disciplines (NCES, 2017a). STEM bachelor's degrees are male-dominated, with the majority of men being White (NCES, 2017a). This is not the case only in the student body, but also among the faculty; women and minorities are underrepresented across faculty ranks on college campuses (Bakian & Sullivan, 2010).

Female underrepresentation in STEM degrees may have a wide-reaching impact. First, it may create a stereotype in society that only a certain type of gender or race belongs in or is interested in STEM. Simultaneously, this stereotype may also convey that if someone who is not part of this group is interested, they will not be happy or successful (Shapiro & Williams, 2012). Next, underrepresentation closes the possibility of greater financial compensation to females who could otherwise earn the credentials and have the option to work for higher wages (Beede et al., 2011). Lastly, without role models, younger females may perceive that since other Latinas have not pursued STEM, STEM may not be for them (Diekman, Steinberg, Brown, Belanger, & Clark, 2017).

Reasons for underrepresentation of Latinas in STEM. There may be many reasons as to why only 5% of those who graduate with STEM undergraduate degrees are Latinas (NCES, 2017a). Research shows that institutional factors, personal factors, and familial factors have some influence over Latinas' decision (Diekman et al., 2017; Garrett, 2008; Jackson, Starobin, & Laanan, 2013; Peralta, Caspary, & Boothe, 2013). However, more research is needed in order to

determine the specific reasons for Latina underrepresentation in STEM fields (Riegle-Crumb, King, Grodsky, & Muller, 2012).

Institutionally, some of the reasons Latinas are underrepresented in STEM may be due to not being recognized as eligible for gifted programs in K-12 (Peralta et al., 2013). Although 8% of Caucasians, and 13% of Asians are identified for gifted and talented education, research shows that only 4.2% of Hispanics are identified for gifted and talented programs. Overall, 6.7% of K-12 students are identified as gifted (NCES, 2008). Another reason may be related to consistent attendance (Andrietti, 2014). In order to encourage persistence, Latinas may need a robust community of peers and faculty who are involved in STEM-related endeavors (Espinosa, 2011; Zerquera & Gross, 2015).

Pre-college curriculum and instruction at the institutional level may play a role in collegiate persistence in STEM education. Attending underachieving high schools with limited resources may be concerning in consideration of Latinas aspiring to pursue STEM (Garrett, 2008). Therefore, although some Latinas may have outperformed their peers in middle school and high school in underachieving schools, they may not be prepared to meet the rigor of STEM courses in the university setting (Taningco, Mathew, & Pachon, 2008). Thus, Latinas' ability to persist in a bachelor's degree in STEM may be thwarted by attending a school that did not make the STEM curriculum a priority, or that cut its support to STEM-related activities (Garrett, 2008).

Further, research suggests that institutional issues warranting concern include lack of support in the university classroom environment, outdated pedagogy, limited peer groups, and lack of female role models (American Association of University Women, 2010). Lastly, financial aid may play a role in fostering opportunities for Latinas (Olivas, 2009; Perez, 2010).

Among the personal reasons Latinas may not persist in STEM is the simple explanation that not all Latinas aspire to enroll and persist in STEM education. Some may possess multiple intellectual strengths (Gardner & Hatch, 1989) that do not include technical strengths. Others may possess the intellectual prowess to persist in STEM education, but may be uninterested. Yet others may not envision themselves in a professional career involving STEM due to a dearth of role models in the field whom they could emulate (Steinke et al., 2007).

Another personal reason Latinas may not pursue STEM could be related to their sense of belonging. Latinas may doubt whether they belong in the STEM classroom because of their gender, ethnicity, or age (Jackson et al., 2013). Family characteristics that may factor into STEM persistence include socio-economic status, gender roles, family expectations, parental involvement, sibling role modeling, and community support (Leyva, 2011; Peralta et al., 2013; Taningco et al., 2008).

Societal repercussions of Latinas' underrepresentation in STEM. In order for American society to maintain a place in global leadership, those who are capable of a technical or scientific career in STEM fields are encouraged to earn a STEM degree (Ejiwale, 2013). By joining the STEM workforce, those capable will further innovation (Hossain & Robinson, 2012; Steinke et al., 2007). Not surprisingly, the most untapped potential is found among underrepresented double minorities (Steinke et al., 2007). Efforts should be made to provide incentives for women, especially women of color, to enter and persist in STEM education (Steinke et al., 2007).

One repercussion of female and minority underrepresentation in STEM education is outsourcing. Outsourcing happens when companies employ workers who live in other countries to perform a job remotely or by having them to move to America on a work visa (Cullen,

Seddon, & Willcocks, 2005). Outsourcing has become increasingly popular because there is not enough work force to meet the demands (National Science Board, 2014). However, it would be economically beneficial for American society to invest in American-educated students' recruitment and retention in STEM than to rely on international workers to boost the STEM workforce. Researchers suggest that outsourcing may be a near-sighted strategy that fills the void temporarily (Moakler & Kim, 2014).

The economic sector may benefit from Latina representation in STEM, and likewise Latinas may benefit from becoming STEM workers. Since Latinas are an educationally marginalized group and most likely to live in poverty (Bittman et al., 2017; Delgado Bernal, Burciaga, & Flores Carmona, 2012; Gonzales, 2008; Villenas, 1996), Latina STEM workers may benefit as well (Tsui, 2007). The financial reward that accompanies working with information systems as well as the other technical STEM degrees is hard to match in any other field (Beede et al., 2011). Employment in STEM may be unequivocally practical for Latinas who come from poverty. In the face of limitations and closed doors, persistence in a STEM degree may offer credentials, financial mobility, and options (Beede et al., 2011).

Additionally, STEM classrooms are maledominated, both among students and instructors (NCES, 2017a). Thus, the field may benefit from the input of diversified groups and perspectives (Tsui, 2007). The narratives of Latinas' lived experiences provide individuals, higher education administrators, and the industry understanding of the factors that inhibit and foster persistence. Understanding the lived experiences of Latinas who persist in STEM fields in higher education may encourage the development of programs, strategies, and other types of supports that may enable this population to persist in a STEM degree. Thus, in all, for historical, cultural, and social reasons, persistence in STEM degrees may denote a symbiotic relationship for Latinas.

STEM programs may benefit from their persistence in STEM, and Latinas may benefit from persisting in a STEM degree (Beede et al., 2011). Voicing their experiences is one way to begin to address the underrepresentation of Latinas in STEM degrees (Crisp, Nora, & Taggart, 2009).

Theoretical Context

There are multiple lenses available through which to interpret the experiences of Latinas in STEM. In this study, the experiences of Latinas persisting in STEM were interpreted through the model of student motivation and persistence (Tinto, 2015).

Model of student motivation and persistence. Tinto's model of student motivation and persistence (Tinto, 2015) provided an appropriate lens through which to explore Latinas' motivation and persistence in STEM education. The model states that goals lead to motivation, and motivation leads to persistence (Tinto, 2015). Further, three constructs directly affect motivation: perception of curriculum, sense of belonging, and self-efficacy (Tinto, 2015). Sense of belonging contains implications both for academic integration as well as social integration (Tinto, 2015). Although this theoretical framework explains the reasons students persist in collegiate degrees, it did not specifically focus on the experiences of Latinas. However, Tinto's (2015) model of student motivation and persistence was an ample framework that has been used to explore the experiences of traditional, non-traditional, minority, and commuter students in the university setting (Pacheco, Lips, & Yoong, 2018; Tinto, 2015; Wladis, Hachey, & Conway, 2015). Offering a word of warning, Tinto (2015) expressed that the model does not account for expected or unexpected external reasons for not persisting.

Factors in the theoretical model. More research is needed to determine what is required from a student in order to earn a STEM degree. Some scholarship suggests that heavy mathematical preparation, great stamina, as well as intrinsic, and extrinsic motivation are

important while earning the degree (Bybee, 2013; STEM Education Caucus, 2017). Therefore, because of the possible rigor of STEM, using a theoretical model that emphasizes a cultural-institutional connection may not be fitting in light of the experiences of Latinas' persistence in STEM.

Rather, since research suggests STEM degrees are much more difficult to attain than most general college degrees (Barakos, Lujan, & Strang, 2012; Litzler, Samuelson, & Lorah, 2014; Sanders, 2008), academic identity, motivation, preparation, and self-efficacy may be major components in persistence models for most STEM students (Tinto, 2015). Thus, Tinto's model of student motivation and persistence seemed most fitting in my efforts to explore the experiences of Latinas' persistence in STEM.

In summary, Latinas have been historically underrepresented in STEM (Hernandez, Schultz, Estrada, Woodcock, & Chance, 2013; Landivar, 2013; NCES, 2017; Tsui, 2007). This underrepresentation has social implications (National Science Board, 2014). Therefore, a study was needed to give a voice in the literature to Latinas persisting in STEM, and Tinto's (2015) model of student motivation and persistence was the theoretical framework with which I investigated this phenomenon.

Critical race theory. Although critical race theory (CRT) was not part of the lens through which the experiences of Latinas persisting in STEM was framed in this study, it has historically been called upon in studies exploring the Hispanic experience (Delgado & Stefancic, 2017). Critical race theory holds to the tenet of Whiteness as Property, which has implications concerning White males dominating STEM, and excluding others (DeCuir-Gunby, Long-Mitchell, & Grant, 2009). Naturally, critical race theorists may purport that the odds are stacked against minorities and females, purposefully or unwittingly, by Caucasian males.

Situation to Self

My motivation for conducting this hermeneutic study has many features. First, I am Latina, and thus things that pertain to Hispanic females interest me. Next, I am an educator, and I want to be aware of how to make education appealing to different cultures, especially if these cultures are known to be underprivileged or underrepresented in high paying employment opportunities. I believe that capable people should be empowered to attain, and many times that means earning credentials through education. For Latinas, attaining credentials means more options and more opportunities in life. This was one of my goals in conducting research with the Latina population.

Next, I was interested in raising awareness about STEM degrees because of my own endorsement to teach biology in grades six through 12. I was interested in the advancement of Latinas in STEM degrees because Latinas are underrepresented in all of the STEM disciplines. My hope is for Latinas to enter STEM disciplines, bring their perspective and enthusiasm into the workplace environment, and thus, change the classroom atmosphere, workplace culture, and STEM environment. My last reason for conducting this study is practical. More specifically, Latinas are the poorest race, ethnicity, and gender combination. Latinas who earn a degree in STEM may have more opportunities to avoid living in poverty (Gonzales, 2008).

There are many designs that could have been selected for this study. I specifically chose hermeneutic phenomenology because of its interpretive aspect. I believe that in order for someone interpret someone else's experiences, the person interpreting has to have had previous experiences with the matter at hand. In fact, Van Manen (1997) addressed this issue when he stated "I reflect phenomenologically on the experiences of teaching or parenting as a teacher or as a parent" (p. 78).

My paradigm for conducting this research was constructivist. In line with constructivism, I believe that knowledge is constructed on an individual level and meaning is created from various experiences. As my educational axiology, I value relationships and education. The two combined create an inseparable key to unlock student success, especially for those students whose parents are not familiar with the American educational system. I say this, of course, in reference to Latinas whose door to persisting in a STEM degree may hinge on the dedication of caring educators who recognize Latinas' potential in STEM, and find a way to motivate and direct their interests. Teachers who actively seek to uncover Latinas' potential while encouraging them may be very valuable to Latinas. They may find that they have an important input in their lives. Pertaining to researchers and participants, I believe that participants' perspective is constructed within themselves and can be drawn out by researchers. Hermeneutic phenomenological researchers draw out people's perspectives through communication using the interplay of their values and interpretations. This dynamic process may evolve into greater awareness and understanding of those perspectives for both the participant and the researcher.

There are also certain philosophical assumptions that need to be addressed. From a rhetorical perspective, I am gathering data from participants who are self-identified Latinas, and who have persisted in attaining a STEM degree. As I am a Latina, and I am familiar with taking STEM courses, interviewing the participants may prove to be fruitful. The dynamic interplay of their voices and my interpretation may yield rich data as I seek to provide thick descriptions through the study findings. My participants will provide multilayered information that may only be harvested through hermeneutic reflection and interpretation of the text in order to understand the phenomenon.

On an ontological level, participants' perspective is often their reality. Reality is constructed within people's minds and can be engaged and explored by a researcher through conversation. My participants' perspectives, which is their reality, is what I am seeking in conducting this research. I want to know the sacrifices these Latinas made to persist in STEM, what was their original goal, how they were motivated, what they perceived as obstacles, and how they overcame them.

The last philosophical assumption to be addressed is epistemological in nature. My fundamental epistemological assumption affirms that God created all knowledge, and that the Bible is God's inerrant and authoritative Word. All people are created in God's image and therefore may possess some truth and knowledge, but without Jesus Christ, no truth and knowledge is complete. I believe people know what they know through reason and observation using the five senses, though these at times may be deceived. I also believe that knowledge can be transferred from human to human. People's reality is subjective, and may not be objectively accurate.

In conclusion, the topic of Latinas persisting in STEM is interesting for many personal reasons. I will be analyzing the data through a hermeneutic phenomenological approach, thus it is important for the reader to be lucidly aware of my assumptions and research paradigm. In view of this, I openly share my rhetorical, ontological, epistemological, and axiological assumptions, along with my constructivist paradigm.

Problem Statement

The digital age, the innovation of computers, and the drive for discovery has rapidly advanced, creating a need for workers who are skilled in science, technology, engineering, and mathematics. Digital technology has changed the way people communicate, manage, and store

information (Bybee, 2013; STEM Education Caucus, 2017). This shift has altered the global workforce, so that people with problem-solving and critical thinking skills are needed, especially those who are trained in computer systems, and scientifically, engineeringly, and mathematically literate (Bybee, 2013; STEM Education Caucus, 2017). Many who foresaw that American society would not have enough students properly prepared to meet the STEM workforce demand have exerted efforts in raising awareness to prepare the general population to fill this need (Barakos et al., 2012; Brown, Brown, Reardon, & Merrill, 2011; Hossain & Robinson, 2012).

The problem is that Hispanic females are underrepresented in STEM bachelor's degrees (Hernandez et al., 2013; Landivar, 2013; NCES, 2017; Tsui, 2007). Latinas make up roughly 9% of the U.S. population (United States Census Bureau, 2016) but persist in earning a STEM bachelor's degree only at a rate of 1.7 % when considering all students who attain STEM bachelor's degrees (NCES, 2015). In summary, Latinas' are underrepresented in STEM fields, and the lived experiences concerning their persistence in STEM are not voiced in scholarly research. In fact, there is no research giving voice to Latinas who persist in STEM bachelor's degrees.

Purpose Statement

The purpose of this hermeneutic phenomenological study is to understand the lived experiences of Latinas who persisted to graduate with a STEM bachelor's degree in the United States. At this stage in the research, the lived experiences of Latinas who persisted in a degree in STEM will be generally defined as self-identified Hispanic females who have graduated with a bachelor's degree in the fields of science, technology, engineering, or mathematics. A Latina is a woman who self-identifies as Hispanic and who was born in a Spanish-speaking country, or is the descendant of a person who was born in a Spanish-speaking country (Zimmerman, Vega, Gil,

Warheit, Apospori, & Biafora, 1994). The theory framing this study is Tinto's (2015) model of student motivation and persistence as it creates a context through which to investigate Latinas' lived experiences in STEM education.

Significance of the Study

STEM degrees are difficult to earn for most students (Barakos et al., 2012; Litzler et al., 2014; Sanders, 2008). In light of this, administrators, policymakers, educators, researchers, theorists, and other stakeholders in STEM education will have valuable insight into the experiences of Latinas who have finished an undergraduate degree in STEM.

Theoretical Significance

Theorists studying Tinto's (1987) model of student departure possess a theoretical framework to understand the needs of traditional students for retention. In fact, many researchers have utilized Tinto's theories of student retention or persistence (Kommers & Pham, 2016; Stuart, Rios-Aguilar, & Deil-Amen, 2014). Furthermore, scholarship suggests that Tinto's model is fitting for African American students, students with disabilities, high poverty students, and non-traditional students (Brooks, Jones, & Burt, 2013; Patrick & Wessel, 2013; Stuart, Rios-Aguilar, & Deil-Amen, 2014). However, since Latinas' persistence in STEM continues to be a concern for researchers and theorists, and Tinto's (2015) model of student motivation and persistence has not been utilized as a contextual framework for studying Latina's persistence in STEM, the present study may yield valuable theoretical information pertaining Latinas' persistence in STEM. This study may even increase understanding of the experiences that lead to persistence among other people who come from collectivist cultures.

The model of student motivation and persistence (Tinto, 2015) may enhance researchers' exploration and discovery of the path to persistence that Latinas embark on. Tinto's (2015)

model of student motivation and persistence frames the flow of how goals affect motivation, and motivation affects persistence. As stated before, although this model has been contextually appropriate in the efforts of understanding many different groups of students, more research is needed to suggest whether this model is wholly encompassing in order to understand the experiences of Latinas persisting in STEM bachelor's degrees (Brooks, Jones, & Burt, 2013; Patrick & Wessel, 2013; Stuart, Rios-Aguilar, & Deil-Amen, 2014).

Consequently, the model will be tested in this study. One aspect of this theory that may need further research in light of Latinas persisting in STEM is that it does not state that self-efficacy is required in goal-setting (Tinto, 2015). However, research suggests that STEM degrees are very demanding (Lindemann, Britton, & Zundl, 2016), and that Latinas are an underrepresented gender and ethnicity intersection in STEM programs (NCES, 2016). Therefore, as a consequence of the demanding nature of STEM degrees and Latinas' underrepresentation which may lead to stereotype threat and impostor syndrome (Lindemann et al., 2016), research is needed to suggest whether Latinas need self-efficacy as a subconstruct to goal-setting.

For many, the time they decide to major in STEM may be before enrolling in college (Komarraju & Nadler, 2013). Thus, self-efficacy even in high school may be a desirable trait for Latinas who are considering STEM (Parker, 2014; Schwartz, Kanchewa, Rhodes, Cutler, & Cunningham, 2016; Talley & Ortiz, 2017). In conclusion, more research is needed to suggest whether Latinas need self-efficacy before setting the goal of majoring in STEM or, as stated in the model, whether self-efficacy is only needed in motivation (Tinto, 2015).

Empirical Significance

Findings from this study will contribute knowledge to the field of student persistence and retention, filling a critical gap in the literature explaining the factors that foster persistence and

increase retention in Latinas in STEM education paths. Administrators serving grades K-12 and undergraduate institutions may become aware of Latinas' needs in order to persist in STEM, which may include academic and social difficulties (Tinto, 2012; Tovar, 2015). They may need support in both areas (Chuang, Thompson, & Schmidt, 2003).

Further, researchers who focus on STEM fields may discover a new aspect when researching different populations' persistence in STEM. This new aspect pertains to the factors that foster persistence among Latinas in STEM degrees. Researchers acknowledge that American society is not homogenous (NCES, 2015); not all students have similar experiences or even similar backgrounds (United States Census Bureau, 2018). Some students may need support in areas that may be traditionally overlooked (Talley & Ortiz, 2017).

Practical Significance

Policymakers, such as those in Congress, Senate, and the White House may find they are at a loss when it comes to knowing how to interest and retain underrepresented minorities in STEM (Library of Congress, 2015). Society as a whole has not made a concerted effort to change the male scientist stereotype (Miller, Eagly, & Linn, 2014). People of Asian and White descent may have many role models in STEM, whereas many underrepresented minorities, especially double minorities, lack role models and access to quality STEM education (Trump, 2017).

Educators may come to the realization that they have unconsciously held stereotypes about who succeeds in their classroom (Reyes, 2011). They may not be cognizant that they call on more males to answer questions, remember European names more, make more eye contact, or that they seem more approachable to people of their own gender or culture (Fassinger, 1995). The important piece of information is for educators to become available to all students, welcome

all students, accept all students, and be willing to motivate and mentor students. It may be important for elementary school, middle school, high school, and college educators to be sensitive to not giving preference to students of their own culture or gender.

Parents of Latinas may benefit from this study because they may become aware of their rights as Spanish-speaking individuals. They may also become more aware of how to navigate the educational pathway to prepare their children to pursue a STEM degree. On a practical level, a list is provided of the mathematics and science courses needed in high school in order to prepare students for the mathematical and scientific literacy needed in STEM programs in Appendix B. I also provide references to websites that explain their legal rights as non-English speaking parents (Department of Education, 2015).

Liaisons, such as outreach coordinators, may also benefit from this research because they may become more aware of culturally sensitive approaches to gain Hispanic parents' trust. Gaining families' and communities' trust may open the door to engage the family to invest in educational endeavors. They will be better able to understand the importance of the family unit, and how extensive familial relationships are in Hispanic culture (Calzada, Tamis-LeMonda, & Yoshikawa, 2013). As they gain the trust of the community, they may become a bridge to foster trust between the community and the school.

Study's effect on society. Residents and citizens alike may be concerned about the need to increase STEM literacy in light of the projected STEM workforce shortage of millions of workers (Reester, 2008). American society needs to raise a greater STEM workforce (Moakler & Kim, 2014). For this reason, this study sought to encourage more people to enter the STEM workforce. Not only would Latinas in STEM benefit society, but entering and persisting in a STEM degree would also benefit Latinas (Tsui, 2007).

Study's effect on women. The social mobility, options, and financial compensation that working in a STEM field entails (Trump, 2017) may certainly justify the sacrifice that earning a STEM bachelor's degree requires. This study can be replicated among any people group, especially other double minority groups, in order to understand factors that encourage interest and persistence. Other double minorities include African-American women, African women, and women of Middle Eastern descent (Hayes, Chun-Kennedy, Edens, & Locke, 2011). Other underrepresented groups that may benefit from greater understanding could be women from Appalachian backgrounds and Roma women (Guy, 2001). STEM education needs more gender balance (Steinke et al., 2007). This endeavor may only be made possible through the effort of many stakeholders.

In conclusion, other researchers have studied similar components, namely increasing STEM interest among students, encouraging persistence in STEM, and engaging minorities in STEM education (Amarnani, Garcia, Restubog, Bordia, & Bordia, 2018; Saw & Chang, 2018). However, more research is needed to study, understand, and give a voice to the underrepresented Latinas in their effort to persist in a STEM degree at the undergraduate level.

Research Questions

The following questions were developed to address the stated purpose of this study:
Central question: What is the essence of the lived experiences of Latinas persisting in a STEM bachelor's degree in the United States?
Sub-questions:

Research Question 1: What formative experiences motivate Latinas to begin a STEM postsecondary degree? Latinas may begin considering a STEM degree early or later in their educational career. If this aspiration came early in life, it may have originated from being

exposed to STEM courses, real-life integration of problem-solving using STEM concepts in core subjects, or watching a role model pursue STEM (Betz & Schifano, 2000; DeJarnette, 2012; Maltese & Tai, 2011). It may be deduced that some early considerations of STEM were accompanied by goal-setting. Thus, setting a goal of persisting in a STEM degree in high school or earlier may impact Latinas' motivation and persistence (DeJarnette, 2012; Moakler & Kim, 2014; Simpson, 2001).

Research Question 2: What are Latinas' perceptions of the curricula based on their experiences in their STEM degree program? Those who persist in a STEM degree are not going through the trouble of earning a STEM degree for a simple line to fill on their résumé. STEM education degree credentials are usually very specific, high-level, technical, and financially rewarding (Barakos et al., 2012; Rothwell, 2013). Therefore, Latinas must believe that they are earning a degree that prepares them for the job they are seeking, and much of that preparation concerns being challenged with a rigorous curriculum (Dejarnette, 2012). A positive perception of the curriculum may aid their persistence (Dejarnette, 2012). Regardless of their situations, STEM students may need to work very hard and be very motivated in order to persist in a STEM degree.

Research Question 3: How do Latinas describe the sense of belonging they experienced during their 4-year postsecondary institution? Tinto (2015) outlined sense of belonging as directly impacting motivation. He posited that students' perception of their sense of belonging socially and academically will have an impact on their persistence (Tinto, 2015). Research suggests that there may be concrete, practical ways for Latinas to develop a sense of belonging with STEM peers and faculty (Graham, Frederick, Byars-Winston, Hunter, & Handelsman,

2013; Maltby, Brooks, Horton, & Morgan, 2016). For example, receiving invitations to join research teams or study groups may enable them to experience academic and social integration.

In addition, sense of belonging for Latinas may be different than for their American counterparts. For many Latinas, experiencing sense of belonging within their community and family may be the most important type of sense of belonging. Thus, their motivation to persist may be inextricably intertwined with communal ways to benefit their family and greater community (Carlone & Johnson, 2007; Diekman et al., 2017; Ong, Wright, Espinosa, & Orfield, 2011; Ong, Phinney, & Dennis, 2006; Peralta et al., 2013) and not as much with STEM peer integration.

Research Question 4: How does Latinas' self-identity motivate their persistence in their STEM degree? The constructs found in Tinto's (2015) model of student motivation and persistence provided guidance as general, encompassing constructs were sought. According to Tinto (2015), self-efficacy directly affects motivation. Moreover, self-efficacy may influence Latina's self-identity (Cobb, 2004). Self-identity is a multidimensional construct comprised of many facets. For the purposes of this study, I mainly focus on two aspects of self-identity in order to research the STEM population and the Hispanic population. The two aspects that may be relevant to this study are cultural identity and academic identity (Carlone & Johnson, 2007; Cobb, 2004; Parker, 2014; Sayman, 2013).

Definitions

Some terminology used in this study may not be commonly used in conventional contexts. The following terms are defined to provide a contextual frame of reference for the reader.

1. *Academic integration* - intellectual connection students feel in an institution (Clark, Middleton, Nguyen, & Zwick, 2014).
2. *Chilly climate* – The cultural environment often found in STEM classrooms, where women and people of minority backgrounds feel socially isolated (Ong, Phinney, & Dennis, 2006).
3. *Classroom environment* – Level of student cohesiveness, teacher support, involvement, task orientation, cooperation, and equity students perceive are in a classroom (Adamski, Fraser, & Peiro, 2013).
4. *Double minority* – Twofold oppression stemming from belonging to two minority groups experiencing bondage (Rouhana, 2015).
5. *Extrinsic motivation* – The desire to engage in activities or behaviors to gain rewards or avoid criticism instead of the satisfaction of doing the activity in and of itself (Baker, 2004).
6. *Goals* – Future intentions which are desirable. They are internal representations of motivators and motives (Austin & Vancouver, 1996).
7. *Hispanic* – Any person who self-identifies as Hispanic and was born in a Spanish-speaking country, or is the descendant of such a person (Zimmerman et al., 1994).
8. *Intrinsic motivation* – Engaging in an activity or behavior voluntarily not as a means to an end, but for the desire of feeling the satisfaction of participating (Baker, 2004).
9. *Motivation* – One's willingness to attend to a given task as evidenced by material learned, and the effort exerted focusing on the task (Abeysekera & Dawson, 2015).

10. *Outsourcing* – A business partnership based on a client-supplier arrangement. The client is an agency that needs specialty support, and the supplier is an offshore provider, often in the information systems field (Cullen et al., 2005).
11. *Persistence* – The decision of the student to exert the necessary effort to successfully finish the degree they started (Graham et al., 2013).
12. *Retention* – Actions institutional agencies take to promote persistence among students (Tinto, 2015).
13. *Self-efficacy* – People's belief concerning their abilities to succeed in a task or behavior (Smith, Lewis, Hawthorne, & Hodges, 2012; Wright, Jenkins-Guarnieri, & Murdock, 2012).
14. *Social integration* – The extent to which students are emotionally and psychologically adapted to the social intra-institutional way-of-life (Clark et al., 2014; Rienties, Beausaert, Grohnert, Niemantsverdriet, & Kommers, 2012).

Summary

Chapter One provided a context and a frame of reference for the advent of science, technology, engineering, and mathematics education. The acronym STEM came about as four separate subjects that were grouped together by educators (Gardner et al., 1983). Consequently, the perception of STEM among American society and education changed. It is believed that America may experience a coming crisis due to the depressed levels of scientific and mathematic literacy (Charette, 2013).

It may be alarming to society that there is no research study giving voice to Latinas who have persisted in a STEM bachelor's degree (Crisp et al., 2009). The fact that Latinas are underrepresented in STEM fields warrants greater concern. The problem and the gap in the

literature must be addressed. My research will address the problem of the underrepresentation of Latinas in STEM by offering valuable information for readers with different backgrounds and interests. Furthermore, this study will fill the gap in the literature by giving Latinas who persisted in STEM undergraduate degrees a voice.

CHAPTER TWO: LITERATURE REVIEW

Overview

The purpose of this hermeneutic phenomenological study is to understand the lived experiences of Latinas who persisted in a STEM bachelor's degree in the United States. The purpose of Chapter Two is to introduce the interested reader to the theory undergirding the dissertation. Also in Chapter Two, the Related Literature will be unfolded. The Related Literature will anchor the study in peer-reviewed, scholarly literature and expound upon the underrepresentation of Latinas in STEM.

Chapter One introduced the social, historical and theoretical backdrop of STEM education and other information surrounding STEM. However, Chapter Two focuses on topics surrounding Latinas themselves, and research concerning different aspects of their experiences. An explanation of the historical context concerning the development of STEM through the last 60 years is discussed in order to understand the importance of Latinas' persistence in STEM education today.

Theoretical Framework

As previously introduced by Chapter One, the theory selected to investigate the lived experiences of Latinas persisting in a STEM degree is Tinto's (2015) model of student motivation and persistence. Many theorists excelled in explaining institutions' effort at retention through institutional lenses, however, they have not focused on student persistence (Astin, 1984; Bean 1983; Museus, 2014; Tinto, 1997). Additionally, other scholarship has discussed theories and frameworks that seem relevant to studying persistence through the eyes of minority groups (Museus, 2014; Rendon, Jalomo, & Nora, 2000; Swail, 2003; Tinto, 2012; Tovar, 2015), nevertheless, they do not take into account the rigor and dedication with which all students,

including minorities, may need to approach STEM programs (Mau, 2016).

The Model of Student Motivation and Persistence

Tinto's (2015) model of student motivation and persistence has a simple flowchart with three main constructs that flow in a unidirectional pattern: goals affect motivation, and motivation affects persistence. First, the model begins with students' individual goals. These goals fuel their motivation as they seek to complete their STEM degree. Then, motivation has three constructs that directly affect it: self-efficacy, sense of belonging, and perception of curriculum. Lastly, Latinas' motivation fuel their persistence until completion.

Goals. Goal-setting affects motivation, and motivation affects persistence (Tinto, 2015). Thus, as an impetus toward persistence, Latinas persisting in a STEM degree may have had the goal of graduating with a STEM degree in mind before enrolling in the university. The first step in goal-setting for Latinas may be to consider what job they aspire to possess, and the skill set and credentials necessary to possess it (Brindle & Layton, 2017). For instance, they may consider becoming mathematicians, marine biologists, or aeronautical engineers, among the many STEM careers. In order to have these types of jobs, a STEM degree may be necessary.

Additionally, along with having the goal of earning a STEM degree prior to starting college, Latinas may have prepared for the STEM education degree before college (Moakler & Kim, 2014; Simpson, 2001). This could mean taking four years of mathematics, including geometry, algebra II, trigonometry, pre-calculus, calculus and even statistics. If Latinas would prefer to do a science-related degree, another course that would prepare them would be an advanced placement biology course. Goal-setting and preparing for a STEM degree before college may affect Latinas' motivation and persistence (DeJarnette, 2012; Moakler & Kim, 2014; Simpson, 2001).

Motivation. The next concept for discussion in Tinto's (2015) model of student motivation and persistence is motivation. Motivation is the willingness to expend the effort to persist even when faced with challenges. It may be fostered or undermined by different factors and influences (Tinto, 2015). In STEM degrees, motivation plays a pivotal role. The three constructs that affect motivation are self-efficacy, sense of belonging, and perception of curriculum (Tinto, 2015). Among the three, Tinto (2015) posits that self-efficacy influences sense of belonging, but not vice versa, and that sense of belonging and perception of curriculum affect each other mutually.

Self-efficacy. Self-efficacy is the perception students have about their own performance, abilities, and accomplishments (Bandura, 1977). Consequently, a high level of self-efficacy fosters motivation (Moakler & Kim, 2014; Talley & Ortiz, 2017). Since Latinas are different in gender, culture and race or ethnicity from typical STEM students, they may feel out of place in the STEM classroom (Diekman et al., 2017). Their very presence in a STEM classroom may defy stereotypes held by their peers, professors and teacher assistants, causing anxiety and impostor syndrome (Lindeman et al., 2016).

Although it is possible that some gain strength from defying stereotype threat (Moore, Madison-Colmore, & Smith, 2003), others may not (Gonzales, Blanton, & Williams, 2002). Latinas may feel stigmatized, and become acutely aware that they may not be seen as good STEM students, but only as representatives of stigmatized people groups (Carlone & Johnson, 2007), and therefore impostor scientists, mathematicians, or engineers. In summary, Latinas' presence and their own perception of their sense of belonging in the STEM classroom may affect their self-efficacy. Low self-efficacy expectations may result in attrition (Smith et al., 2012).

However, enhanced self-efficacy expectations may foster confidence and motivation to persist in their STEM degree (Bandura, 1989; Smith et al., 2012).

Sense of belonging. Latinas' motivation for pursuing their STEM degree may be affected by many factors, including their academic and social integration. Scholarship has suggested that academic integration, or the intellectual connection students feel in an institution, is an essential component in student persistence (Clark et al., 2014; Graham et al., 2013; Tinto, 2015).

Graham et al. (2013) in the Persistence Framework, discuss academic integration, noting that early research, active learning, and learning communities may help students learn science and identify as scientists, resulting in increased confidence and motivation (Graham et al., 2013). The advantage that academic integration has may not be limited just to the sciences. In fact, students who enroll in technology, engineering, and mathematics may also potentially benefit from early research, active learning, and learning communities since they may feel academically integrated (Bers & Smith, 1991; Clark et al., 2014). Such integration could manifest itself in many ways. More specifically, inclusion in study groups, research groups, projects, mentoring, tutoring, and professor's involvement may all be important factors in Latinas' academic integration (Clark et al., 2014).

The second construct to consider is social integration. Social integration is the extent to which Latinas are emotionally and psychologically adapted to the social intra-institutional way-of-life (Clark et al., 2014; Rienties et al., 2012). Latinas may wonder whether they belong with their peers (Smith et al., 2012). Since they are different in gender and ethnicity than the majority of STEM students and professors, they may feel a disruption in their STEM identity or a sense of isolation (Carlone & Johnson, 2007). Researchers have suggested that students experience a sense of belonging and thrive in classrooms where the climate exudes warmth, acceptance, and

support (Cole & Espinoza, 2008). However, more research is needed to understand how social and academic integration affects Latinas' persistence in STEM degrees.

Perception of curriculum. According to the theoretical framework of this study, Latinas' perception of the STEM curriculum may be a key component to their motivation (Tinto, 2015). Researchers argue that when multicultural students can apply their personal funds of knowledge to what they are learning in the classroom, they may become more engaged (Wilson-Lopez, Mejia, Hasbún, & Kasun, 2016). In turn, scholarship suggests students may be more engaged when they understand how the knowledge taught in the classroom can be integrated and applied in authentic, real-world scenarios (Kelley & Knowles, 2016). Researchers argue that the fragmented curriculum framework is less helpful than a conceptual, integrated STEM curriculum (Kelley & Knowles, 2016). Thus, the unheard voices of Latinas persisting in a STEM degree are necessary in order to understand their lived experiences when persisting in STEM.

Persistence. The last construct in the model of student motivation and persistence is persistence (Tinto, 2015). Tinto (2015) defines persistence as having the motivation to work toward the goal (i.e., graduate). Some researchers suggest that communal goal pursuit has a pivotal effect on the pursuit of STEM degrees for women (Diekman et al., 2017). Others suggest that low confidence or low sense of belonging in the chosen STEM field has a negative effect on STEM persistence (Graham et al., 2013). Thus, further research is necessary in order to understand how Latinas persist in STEM fields.

Nevertheless, successful completion of a STEM degree for Latinas may be accompanied by higher credentials, greater employment options, superior wages, social mobility, and a decreased gender wage gap (Beede et al., 2011). Women who graduate with a STEM degree may find themselves serving as role models for their peers, younger girls and boys, as well as their

own siblings (Bond, Chykina, & Jones, 2017; Diekman et al., 2017).

Possible Limitations in Model

Tinto's (2015) model of student motivation and persistence provides an excellent framework for investigating Latinas' persistence in STEM education. However, it may be limited. First, the model starts with goals as an independent construct that feeds into motivation (Tinto, 2015). However, scholarship suggests that preparation in high school may aid in persistence in STEM degrees (Bottia, Stearns, Mickelson, Moller, & Valentino, 2015; Maltese & Tai, 2011). Research shows that even exposure as early as elementary school will have an impact on persistence in STEM degrees (Ashford et al., 2016; Dejarnette, 2012). Therefore, adding preparation as a bidirectional subconstruct to goals may be an idea to consider. The literature suggests that it may be important to set goals early on and prepare for undergraduate STEM courses (Moakler & Kim, 2014; Simpson, 2001). Most undergraduate degrees may not require specific preparation prior to starting college, however STEM education degrees may be uniquely different (Card & Giuliano, 2016; Carlone & Johnson, 2007; Moakler & Kim, 2014).

Further, research suggests that taking less than four years of mathematics in high school may work against students' persistence in STEM degrees (Moakler & Kim, 2014; Simpson, 2001). Students may find themselves earning lower level mathematics credits in college, which could impose additional semesters in their STEM degree attainment.

The next construct brought into the spotlight in the model is sense of belonging (Tinto, 2015). Tinto (2015) refers to students' feelings about fitting in with other students and their professors academically and socially. Although academic and social integration may be quintessential for most students, it may not be the case for Latinas. Latinas may strive to persist in their STEM degree in spite of a lack of sense of belonging because Hispanics are family- and

community-oriented, and have largely been taught that family comes first (Calzada, Fernandez, & Cortes, 2010). Their family and community encouragement and support may be sufficient to meet their need to be supported emotionally and psychologically, even if they lack a sense of belonging intra-institutionally.

Many Latinas feel a sense of belonging among the people in their family and community, and it may be sufficient to foster persistence if their family or community encourages them to persist. As Latinas struggle with developing their scientific identity, they may feel motivated in knowing that their families believe in them, are proud of them, and need them to succeed (Carlone & Johnson, 2007).

One way this theory may miss the mark for Latinas in STEM education is that it states that self-efficacy is not required in goal setting (Tinto, 2015). However, research suggests that STEM degrees are very rigorous (Lindemann, Britton, & Zundl, 2016) and that Latinas are underrepresented in STEM degrees (NCES, 2016), which may lead to stereotype threat and impostor syndrome (Lindemann et al., 2016). Thus, Latinas considering STEM may require self-efficacy before they enroll, perhaps even during the time they set their goals. In other words, Latinas may need self-efficacy as part of their impetus to consider STEM (Parker, 2014; Schwartz et al., 2016; Talley & Ortiz, 2017).

Often Used Lenses

Critical race theory and one of its branches, Latino critical race theory, otherwise known as LatCrit, are theories often used when discussing the experiences of Hispanics in educational settings (Bernal, 2002; Pérez Huber, 2010). Critical race theory holds to the tenet of Whiteness as Property, which includes the idea that in STEM, White males have the right of use and enjoy,

and the right to exclude (DeCuir-Gunby, Long-Mitchell, & Grant, 2009). Naturally, critical race theorists may believe that the White male domination in STEM programs undermine Latinas.

Although critical race theory and LatCrit are not theories that are utilized in this study to explore the experiences of Latinas persisting in STEM, these theories are helpful in pointing out the different ways in which Latinas are different than any other gender and race intersection. Thus, many researchers who focus their writing on Hispanics use LatCrit (Landale, Oropesa, & Llanes, 1998; Peralta et al., 2013; Vela, Sparrow, Ikonomopoulos, Gonzalez, & Rodriguez, 2016; Villalpando, 2004; Zerquera & Gross, 2015).

According to LatCrit, the factors that may affect Hispanic educational achievement include English language proficiency, migration patterns within the United States, immigration status, socioeconomic status, heaviness of accent, bicultural identity, and quality of education received (Villalpando, 2004). In STEM specifically, exposure to mentors and encouraging role models in STEM fields are also included as potential factors that affect Hispanic educational achievement (Cole & Espinoza, 2008; Peralta et al., 2013). The life experiences that Latinas encounter may be unique to them, and no other gender and ethnicity may interpret, translate, process or internalize them in the same way (Rodriguez, Guido-DiBrito, Torres, & Talbot, 2000).

In conclusion, Tinto's (2015) model of student motivation and persistence served as the framework I used to explore Latina's lived experiences persisting in a STEM degree. The main constructs in this model are goal, motivation and persistence, with self-efficacy, perception of curriculum, and sense of belonging as sub-constructs that affect motivation (Tinto, 2015). Sense of belonging has academic and social integration implications. Further, this study will expand Tinto's theory to a population that has not yet been a significant focus of research.

Related Literature

Many researchers report an alarming underrepresentation of females and minorities in STEM courses in higher education (Cole & Espinoza, 2008; NCES, 2017; Steinke et al., 2007). In addition, researchers have also documented Latinas' missing voices in the literature concerning their experiences when persisting in a STEM degree (Medina & Luna, 2000; Talley & Ortiz, 2017). Therefore, a research study focusing on the experiences of Latinas who persist in STEM degrees is necessary.

Hispanics in Education

First, Latinas are part of an ethnic group that has exponentially increased in number more than any other ethnic or racial group in the United States in the last three decades, and they are expected to continue in this rapid growth trajectory (NCES, 2017b). Hispanics account for over 57.4 million of the nation's population (United States Census Bureau, 2016). However, from this amount, only one third of Hispanics living in the United States are foreign-born (Stepler & Brown, 2016). Among the Latino adult population, only 45.8% have completed higher education (NCS Research Center, 2017). However, among other groups, Asians have completed higher education at 63.2%, Whites at 62%, and Blacks at 38% (NCS Research Center, 2017).

As for household earnings, the median annual household earning for Hispanics is $47,675 (United States Census Bureau, 2017). This number is below the national median income by almost $12,000. In consideration of other groups, the median annual household earnings is $65,041 for Whites, $81,431 for Asians, and $39,490 for Blacks (United States Census Bureau, 2017). Consequently, household income and Hispanic parents' degree attainment are environmental considerations that may affect Latinas' goals, motivation and persistence as they consider pursuing a degree in STEM (Bandura, 1989).

Many topics surrounding Hispanics have been studied. Researchers have studied Hispanics as a culture-sharing group (Ayón, Marsiglia, & Bermudez-Parsai, 2010; Calzada, Tamis-LeMonda, & Yoshikawa, 2013; Calzada Fernandez, & Cortes, 2010). Researchers have also reported on the benefits of STEM fields for women, minorities, and minority women (Beede et al., 2011; Carlone & Johnson, 2007; Espinosa, 2011; Griffith, 2010). Further, other researchers have focused on Hispanic males in efforts to reform the curriculum in order to engage Latinos in the classroom (Saenz & Ponjuan, 2009; Strayhorn, Long, Kitchen, Williams, & Stenz, 2013). On the other hand, persistence from the students' perspective has also been largely studied (Elkins, Braxton & James, 2000; Milem & Berger, 1997; Tinto, 1997, 2012).

However, no research has been conducted focusing on understanding the experiences of Latinas who persist in a STEM degree (Crisp et al., 2009). In an effort to increase diversity in STEM degrees and decrease Latinas' underrepresentation, scholarly research efforts must be directed to understand Latinas' unique perception of their life experiences concerning STEM education. Efforts must also be spent to reflect on the constructs that factor into their persistence in STEM education and to interpret the essence of the meaning of these life experiences.

A disconnect between the K-12 educational system and Hispanics. Hispanics, as the nation's largest minority population (Flores, 2017), may represent some challenges for educators, administrators, and policymakers. Hispanics are among the lowest achieving groups in education (Fry & Lopez, 2012). On the other hand, most educators are not Hispanic (NCES, 2012). Thus, they may not be aware of culturally sensitive strategies to engage Hispanics (Simpson, 2001; Tinkler, 2002; Wilson-Lopez et al., 2016).

Another challenge is in the communication lines. Although schools are legally required to communicate with parents who do not speak English in their own language (Department of

Education, 2015), there have been parents who have felt slighted or ignored by school staff because they do not speak English (Olivos, 2004). Researchers have documented the minimal or non-existent efforts made by schools to foster communication (Carreón, Drake, & Barton, 2005; Olivos, 2004). Lastly, another challenge to persisting in STEM among Latinas is that Hispanic students are not being exposed to STEM education and STEM tools early and consistently (Dejarnette, 2012).

The benefit for society. The nation is in dire need of people to earn STEM degrees (Talley & Ortiz, 2017). Since the innovation of computers and digital information, the way organizations communicate, manage and store information has changed (Duncan, 2011). This change has caused a great shift in the nature of the global workforce, creating a need for a knowledge economy (Duncan, 2011). Therefore, the workforce may benefit from Latinas persisting in STEM. Efforts may need to be exerted by society to ensure that Latinas are fully aware of the opportunities that pursuing a STEM degree can provide (Parker, 2014; Schwartz et al., 2016; Talley & Ortiz, 2017). Society is in such a need of STEM workers that the US government noted that the principle reason STEM was prioritized in educational circles was to ensure a high level of innovation (U.S. Department of Education, 2015), thereby maintaining America as a global leader (Fransman, 1995; Nelson & Wright, 1992). The idea was enacted in society with such a force because a deleterious crisis in the STEM workforce is anticipated.

The literature suggests that economic projections for a future dearth in STEM professions may warrant concern (Barakos et al., 2012; Brown et al., 2011; Hossain & Robinson, 2012). Olson & Riordan (2012) report that the U.S. will have an approximate 1 million STEM professional shortage at the current rate over the next decade if it is to maintain scientific and technological global leadership.

Evolution of STEM and Its Effect on Education

During the 20th century, American society witnessed much technological advancement (Glick, 1988; Lee & Winzenried, 2009; Murdock, 2014). Beginning in the late 1940s and ending in the early 1990s, the Cold War effectively created an urgency for technological advancement in aircraft design and weaponry (Wang, 2008). This urgency for technological advancement influenced other areas of American society, including politics, businesses, educational systems, and homes (Cooper, 1958; Garrett, 2008).

In 1951, schools began using televisions (Lee & Winzenried, 2009; Murdock, 2014). Also, a first-generation Universal Automatic Computer (UNIVAC) was given to the U.S. Census Bureau to be used by the government (Glick, 1988; Murdock, 2014). In 1954, the Universal Automatic Computer first began to be used for business purposes (Stein, 2013). The school buildings became overcrowded due to the baby boomer generation's rise in enrollment (NCES, 2014). Schools continued to employ a teacher-centered pedagogy in the face of great change (Murdock, 2014).

The Cold War intensified the need for technological advancement as the Soviet Union launched Sputnik I into space (Dickson, 2001). In 1958, the National Defense Education Act brought funds along with new technology into schools for vocational education (United States Senate, 1957). However, mainframe host computers were not used in the classroom during this time (Murdock, 2014). By the end of the decade, the public swayed and favored funding technological developments needed for space exploration over investing in technological advancements to be used in education (Murdock, 2014). There were many changes witnessed during this decade; however, the field of education was slow to adapt.

John F. Kennedy ran for presidency, and promised to invest more money into education (Long, 1968; Murdock, 2014). He was elected, and in 1963, the Vocational Education Act was passed, with more money given to fund more technology usage in schools (Murdock, 2014). Further, the Elementary and Secondary Education Act of 1965, a precursor to No Child Left Behind (Thomas & Brady, 2005) diverted more money for housing mainframes and minicomputers in schools (Murdock, 2014). The president also called for an urgency in scientific development that would enable the United States to put a man on the moon (Kennedy, 1961). Also during this decade, Americans were alarmed by the discovery of nuclear missiles sites in Cuba by the Soviet Union (Weldes, 1999).

In the early 1960s, Common Business-Oriented Language (COBOL), a programming language that businesses used, was invented (Wexelblat, 2014). Mainframe and minicomputers, the computers in use at this time, used batch processing methods that were not congruent with content-centered pedagogy (Murdock, 2014). Thus, even though computers were present at schools, they were mainly being used by staff. During this decade, IBM 360 computers as well as BASIC and other high-level programming languages were developed to train programmers at the university-level (Murdock, 2014). It was also during this century that airlines began to use computerized reservation systems (Murdock, 2014).

Military technology also progressed, as high-tech weaponry development to bomb North Vietnam was sought, though the war was very unpopular (Nonami, 2007). As an unfortunate end to the decade, certain programs that were designed to fund technological progress in schools were canceled, and most schools did not adopt computer usage in the classroom (Murdock, 2014). However, to Americans' relief, Neil Armstrong walked on the moon (Hansen, 2012).

Although until this time technology in the classroom did not progress consistently, the following years witnessed a more steady advancement.

During the 1970s, mainframes and minicomputers were used widely in businesses (Todd, McKeen, & Gallupe, 1995), though not in classrooms. However, PCs were developed, and Apple 1 PCs were donated to schools and even became popular in some small businesses (Murdock, 2014). By the end of the 1970s, 15 million PCs were thought to be in use globally, but mainframes and minicomputers were also popular. Next, in the 1980s, classrooms welcomed Apple II personal microcomputers, since they were perceived to support teacher instruction (Hart, 1985). PCs were also in wide use for career guidance, and by the end of the decade, 60% of all workers in America used computers (Murdock, 2014).

Although the Cold War created an urgency for technological advancement in society, it also diverted funds that were originally intended for technological advancement in schools, and favored military advancement. At last, the American public witnessed the end of the Cold War at the end of the century (Risse-Kappen, 1994). As the war ended, a rapid shift in computer usage in the schools is witnessed (Purdue University, 2018).

Around the early 1990s, multimedia PCs became commonly used in instructional support since they were designed to work with videodiscs and CD-ROM disks to display animation, sound, simulations, educational databases and other kinds of computer-assisted instruction (CAI) (Murdock, 2014). Gopher servers, digital video, virtual reality, and educational software caught the public's attention, as most classrooms had access to at least one PC for instructional purposes (Murdock, 2014). The World Wide Web gained monumental popularity as businesses, schools, and the general public began creating webpages (Albert, Jeong, & Barabási, 1999).

In fact, many schools began wiring their buildings in order to gain Internet access. Some schools even installed web servers to offer their faculty a place to create their own instructional webpage (Murdock, 2014). As with every major change, there are continuous concerns. For instance, one debate surrounding using technology in schools involves how cell phones are changing the social lives of teenagers, and whether cell phones are more of a distraction and a way for students to cheat, or whether they can be safely used as tools in the classroom (Webb, 2013).

In summary, society witnessed great development in the area of technology (Glick, 1988; Lee & Winzenried, 2009; Wang, 2008) over the last decades. This development has caused a great change in society, affecting weaponry, politics, education, recreation, entertainment, and the overall market (Garrett, 2008). Technological advancement has had an irreversible effect on society, and like an unquenchable thirst, society demands to have newer and better technology.

A cry for STEM literacy in the rising generation. Finally, at the turn of the century, politicians and educators began viewing science, mathematics, engineering, and technology as fields that needed to be emphasized in a cluster (STEM Education Caucus, 2017). In fact, the American government ensured that this would be the case by organizing the STEM Caucus in 2005 (STEM Education Caucus, 2017). The aim of this caucus was not only to raise awareness of STEM education around the country, but also to ensure that the rising generation is apprised of computer software, computer hardware, critical thinking skills, and problem solving abilities, as well as literacy in scientific and mathematical principles (Bybee, 2013; STEM Education Caucus, 2017).

A rising market for STEM in society. America has witnessed and continues to witness technological advancement in the classroom at break neck speed. This exponential change in

innovative technology has created a hunger in society for more innovative technology (Tarafdar, D'Arcy, Turel, & Gupta, 2015). Immediate access to the World Wide Web on public and private servers or devices is customary. Customers demand faster results, more technology, and greater innovative discovery (Brynjolfsson, Hu, & Rahman, 2013; McKenna, 1997). This demand creates a vast market for STEM education (STEM Education Caucus, 2017).

An opportunity for Latinas. STEM workers of diverse backgrounds are needed to meet the economic demands of the nation (Taningco et al., 2008). Although some researchers suggest that White women, in comparison to other women, are overrepresented in the STEM fields (Ong et al., 2011), other scholarship suggest that all females are underrepresented in STEM (Diekman et al., 2017; NCES, 2017). Looking at the percentage of women in any race earning STEM education degrees in Figure 3, one would see that Black women have the highest proportionate number of STEM bachelor degrees when compared to Black males.

Black females graduate from STEM education degrees at 44%, while White women persist in STEM at a 33% rate (NCES, 2017a). Among all majors in college, 37% of White students and 65% of students of color experience attrition in science or math majors before they graduate (Barakos et al., 2012). This alarming trend has created a shortage in the STEM workforce.

The baby boomer generation currently provides a large amount of college-educated skilled employees, including engineers (Reester, 2008). Thus, their retirement will create a vacuum. This vacuum will either be filled by qualified foreigners, which creates brain drain in other countries (Moakler & Kim, 2014), or by qualified Americans. This may be a great opportunity for Latinas and other underrepresented groups in the United States. They are the most untapped potential human workforce in STEM fields (Diekman et al., 2017; Landivar,

2013).

Opportunities Thwarted in Latinas' Lives

In American society, Latinas may have incredible opportunities (Omenn, 2006). However, these opportunities may be missed or thwarted because of lackluster educational experiences (Fallis & Opotow, 2003), the current climate in STEM education (Ong et al., 2006), and other external factors affecting Latinas (Olivas, 2009; Passel & Cohn, 2009).

The future may appear limited for Latinas who follow the humble footsteps of the majority of Latinas. Caretaking, cooking, and other service jobs are the types of employment most Latinas in society currently pursue (Gonzales, 2008). In order for Latinas to persist in STEM education, they may have to fight against stereotypes, low expectations in society, stigmas within the STEM institution, and the traditional gender role expectation within the Hispanic community (Barnes, 2012; NCES, 2017a; Ong et al., 2011).

Educational background among Latinas. In the following sections, I discuss the number of Hispanics in their respective grade levels, and their educational attainment in reading and mathematics from kindergarten to 12th grade. Lastly, this section addresses the community college phenomenon among Hispanics, the lack of bachelor's degree attainment, and the STEM gender inequality among those who graduate.

Nearly one in four children attending public schools from kindergarten to 12th grade are Hispanic (Fry & Lopez, 2012). Furthermore, a 33% increase is projected among Hispanic students from 2011 to 2022 (Hussar & Bailey, 2014). Due to this amount of students and the potential workforce they represent, ensuring the success of this large student population to the best of educators' and society's abilities may be essential.

Reading. Hispanics are primarily Spanish-speakers, and English is not usually a language

practiced or spoken in the home (Hakimzadeh & Cohn, 2007). As evidenced by the scores in the Nation's Report Card, Hispanics may need reading support (National Assessment of Educational Progress, 2015). In 4th grade reading, Hispanics average a score of 208, Asians average 239, Whites average 232, and Blacks average 206 (National Assessment of Educational Progress, 2015); see Appendix B, Table A1.

In 2015, Hispanic students in 8th grade earned a scaled score of 253, just slightly above the scaled score of Blacks, which was 248. Whites earned a scaled score of 274, and Asians of 280; see Appendix B, Table A2. Then in grade 12, Hispanics earned a scaled score of 276, Blacks of 266, Whites of 295, and Asians/Pacific Islanders of 297 (National Assessment of Educational Progress, 2015). See Table A3 in Appendix B.

There exists a positive relationship between word knowledge and reading comprehension (Tannenbaum, Torgesen, & Wagner, 2006). Therefore, reading is foundational for knowledge attainment. It is suggested that low reading proficiency may inevitably affect academic attainment among Hispanics in every area in every grade (Perfetti, 2007). Thus, early reading comprehension may be a factor affecting Latinas' interest and motivation in STEM.

Mathematics. A standardized mathematics test is carried out in fourth grade. Hispanics averaged a scaled score of 230, Whites 248, Blacks 224, and Asians 257 in 2015 (National Assessment of Educational Progress, 2015), see Table A4 in Appendix B. Then, in 8th grade, Hispanics averaged a scale score of 270, Blacks 260, Whites 292, and Asians 306, see Table A5 in Appendix B for details. Lastly, in 12th grade mathematics, Hispanics averaged a scale score of 139, Blacks 130, Whites 160, and Asians 170. See Table A6 in Appendix B.

There exists a negative relationship between persistence in postsecondary STEM education and low mathematics scores (Parker, 2014). Therefore, the Latinas who fall in line

with these statistics but are seeking to persist in postsecondary STEM may find themselves struggling more than their peers (Cole & Espinoza, 2008). The effect of this consistent lack of attainment in mathematics throughout elementary and secondary grades may be that Latinas are ill-prepared in postsecondary STEM classes and may consequently experience attrition (Cole & Espinoza, 2008).

In summary, there are many variables, factors, and influences to be considered when seeking to understand the experiences of Latinas who persist in postsecondary STEM. Asians and Whites displayed superior performance in reading and mathematics consistently in each tested grade (National Assessment of Educational Progress, 2015). The data suggests that an achievement gap may exist, with Whites and Asians having higher achievement scores than Blacks and Hispanics (Goldsmith, 2004; Ladson-Billings, 2006).

High school graduation. The consistent low scores experienced in elementary, middle, and high school in reading and mathematics may have a lasting impact among Hispanic students. Research suggests that the academic challenges and failures experienced from early on may lead some Hispanic youth to drop out of high school (Wiltz & Slate, 2016).

Currently, the rate of high school attrition among Hispanics is 12% (Fry & Lopez, 2012). In comparison to other races, 7% of Blacks, 5% of Whites, and 1% of Asians drop out of high school (Fry & Lopez, 2012). In other words, about 1 in 8 Hispanic students drops out of high school (Ogunwole, Drewery, & Rios-Vargas, 2012). They have the highest percentage of dropouts of all other major races and ethnicities (Fry & Lopez, 2012; NCES, 2016c).

Dropout rate for Latinas. Latinas have an 8.4% dropout rate (NCES, 2016c). This dropout rate among Latinas may be due to a number of variables, including negative peer influences, having to work or provide childcare to help the family (Ong et al., 2011), low grades,

or low English proficiency (Villalpando, 2004). However, it may also be due to Latinas' lack of interest in school due to lackluster education (Fallis & Opotow, 2003). The low quality of education Latinas receive may be connected to the overall low socioeconomic status of the district (Clotfelter, Ladd, Vigdor, & Wheeler, 2006; Ullucci & Howard, 2015) and dangerous neighborhoods (Bowen & Bowen, 1999).

Poverty. Poverty may affect Latinas' lives in multiple dimensions. The array of highly qualified teachers willing to teach in a school that primarily serves students from low socioeconomic backgrounds may be limited (Ingersoll, 2004). A deficit in experiencing highly qualified and knowledgeable teachers may result in disengagement, lack of motivation (Kiemer, Gröschner, Pehmer, & Seidel, 2015), and consequently, a low academic identity. Year after year, this cycle may culminate in negating Latinas' access to quality education.

Current research shows that high poverty has a negative effect on children's educational outcomes. In fact, 83% of children in high poverty are at an increased risk of not graduating from high school (Fiester, 2010). Moreover, "the share of low-income Black, Hispanic, and Native American students who score below proficient on the NAEP reading test is catastrophically high [89%, 87%, and 85%, respectively]" (Fiester, 2010, p. 7).

Effect of tracking on Latinas. Further, even if the school does provide high quality education and advanced courses, and the teachers teaching those courses are highly qualified, Latinas may be placed in a lower track within the school system (Parker, 2014). The result of staying in a less rigorous, lower track may be that Latinas do not graduate from high school with the capability of managing the material in freshmen weed-out courses, and the ability to keep up with the academic rigor of advanced STEM courses (Card & Giuliano, 2016; Carlone & Johnson, 2007; Moakler & Kim, 2014).

Research suggests that being trapped in a lower, less rigorous track can happen as early as middle school (Parker, 2014). Student tracking may affect Latinas' persistence in a STEM degree, rendering them unprepared for colleges' social and academic demands (Card & Giuliano, 2016; Mau, 2016). Without the opportunity to enroll in advanced placement courses, Latinas may not be able to befriend other students with a high academic identity and may not be prepared to adapt socially and academically to their college surroundings (Tinto, 2012). According to Tinto's (2012) theory of student departure, both social and academic congruence may be necessary for persistence in college (Banda & Flowers, 2016).

The weed-out culture is a documented intra-institutional phenomenon that often occurs in STEM programs (Seymour & Hewitt, 1997; Lindemann et al., 2016). Scholarship has pointed out that female and students of color perceive that STEM exams are made so difficult that they dishearten students and discourage them from persisting in STEM degrees (Reyes, 2011).

Postsecondary trends among Hispanics. Only 35% of Hispanics are enrolled in a two- or four-year college as 18 to 24 year olds (Krogstad, 2016). Most choose to attend a public two-year school, such as a community college, but often do not transfer to a university in order to complete a bachelor's degree. In fact, as shown in Figure 1, only 15% of Hispanics attain a bachelor's degree by the time they are 29 years of age (Krogstad, 2016).

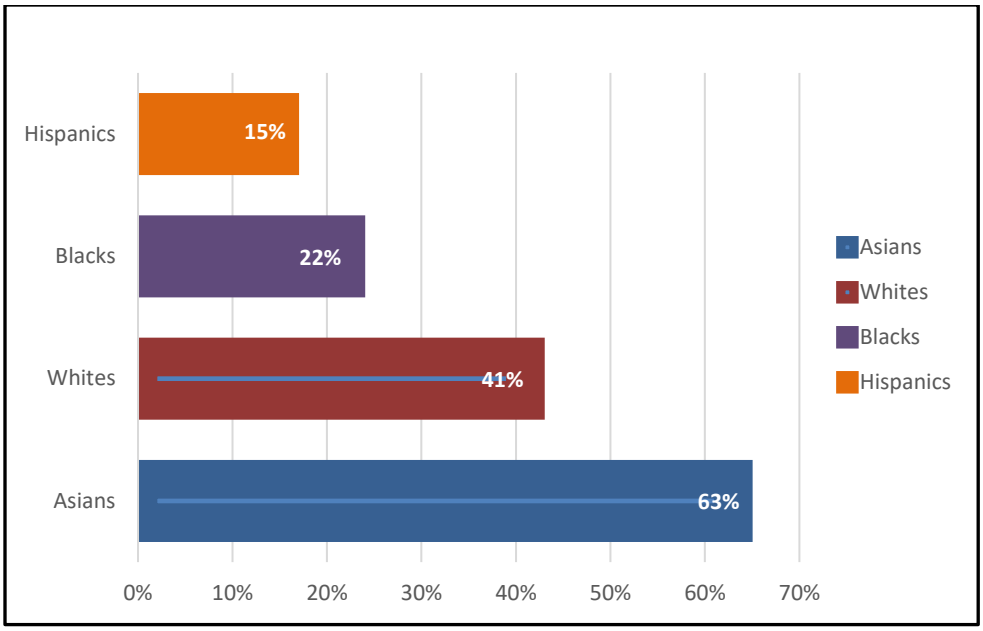

Figure 1. College completion of Hispanics, Blacks, Whites and Asians ages 25-29 in 2014 (Krogstad, 2016).

Community college. Considering that *familismo* and *respeto* are cultural values among Hispanics (Calzada et al., 2010), it should be no surprise that almost half of college-bound Hispanics enroll in a public community college, where they can attend without moving (Krogstad, 2016). Among all Hispanics enrolled in higher education, 48% are enrolled in a community college; Blacks enroll in community colleges at 36%, Asians at 32%, and Whites at 30% (Krogstad, 2016), as shown in Figure 1. Only 30% of Hispanics enrolled in a 2-year community college successfully complete this degree within six years (NCES, 2016b).

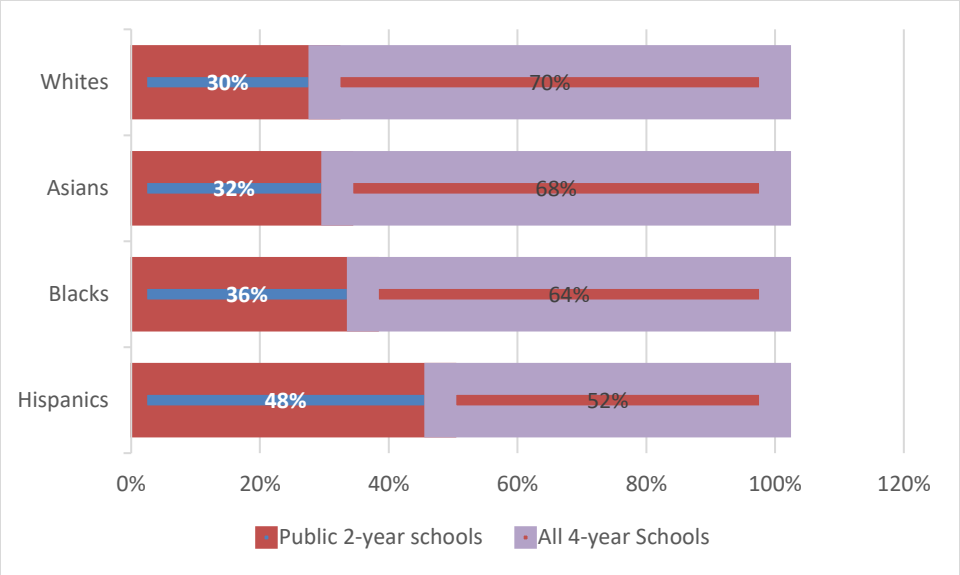

Figure 2. Rate of postsecondary enrollment of Hispanics, Blacks, Whites and Asians in public, 2-year schools and 4-year schools (Krogstad, 2016).

University completion. Additionally, Figure 2 indicates that within each group, Hispanics enroll in a four-year university at a 52% rate, Blacks at 64%, Asians at 68%, and Whites at 70% (Krogstad, 2016). Some enroll, but fewer graduate. From the total population of Hispanics who are of traditional age to attend college, only 13% effectively graduate with a bachelor's degree (Ogunwole et al., 2012). Whites earned a bachelor's degree at 29%, Blacks at 18%, and Asians at 50% (Ogunwole et al., 2012). In summary, about half of college-bound Hispanics go to a community college, and the other half attend 4-year colleges. Nevertheless, about one in eight college-bound Hispanics graduate from a 4-year university.

Statistics for STEM education. From the number of total bachelor's degrees conferred by postsecondary institutions as shown in Figure 2, 31% of Asians, 17% of Whites, 14% of Hispanics, and 11% of Blacks earned a STEM education degree. The percentage of people earning STEM degrees is disproportionate across the genders within each race; 36% of Latinas, 33% of White women, 44% of Black women, and 40% of Asian women earned STEM education

degrees versus their male counterparts. Although more bachelor's degrees were earned by females in 2014 (namely 57% versus 43%), more males earned STEM degrees (namely 65% versus 35%) (NCES, 2017a). This pattern proved to be true across racial and ethnic boundaries (NCES, 2017a).

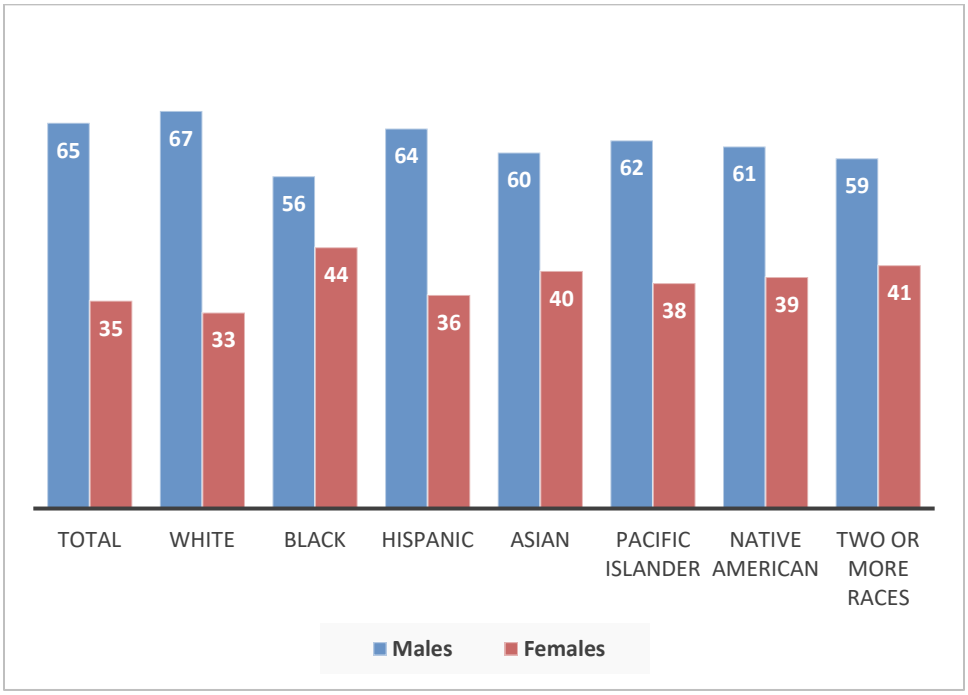

Figure 3. Percentage of STEM bachelor's degrees by race/ethnicity and gender, including the total amount, conferred by postsecondary institutions in the 2013-2014 academic year (NCES, 2017a).

African-American women in STEM. It is worth noting that African-American women are a gender and race intersection that has nearly approached an even distribution in STEM attainment in comparison to their male counterparts. There are certain factors to consider, including family, peer, and faculty support, or the impact on the persistence of African American women in STEM who graduate from historically Black universities (Perna et al., 2009). Alternatively, another factor may be considered as well, such as that as African-American

women found themselves inadequately portrayed in the literature by black men or white people (Hudson-Weems & Sofala, 1995). As such, they sought to start a movement to free themselves from this misrepresentation.

Africana womanism. In recognizing and addressing the inappropriate portrayal of themselves, African-American women may have awakened to academic achievement through such critical lenses as Africana womanism (Hubbard, 2010; Hudson-Weems & Sofala, 1995). Africana womanism affirms that Black women must speak for themselves about their own historical truths in order to voice their own statuses and aspirations, not simply be passive while Black men or White men or women voice it for them (Hubbard, 2010). Thus, womanism purports the self-definition and self-empowerment of Black women as they have been historically stripped of their constitutional rights (Truth, 1852), and misrepresented by Black men and White women (Hudson-Weems & Sofala, 1995). Thus, through the words of Anna Julia Cooper, a key thinker in the advent of womanism, concepts that directly affect womanist theory are addressed, including affirming that with the proper tools and educational environment, anyone could attain empowerment through academic achievement (Hubbard, 2010).

Sense of belonging among African-American women in STEM. Scholarship has endeavored to unearth factors that hinder or enhance the persistence of African American women in STEM. African American women are a particularly interesting gender and race intersection since they, just as Latinas, are a double minority. Some researchers suggest that they need a space that is in the central area of the STEM program, where they are welcome to vent their frustrations, validate their knowledge, and find comradery with other African-American women (Ong, Smith, & Ko, 2018). In fact, some researchers suggest that among all of the possible constructs, sense of belonging may have the most powerful impact on African American

women's persistence in STEM (Charleston, Adserias, Lang, & Jackson, 2014; Charleston, George, Jackson, Berhanu, & Amechi, 2014; Ong et al., 2018; Joseph, 2012).

The dearth in sense of belonging that African American women experience may limit their preparation as emerging scientists, mathematicians, engineers, or persons in technology, since they may not feel comfortable enough to attend seminars, ask questions, or request help (Joseph, 2012; Perna et al., 2009). Thus, not experiencing sense of belonging may have a domino effect, hindering growth in knowledge and self-efficacy. For instance, scholarship suggests that psychological factors such as self-efficacy and stereotype threat may have an effect on African American women persisting in STEM (Perna et al., 2009).

Keeping in mind the possible isolation African-American women may feel concerning the STEM program they are a part of, the literature discusses some ways to combat this. STEM faculty are encouraged to offer research opportunities, provide mentorship, foster professional experiences such as research presentations, and consistently encourage their persistence (Ong et al., 2018).

African American women and Latinas are double minorities whose persistence in STEM continues to concern researchers (Ong, et al., 2018; Joseph, 2012; Perna et al., 2009). There are many similarities, and in fact, many researchers have studied these two groups together (Reyes, 2011; Syed, & Chemers, 2011). However, it is important to understand that they are culturally different (Johnson, 2011). Thus, African American women may perceive experiences in STEM differently than Latinas. Further, factors that foster or hinder African American women's persistence in STEM may not enhance or hinder persistence in the other. Thus, more research is warranted in order to suggest which influences and experiences are similar between the two.

External factors affecting Latinas. The environmental variables that influence Latinas' decision-making after high school graduation may be expected or unforeseen. For example, some Latinas may be told before or after graduating that they are, in fact, undocumented, and not able to attend a university. In addition, gradual and foreseeable environmental variables that some Latinas may face include the lack of exposure to opportunities and resources that accompany those who face high poverty (Skiba, Poloni-Staudinger, Simmons, Feggins-Azziz, & Chung, 2005; South, Crowder, & Chavez, 2005). Some Latinas may be unaware of the myriad types of STEM degree opportunities, or may not believe that it could be for them (Taningco et al., 2008).

***Documentation status after high school graduation*.** Documentation status can deter some from entering the world of postsecondary education. This may be due to families entering the United States through unauthorized means, while others may have overstayed their legal welcome (Warren, 2017). Those who have lived in the United States through unauthorized means may not have been offered amnesty. In fact, the last opportunity that unauthorized residents received to register in the American government exculpated was in 1999. The Legal Amnesty Restoration Act of 1999 amended the Immigration and Nationality Act, limiting the denial of status adjustment to unauthorized residents. For certain undocumented residents, this became the way to receive their permanent residency in the United States (Jackson-Lee, 1999).

Those residing in the United States without proper documentation may apply to universities; however, there will be major struggles. Paying full tuition to attend a four-year university may deter some. Without a federal mandate, the choice to offer undocumented students in-state public tuition is left to each individual state (Olivas, 2009). Alabama, Indiana, North Carolina, Georgia, Arizona, and South Carolina are states that have banned in-state tuition to undocumented students (Nguyen & Serna, 2014). In other words, undocumented residents are

at risk in their eligibility to receive federal and state financial aid in most states (Olivas, 2009; Perez, 2010).

***Parental occupation*.** Documentation status will have a great impact on parental occupation, and in turn, parental occupation will influence young Latinas' horizon. Many Latinas residing in the U.S. work in offices providing administrative support roles, or blue-collar occupations such as building or grounds cleaning, house cleaning, food preparation, serving-related jobs, production factories, personal care, and other service occupations (Gonzales, 2008). Hispanic women are two times more likely to live in poverty than other women (Gonzales, 2008). Therefore, on a practical level, it is important to emphasize that STEM education can provide the credentials necessary to offer them a variety of options (Beede et al., 2011). Persisting in STEM can provide opportunities to join highly skilled, professional employment (Beede et al., 2011).

For many Latino men across the nation, the major source of employment is construction (Passel & Cohn, 2015). Other major forms of employment include farm labor, forestry, fishing and hunting (Passel & Cohn, 2015). Latinos work longer than any other males, but earn the least (Bureau of Labor Statistics, 2016; Bureau of Labor Statistics, 2017). Figure 4 indicates that Latinos earn the least of all males and Latinas earn the least of all groups of females (Bureau of Labor Statistics, 2017). These trends are important to note because Latinas growing up in American society may be impacted by their parents' occupation, available time, and income (Cole & Espinoza, 2008; Talley & Ortiz, 2017). Their family income may affect the types of activities and resources they can and cannot provide, and the information they will be exposed to (Cole & Espinoza, 2008; Talley & Ortiz, 2017).

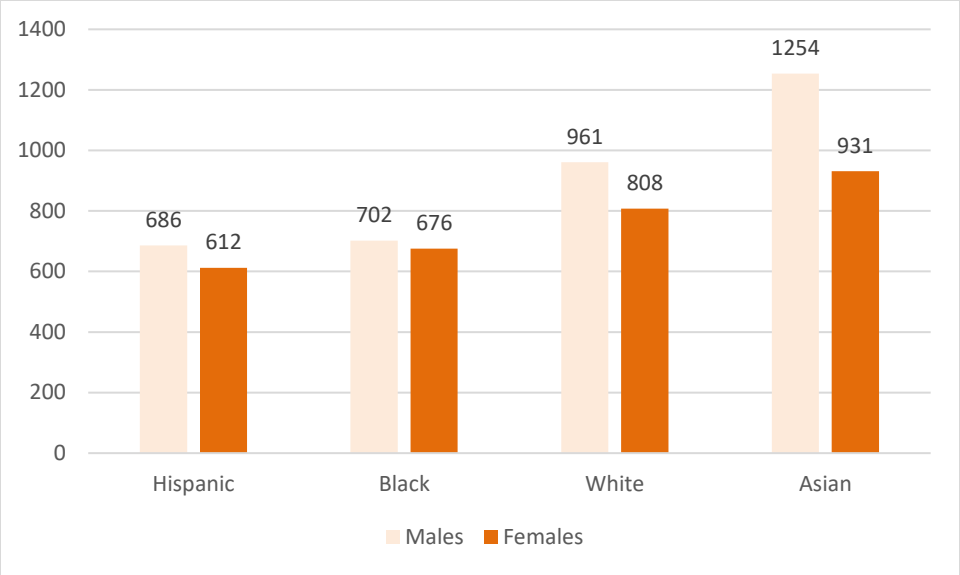

Figure 4. Weekly wages of full-time employees by race/ethnicity and gender (Bureau of Labor Statistics, 2017).

Many people migrate to the United States in search of greater opportunities (Martin & Widgren, 2002). However, employment opportunities for undocumented residents is limited. For instance, one in three unauthorized immigrants holds a service job, such as a janitor, cook, server, or childcare worker (Passel & Cohn, 2009). Research suggests that one in three dry wall installers, one in four maids or housekeepers, and one in four construction painters is an undocumented immigrant (Passel & Cohn, 2015). Therefore, the daughters of unauthorized Hispanic immigrants may be limited in the type of school they attend, the recreational activities they participate in, the amount of time they spend with their parents, the amount of homework support they receive, and the quality of English they hear, (Passel & Cohn, 2009). In addition to all of these factors, they may experience high poverty (Passel & Cohn, 2009). These environmental factors impact one's social capital, academic aptitude, and cultural capital (Cincinnato, De Wever, Van Keer, & Valcke, 2016).

Final Considerations for Latinas

Entering STEM fields may be advantageous for Latinas from disadvantaged backgrounds. First, women employed in STEM fields can earn 33% more than women in non-STEM jobs (Beede et al., 2011). Second, the gender wage gap, which is at 21% in non-STEM jobs, is at 14% in STEM jobs (Beede et al., 2011). Although women comprise 48% of the nation's workforce, they only apply to STEM jobs at a 24% rate. Therefore, if the STEM field were to mirror the overall workforce, there is a female shortage by half (Beede et al., 2011).

Latinas' persistence in STEM affects educational systems, communities and society. The low educational attainment of any people group that represents one in four children in K-12 public schools may call for an educational overhaul (Oliva, 2008). Fractioned, half-hearted, disconnected, and inefficacious efforts to reach the Hispanic student population may be misguided. Teacher education programs must effectively train teachers to teach suburban students as well as high poverty students. If no steps are taken to encourage, coach, mentor and empower Hispanics to take control of their educational achievements, this untapped potential workforce may become a loss for the American society.

Hispanics are culturally collectivists; they may be taught to value the family more than the individual and to put the family's needs before their own (Calzada et al., 2010; Villalpando, 2004). Although this is a noble perspective, if Latinas feel pressure to help provide for the family's immediate needs instead of being allowed to invest in educational endeavors, they may shortchange their long term opportunity to provide for their family (Ong et al., 2011). On the other hand, nearly 90% of Hispanics agree that earning a college degree is important to upward mobility (Taylor et al., 2009). Thus, students who work an unskilled job to provide for the family's immediate need instead of earning a college degree to pursue a career may stifle their

opportunities at a prime age (Purdy, & Arguello, 1992; Taylor et al., 2009).

One aspect of traditional Hispanic culture is adhering to the idea of traditional gender roles (Ong et al., 2011; Reis, 1995). This is the idea that the role of women in the culture is to spend more time concerned with family and home affairs than school and work affairs (Gutek, Searle, & Klepa, 1991). In addition, many Hispanic communities expect young Latinas to marry, have children, and take care of the elderly (Purdy & Arguello, 1992).

Thus, Latinas who persist in STEM may find themselves having to negotiate their traditional role as prescribed by their community, and step into a new identity (Leyva, 2011). This is not the case in every home, as Hispanic families vary in level of adherence to tradition (Flores, 2011; Purdy, & Arguello, 1992).

Though few, some Hispanic families foster a focus on education and a pursuit of a career in their daughters (Kekelis, Ancheta, & Heber, 2005). Furthermore, this limited encouragement for career-mindedness is not only found among those who raise Latinas. Many Americans may not foster in their daughters, step-daughters, granddaughters, nieces, or foster daughters the value of education and career pursuit (Lindsey, 2015; Oakley, 2016; Reis, 1995; Skinner & McHale; 2018).

Preparing Latinas to enter STEM fields will require changes in the educational system. Some authors have suggested that the approach educators use to teach European American children does not have the same impact in settings with minority and high poverty children (Gay, 2002; Ladson-Billings, 1992). Pedagogical perspectives, such as culturally responsive teaching, which is defined as "using the cultural characteristics, experiences, and perspectives of ethnically diverse students as conduits for teaching them more effectively" (Gay, 2002, p. 106) and culturally relevant teaching (Ladson-Billings, 1992) may be key in educators' efforts to engage

children from diverse backgrounds.

Culturally responsive teaching is an educational perspective that came about from the observation of consistently decontextualized curriculums across the country (Gruenewald & Smith, 2008). Though schools are working to educate and shape the minds of youths, they may fail to consider that the way to connect and engage children from different backgrounds, aptitudes, and socioeconomic statuses may be different from the way one would connect with children from more typical backgrounds. Thus, one way to ground culturally responsive teaching is through place-based education, which proposes to spur student interest by being mindful of the local community and incorporating teaching about the local community into the formal curriculum (Gruenewald & Smith, 2008), thus adapting the curriculum to reflect a more multicultural perspective.

Culturally relevant teaching is a phrase coined by Gloria Ladson-Billings (1995) in reference to the assets low-achieving, urban students bring to the classroom, and the teachers who experienced didactic success with them (Ladson-Billings, 2014). Ladson-Billings (2014) stated that teachers who are successful with these students exercise three major domains in their work. First, they exert themselves in growing the students intellectually through instruction and meaningful learning experiences. Next, they exert themselves in cultural competence by helping students appreciate their culture of origin while gaining fluency in one other culture. Lastly, these teachers exert themselves socio-politically, while taking student engagement and helping them become literate in identifying and solving real-world problems (Ladson-Billings, 2014).

Data suggest that 81.9% of teachers in society are Caucasian (NCES, 2012). Though it is unlikely that they have the same multicultural experiences as their Latina students who may reside in a low socioeconomic neighborhood and district, they can be sensitive to Latinas'

perspectives and prior knowledge. Teachers may need proper training to engage Latinas, and to understand what is valuable to them, what motivates them, what they are familiar with, and to use this knowledge in the classroom to engage them in culturally-sensitive ways (Gay, 2002; Wilson-Lopez et al., 2016). Latinas from underserved backgrounds may need educators to invest, mentor, and coach them in order that they may view education as a pathway into choices and options in life (Parker, 2014; Schwartz et al., 2016; Talley & Ortiz, 2017).

Summary

In conclusion, Latinas' persistence in STEM disciplines may be a culmination of lived experiences, environmental, and personal factors. In order to understand the essence of the meaning Latinas make of these lived experiences, it is important to unearth and explore them. The experiences of African American women in STEM are examined because they share with Latinas the status of being double minorities and there may be lessons to learn from their experiences. However, research is needed to determine if the strategies and supports that motivate African American women also motivate and support Latinas to persist in STEM. The literature suggests that double minorities may experience persistence in STEM differently than other minority groups (Ong et al., 2011).

It may be paradoxical that Hispanics work the most yet earn the least (Solis & Galvin, 2012). However, it may be possible to channel their work ethic to invest in the educational preparation that STEM careers require. More research is needful in order to suggest how to create meaningful formative experiences for Latinas to become interested in STEM in culturally sensitive manners (Calzada, Tamis-LeMonda, & Yoshikawa, 2013).

That which is not known from the literature is the specific experiences that are meaningful for Latinas to persist in STEM education. This study will fill the literary gap by

providing a platform for Latinas to voice the experiences, influences, and factors that aided them to persist in their STEM degree, thereby addressing their underrepresentation in STEM degrees.

CHAPTER THREE: METHODS

Overview

Latinas are an underrepresented group in science, technology, engineering, and mathematics (STEM). No research study voiced Latinas' experiences during their persistence in a STEM bachelor's degree (Crisp et al., 2009). Therefore, a study seeking to understand the essence of the lived experiences of Latinas' persistence in STEM was needful. This chapter presents the details of the hermeneutic phenomenological design and the data collection procedures, which included a demographic questionnaire, semi-structured interviews, focus groups, and letters of advice. Next, the details of data analysis were discussed, including: transcription, the self-reflective journal, conducting thematic analysis, and reflection (Van Mannen, 1997). Moreover, sections expounding upon the research questions, settings, participants, the role of the researcher, ethical considerations, as well as trustworthiness are also included.

Design

During the process of developing the research design, researchers must first consider what type of information they desire to gain from the study. Developing a qualitative study versus a quantitative study will yield different types of data (Creswell, 2013). Quantitative studies utilize formulaic tests and seek correlations among variables in a larger sample to arrive at descriptive, formulated results, while qualitative studies yield data that is grounded in insight into the experiences of people (Barnham, 2015). Considering that in scholarly literature no study gave voice to the experiences of Latinas who persisted in a bachelor's STEM degree (Crisp et al., 2009), a qualitative design was appropriate. Qualitative studies require that the final report include "the voices of the participants" (Creswell, 2013, p. 44).

When choosing a qualitative design, five major approaches may be considered (Creswell, 2013). I employed a phenomenological lens in this qualitative study. Though there are multiple ways to approach the data, phenomenological researchers seek to grasp the nature of an object, event, or phenomenon from various persons who have experienced it (Creswell, 2013). It is an attempt to capture the essence of lived experience as understanding is methodically revealed.

Understanding the essence of what was experienced and how it was experienced is the goal of phenomenologists (Creswell, 2013). The problem that needed to be addressed is that Latinas are underrepresented in STEM (National Center of Education Statistics, 2017a). The gap in the literature called for Latinas to voice their lived experiences in persisting in STEM (Crisp et al., 2009). Therefore, phenomenology was the chosen approach for the present study.

Relevant Aspects of Phenomenology

Phenomenological researchers study the lived experiences of people as a philosophical discovery (Creswell, 2013). These experiences are perceived in the realm of consciousness and they are part of people's reality. The goal of phenomenological research is to develop descriptions, explanations, and themes in context (Creswell, 2013; Van Manen, 1997).

Another critical aspect of phenomenology lies in its philosophy. Researchers believe that participants' lived experiences have objective and subjective aspects to them. As Van Manen (1997) states, "our human science orientation to education redefines the meaning of concepts such as 'objectivity' and 'subjectivity,' and it does not make unbridgeable distinctions between fact and value, the empirical and the normative" (p. 16). He goes on to explain that phenomenological researchers do not set out to define what is objective, but rather to remain objective to the nature of the object being studied, namely the essence of the lived experiences of

Latinas persisting in STEM education. It is critical for phenomenologists to "show it, describe it, [and] interpret it while remaining faithful to it" (Van Manen, 1997, p. 20).

In a sense, phenomenological researchers aim to reflect and interpret the descriptions of objective and subjective experiences that people have had with the phenomenon while respecting their individual perspectives (Van Manen, 1997). They are searching for commonalities in an attempt to understand and describe the very essence of the phenomenon. During this endeavor, they must guard themselves from distractions, coincidental traps, or other marginal elements (Van Manen, 1997).

Hermeneutic Phenomenology

The two major forms of phenomenology are transcendental phenomenology and hermeneutic phenomenology. In transcendental phenomenology, researchers bracket out their own experiences and focus on the experiences of the participants (Creswell, 2013). Others believe that it is impossible to completely bracket out one's experiences, advocating for a hermeneutic approach in which the researchers fill the role of interpreters of the experiences of their participants (Van Manen, 1997).

In this particular study, I employed a hermeneutic approach to phenomenology. While hermeneutic phenomenologists aim to describe the lived experiences of participants, they have the duty of interpreting the "texts of life" (Van Manen, 1997, p. 4). The process of interpretation in hermeneutic phenomenology involves the "textual reflection on the lived experiences and practical actions of everyday life with the intent to increase one's thoughtfulness and practical resourcefulness or tact" (Van Manen, 1997, p. 4). Thus, researchers must pay careful attention to textual reflection and interpretation while acknowledging that they do not set aside their own experiences in the phenomenon (Van Manen, 1997). As the hermeneutic interpreter of this study,

I chose to focus on Latinas persisting in STEM degrees because I am a Hispanic female and I have persisted through a master's degree in teaching, while endorsing biology and Spanish. In my experiences, persisting in biology courses opened my eyes to the reality that Latinas are underrepresented in STEM, and to the widely held belief among undergraduate students that STEM classrooms have a weed-out culture (Seymour & Hewitt, 1997; Lindemann et al., 2016).

In an effort to become oriented to the phenomenon, hermeneutic researchers pay close attention to the ontic and the ontological aspects of a lived experience (Van Manen, 1997). The ontic has to do with the concreteness of a lived experience, and the ontological aspect involves the essential nature of it (Van Manen, 1997). The hermeneutic endeavor requires that participants and researchers recollect the lived experience:

> in such a way that the essential aspects, the meaning structures of this experience as lived through, are brought back, as it were, and in such a way that we recognize this description *as a possible experience*, which means *as a possible interpretation* of that experience. (Van Manen, 1997, p. 41)

In fact, the hermeneutic researcher acknowledges that the findings are a construction of a possible interpretation of the essence of the participants' experience (Van Manen, 1997).

Research Questions

Central question: What is the essence of the lived experiences of Latinas persisting in STEM education?

Sub-questions:

1. What formative experiences motivate Latinas to begin a STEM postsecondary degree?
2. What are Latinas' perceptions of the curricula based on their experiences in their STEM degree program?

3. How do Latinas describe the sense of belonging they experienced during their 4-year postsecondary institution?
4. How does Latinas' self-identity motivate their persistence in their STEM degree?

Setting

There were several settings for this study. Most of the settings were in the Eastern United States. The states that I gathered participants were Virginia, Maryland, Georgia, and the nation's capital, Washington, D.C. The rest were found through gatekeepers in social network sites (SNS). My participants in online networks lived in various parts of the country. I selected these settings because Maryland, Virginia, and Washington, D.C. make up the D.C. metropolitan area, and this area has a substantial Hispanic population. The D.C. metropolitan area has many universities and research institutions, including American University, NIH, Georgetown University, University of Maryland, American Institutes for Research, Brookings Institution and University Research Association, Inc. Due to these large, STEM-related corporations, there was a greater chance of finding Latinas who were highly-skilled professionals working in STEM fields. The accessibility of the D.C. metropolitan area is also an advantage.

Georgia has a large Hispanic population and numerous institutions. Georgia Tech, University of Georgia, Georgia State University, as well as technical colleges and community colleges make up some of the educational institutions. My goal was to find Latinas who have graduated with a STEM degree from one of the many educational institutions through a gatekeeper. Lastly, I searched for participants through online social groups. I selected SNS because many Hispanics are actively connected through interests in social network sites.

Furthermore, the Latinas had to have studied in different STEM fields. I covered each of the four general disciplines from science, technology, engineering or mathematics. More

specifically, the participants earned a bachelor's degree in Mathematics, Biology, Computer Science, Engineering, or something related to each of these degrees. For a complete list of STEM fields, see Appendix A. I sampled participants from different schools and different regions.

Participants

Creswell (2013) recommends that a sample size of 10-15 is sufficient for a phenomenological study. Thus, I used purposeful, convenience, and snowball sampling to find 10-15 self-identified Latinas who have lived in the United States and persisted in attaining a bachelor's degree in STEM in the United States within the last 16 years (Creswell, 2013). The definition of Latina is a woman who self-identifies as Hispanic and who was born in a Spanish-speaking country, or is the descendant of a person who was born in such a country (Zimmerman et al., 1994). In this study, the most important aspect is that they self-identify as Latina, and the amount of generations that they were removed from their Hispanic ancestor is not delimited.

Once I received IRB approval, there was preliminary information that I needed to be aware of before I invited the Latinas to be part of the formal study. Once I met or was referred to a Latina who may qualify as a participant, I asked her to fill out an informed consent form (see Appendix C) and the following online Google Forms questionnaire:

1. Please fill out the following descriptors and questions:

   Are you willing to participate in an interview and focus group discussing your experiences persisting in a STEM bachelor's degree?

   Marital status:

   Highest degree attained, and year:

   Specialized licenses or certifications:

   Current employment:

2. Where is your family from?
3. What is your age?
4. How would you describe your culture?
5. What is your country of origin or heritage?
6. Do you consider yourself Latina?
7. What is the title of your bachelor's degree, and what year did you graduate?
8. What is your religious affiliation, if any?
9. What is your name and preferred contact information?

These questions helped me determine whether these women were Latinas, and whether they earned a bachelor's degree in a STEM field. Next, once they agreed to become a participant in this study, I offered them a $25 gift card to a place of their choice upon completion of the data gathering. My intention was to hold face-to-face interviews and focus groups with my participants in Virginia, and WebEx interviews with my participants in Georgia, Maryland, Washington, D.C., and SNS. In addition, I asked them to choose a pseudonym for their interviews and focus groups, and then I scheduled a time to interview them. Finally, using their pseudonym, I reported demographic data, which included their age, country of heritage, length of degree, major, and type of university and housing arrangement.

I used purposive, convenience, and snowball sampling methods to find the 10 participants from Georgia, Maryland, Washington, D.C., and Virginia. The rationale in snowball sampling is that Latinas in STEM education will be connected to other Latinas in STEM education who may desire to voice their meaningful experiences in STEM education (Atkinson & Flint, 2001). I also employed snowball sampling through SNS. This meant that I looked for participants on social network sites (Baltar & Brunet, 2013). I targeted online groups or connections that were relevant

to Latinas in STEM and contacted board members to see if they were willing to participate in my study. Once I secured board members' participation, I asked them if they knew of other Latinas who may also be interested in sharing their story. I continued to sample until I reached thematic saturation in data analysis and no new findings presented themselves (Lowe, Norris, Farris, & Babbage, 2018). The following table contains information about each participant under her pseudonym.

Table 1

Demographic Table of Participants

Participant Pseudonym	Age	Country of Heritage and religion	Length of Degree	Major	Type of University and Housing Arrangement
Dalia	24	Guatemala Protestant	4	Biology	4-year private university Lived on campus
Elizabeth	32	El Salvador Catholic	6	Community Health	Community college to public university Lived at home
Rosita	26	Mexico Catholic	5	Kinesiology	Community college to public university Lived at home
Ada Lovelace	26	Colombia Agnostic	4	Digital Marketing	Public university to private university Lived on campus then lived at

					home.
Lynn	29	Colombia Protestant	4	Biology	4 year private university Lived at home
Karlita	32	Guatemala Catholic	5	Chemical Engineering	4 year private university Lived on campus
Alba	26	Mexico Protestant	4	Math and economy	4 year public university Lived on campus
Juliana	46	Paraguay Protestant	4.5	Biology	4 year public university Lived at home
Mayra	44	Mexico Catholic	8	Computer Science	2 public universities Lived at home
Jenny	24	Mexico Catholic	4	Biology	4 year public university Lived on campus

Table 1. Demographic table of participants

Procedures

Upon successfully defending my proposal and receiving approval from my committee, I applied for IRB approval. Once I secured IRB approval, I found participants through convenience, snowball, purposive sampling methods in Maryland, Virginia, Washington, D.C., Georgia, and on SNS. I did this through the gatekeepers who I know personally in the D.C. area and Georgia. I found 10 participants.

The Role of the Researcher

Members of both sides of my family for at least two generations are Peruvian. I was born in Lima, Peru, and grew up speaking Spanish. However, around the time of my birth, members

from my mother's family migrated to the United States. Thus, even living in Peru, my mother, older brother, and I dreamed of joining them and moving the United States.

I come from a family that values education. I lived in Peru for the first ten years of my life. During that time, even though we did not have a lot of money, my parents sent both my older brother and I to private Catholic schools. Finally, one of my uncles was able to secure visas for my entire family. My father stayed while my mother, brothers, and I immigrated to the United States. I entered into the American public school system in fourth grade and did my best to learn English, since I wanted to make friends and be able to communicate. I received private tutoring as well as small group instruction throughout my early years in school, and eventually learned to speak, read, and write English.

During my high school career I was not particularly interested in school, even though I did well. I started my post-graduate education at a four-year university seeking a nursing degree. In order to enter the program, I needed to take biology-related courses. Prior to my undergraduate degree, I had little experience in the science world. In fact, I remember being very confused in my high school chemistry class, and enjoying but not being particularly good in my honors biology classes.

I was accepted into the nursing program, however, I was dismissed during my junior year, but went on to graduate with a B.A. in Communication Studies. The first time I entertained the idea of pursuing teaching a STEM subject was when I began pursuing my Master of Arts in Teaching degree.

My cultural identity consists of an amalgamation of American and Peruvian heritage. I have known many Hispanics in different settings and I am interested in finding ways to engage Latinas in STEM opportunities. As an underrepresented people in STEM classrooms, I am

calling Latinas to rise to address the issue of STEM underrepresentation, reverse the trend and thereby change society.

In my personal life, I have known three of the potential research participants since middle school. One of my participants and I met in a graduate class during our doctoral journey.

My role as a hermeneutic phenomenological researcher was to interpret the participants' text of life. The data that I collected came in a package of multilayered themes. I reflected on it and interpreted it (Van Manen, 1997). I also conducted thematic analysis to uncover thematic formulas and essential themes in context through free imaginative variation, ultimately interpreting their voice. My assumption was that the perceptions, assumptions, and experiences that are part of my identity were valuable in reflecting, understanding, and interpreting my participants' lived experiences.

Data Collection

I utilized purposeful convenience and snowball sampling to gather Latinas living in the metropolitan area of Georgia, Washington, D.C., Virginia, and Maryland. All of the data gathering was done over Google Hangouts or Whatsapp unless the participants lived in Virginia. I gathered participants over social network sites as well and communicated with them over Google Hangouts. Before approving them as participants, I sent them the online questionnaire to ensure that they were Latinas and that they had completed a bachelor's degree in a STEM field. I asked each of my participants to allow me to interview them, and to attend one focus group meeting. Lastly, I asked each participant to write a letter of advice to a younger Latina interested in STEM. In this letter, they can include their occupation, the support they experienced, and how they stayed motivated to persist.

Recording Procedures

I conducted semi-structured interviews with each participant. The interviews were recorded with two different apps on two different devices. First, I used the recording app on my iPhone, then I used the Voice Recorder application on my PC. Both of these devices were password-protected.

Second, I also recorded the focus groups using the same methods. Each focus group was done over Google Hangouts. I used two methods of recording in case one failed, stopped, lost battery, did not audibly pick up their voice, or was interrupted. I asked the participants in Virginia to meet me for coffee or tea in a public, familiar place. I transcribed the recordings myself.

Interviews

During the initial data gathering phase of this study, I conducted interviews. I chose to hold interviews first because I wanted to personally hear from my participants in a private, one-on-one setting. I wanted to hear their unique reflections and perspectives about persisting in STEM education first, apart from the opinions of other participants or the opinion of the group, thereby avoiding groupthink (Kaba, Wishart, Fraser, Coderre, & McLaughlin, 2016).

In the interviews, it was important for me to consider the possible commonalities between my participants' experiences by conducting a content analysis of their potential experiences through the lens of the theoretical framework (Berger, 2015; Merton & Kendall, 1946). The Theoretical Framework section presented detailed information on Tinto's (2015) model of student motivation and persistence. I analyzed this theory and developed most of the semi-structured interview questions using the theory's main constructs (Patton, 2015). This theory

helped me identify the potential experiences that the participants may have in common and ask questions based on those potential experiences.

In order to conduct the interview, an interview guide was developed. This interview guide addressed important areas of inquiry during the semi-structured interviews with each participant (Patton, 2015). I included semi-structured interviews in my study because I wanted to ask the participants open-ended questions that stimulated self-reflection and focus. In addition, I wanted to increase my understanding of the lived experiences that were meaningful in their persistence in a STEM education degree (Creswell, 2013). My goal was to interpret the data properly.

There were many aspects to Latinas' lived experiences that needed to be investigated and understood. I wanted to inquire about their academic identity, goal-setting, values that were important to them, how those values evolved, the experiences that affirmed their pursuit of a bachelor's degree in STEM, how confident they were that they would succeed, and what they viewed as obstacles. When inquiring about their obstacles, I wanted to ask them whether they had any doubts, setbacks or negative experiences that worked against their motivation to persist, and how they overcame them. I conducted interviews until saturation was reached and new themes were no longer identified.

Interview questions. The following 30 questions were used to structure and guide the interview process.

Family

1. Whom do you consider part of your family?
2. How did your family's expectations affect your persistence in STEM?
3. What goals did your family have for you, if any?

4. How did your family respond to the idea of you persisting in a STEM education degree?

Pre high school

5. What did you see yourself doing as an adult?
6. When did you become interested in STEM education? What motivated this interest?
7. What was the first time you remember thinking STEM could be useful to you? Please explain your initial thoughts and feelings.
8. Whom did you aspire to be like and why?
9. Whom do you consider a mentor or teacher who affected you in particular and why?

High school

10. What career, technical, or vocational courses did you take in high school, if any? What motivated you to enroll in these specific courses? What were your experiences in these courses?
11. During high school, how did you feel about your abilities? What factors shaped this self-perception?
12. What academic experiences in high school shaped your decisions about where to attend college and what degree to pursue?
13. What are some instances when you felt recognized as a STEM-person in high school or college?
14. What role did your family play in shaping your decision to pursue STEM at this time?

College

15. Please describe the events surrounding when you began to see yourself as a STEM-person?

16. How did being a Latina in a STEM program make you feel?
17. When you developed a STEM identity, how was it sustained?
18. How involved in STEM were you in college?
19. What was the process of your goal development for declaring your major?
20. What was your perception of the STEM curriculum in your program during your time persisting in your STEM degree?
21. How long did you attend your university institution?
22. How did obstacles affect your persistence in STEM?
23. What experiences before deciding on majoring in your degree were significant to choosing STEM?
24. What kept you motivated in STEM? Please describe a time you considered quitting, and why, and why or how you chose to persist.
25. During your time in the university, how confident were you that you would graduate with your STEM degree? What impacted your confidence?
26. What type of connections did you make in the university with students? Faculty? Others?
27. What type of academic support from the university did you experience?
28. What was the STEM classroom climate like in your university institution?
29. Please describe any other formative experiences in your degree attainment (e.g. internships, research groups, mentorships)? Is there anything else about your experiences in STEM that you feel is important for me to understand?
30. What role did your family play in your persistence in STEM during this time?

Explanation of the semi-structured interview questions. There were several constructs to take into consideration and discuss in order to extract the proper meaning and essence of the lived experiences of Latinas persisting in an undergraduate degree in STEM. These constructs included cultural identity (Parker, 2014; Sayman, 2013), academic identity (Carlone & Johnson, 2007; Cobb, 2004), self-efficacy, motivation, goals, and sense of belonging (Bandura, 1989; Herrera & Hurtado, 2011; Talley & Ortiz, 2017; Tinto, 2015). Together, these constructs aided me to properly interpret and understand the different layers, facets, and dimensions of the lived experiences among Latinas persisting in STEM education.

Although self-identity was particularly relevant to Latinas persisting in STEM education, I wanted my questions to be more specific and profound than a general idea of self-identity. Therefore, I divided self-identity into two categories. I asked questions specifically addressing cultural identity and academic identity. Cultural identity is related to the larger construct of self-identity (Hall & Du Gay, 1996). Cultural identity involves questions about language, cultural values, and cultural norms (Pretelt, 2016). Since these Latinas have lived in the United States for some time, but may have also lived in the country of their heritage or been raised in America with Hispanic culture, it was important to explore the values they may possess from each culture (Sayman, 2013; Schwartz et al., 2015).

Cultural identity. During the interview process, I sought to explore the component of cultural identity in their perspectives, and how it affected their decision-making. I used the terms cultural identity and bicultural identity interchangeably because adapting to both cultures is part of the identities of many Hispanics living in America (Sayman, 2013; Schwartz et al., 2015). Their cultural identity may be affected by their command of Spanish and English languages (Villalpando, 2004), as well as their values (Pretelt, 2016).

Although Latinas may speak Spanish at home, STEM education in the classroom is conducted in English. Therefore, Latinas' command of the English language in both written and spoken forms may affect their persistence in STEM (Villalpando, 2004). In a different sense, the things that Latinas value impact their cultural identity. If Latinas value *familismo* and *respeto,* then they tend to align more with values important to the Hispanic culture (Calzada et al., 2010). *Familismo* and *respeto* may impact Latinas' persistence in a STEM degree, since Latinas' motivation to persist may depend on meeting their family's expectations (Talley & Ortiz, 2017). Therefore, Latinas who possess a higher Hispanic cultural identity tend to submit to their family's expectations. In addition, if the family supports the Latinas' persistence, they may not have to negotiate pursuing a career with their family role (Ong et al., 2011).

However, American culture values individualism (Twenge, Dawson, & Campbell, 2016). Therefore, Latinas who have a higher American cultural identity may be more independent in their goal setting, motivation, and persistence. If this is the case, they may decide to persist in a STEM degree, but may not enjoy the support of their family, having to negotiate between persistence in STEM and family expectations. Therefore, in questions 1-3, I identified the degree of their American and Hispanic cultural identity.

In my first question, I wanted to know whom their family consists of. They may consider their family their parents and siblings, their grandparents, aunts, and uncles, or they may be married and consider their husband and children their family. I asked the first question to clarify. Question 4 addressed whether they had the support of their family during their persistence in STEM or not. Next, question 16 entails their perceptions of themselves in the STEM classroom. I want to know whether they felt different in the STEM classroom. They may have felt very comfortable in this setting or they may have felt uncomfortable. It may also have been a

progression from feeling uncomfortable to feeling comfortable in their personal experiences. I will allow them to talk through how they felt and why they felt the way they did.

Additionally, questions 14 and 30 both invite my participants to assess their experiences throughout their academic journey in light of their family involvement. It may be that for some of the participants, the support of their family was a decisive factor in their persistence in STEM (DeFreitas & Bravo, 2012). I question my participants about the impact their family had on them in both high school and college. It will be important to explore whether their family encouraged an initial interest in STEM or motivated them to persist. More research is needed in order to suggest how decisive family support may be to some Latinas.

Academic identity. Academic identity, in relation to STEM education, is a notion surrounding the concept of how Latinas form and sustain meaning from their STEM experiences through competence, performance, and recognition (Carlone & Johnson, 2007). Furthermore, academic identity is not obsolete when it comes to questions about persistence. It is very relevant to cultural identity, motivation, and self-efficacy, bringing symmetry between who Latinas perceive themselves to be currently, and who they are anticipated to become (Cobb, 2004) in their STEM education program. Latinas with a high academic identity may be intrinsically motivated to achieve greater levels of STEM competency (Talley & Ortiz, 2017).

Questions 13, 15, 17, 18 align with the construct of STEM identity. Question 17 mentions STEM identity and how it was sustained. Question 15 asks about instances when they felt recognized as a STEM person. This recognition will affirm their academic identity. For instance, participants may mention peers or siblings who looked to them to solve problems, recall information, or think critically (Cummins, Hu, Markus, & Montero, 2015). They may also

mention family members who thought they were exceptionally intelligent and had high academic expectations for them (Perez, Cromley, & Kaplan, 2014).

Question 18 asks the participant to talk about their involvement with STEM education during college. This could be research endeavors, study groups, or being a student-worker for a STEM professor (Swail, 2003). In relating their capacity in a STEM-related role they may tell a different aspect of their academic or STEM identity. Lastly, question 15 seeks to uncover the timing of their development in becoming a STEM-person. I aim to understand how early they were exposed to STEM education and how early they perceived themselves as STEM-people. This knowledge may reveal how early in life they developed a high academic identity (DeJarnette, 2012).

The model. The rest of the constructs are directly taken from Tinto's (2015) model of student motivation and persistence. Delving into the model, the main three constructs presented are goals, motivation, and persistence (Moakler & Kim, 2014; Tinto, 2015). Motivation also has three constructs that directly affect it: self-efficacy, sense of belonging, and perception of curriculum (Harackiewicz, Canning, Tibbetts, Priniski, & Hyde, 2016; Tinto, 2015).

Goals. The first construct that is part of the model is addressed by questions 3, 5, 6, 10, 19, 21 (Tinto, 2015). It may be very consequential that Latinas first develop life and career goals in order to persist in a STEM degree (Bandura, 1989; Carlone & Johnson, 2007; Herrera & Hurtado, 2011; Moakler & Kim, 2014; Talley & Ortiz, 2017). Thus, questions 3, 5, and 19 address goal setting. Preparation may also factor into goal development (Moakler & Kim, 2014), and thus, in questions 6, 10, and 21, I specifically inquire about prior experiences and practices before entering into the university institution.

Motivation. The next construct in Tinto's model of student motivation and persistence is motivation. According to the model, motivation directly affects persistence (Tinto, 2015). Therefore, questions 8, 9, 22, 23, and 24 address motivation in Latinas to persist in STEM education. Questions 8 and 9 open the conversation to talk about whether they maintained mentoring relationships or had role models during the time of their persistence in STEM, since Latinas who have positive experiences with faculty or mentors may be more likely to persist in STEM (Ong et al., 2011).

More specifically, in questions 23, I asked about significant prior experiences that motivated them. Familiarity with STEM education, including early exposure and early experiences with STEM-related tools, may be helpful in developing interest and motivation (Becker & Park 2011, DeJarnette, 2012; Talley & Ortiz, 2017). In question number 24, I simply open the time in the interview for my participants to think of any motivators, since each Latina will have a different perception of the things which motivate her.

Self-efficacy. Self-efficacy is related to Latinas' perception of their performance capability, namely, what they think they are able to do (Moakler & Kim, 2014). This was directly affected by their performance accomplishments and personal mastery of the STEM curriculum and STEM content (Bandura, 1977). In turn, research suggests that a high level of self-efficacy in STEM is conducive to interest, motivation, and greater scholastic achievements (Moakler & Kim, 2014). Furthermore, research also shows that self-efficacy encourages internal motivation (Talley & Ortiz, 2017). Therefore, questions 11, 12 and, 25 address self-efficacy in Latinas.

Sense of belonging. Finally, the last construct to explore in Tinto's model of student motivation and persistence is sense of belonging (Herrera & Hurtado, 2011; Tinto, 2015). This construct directly affects motivation, which directly affects persistence (Fuller & Meiners, 2005;

Tinto, 2015). Sense of belonging has many different components, since what one person perceives as belonging may not be perceived the same by another (Johnson et al., 2007). Sense of belonging entails recognition, social connections, and external affirmation (Carlone & Johnson, 2007; Talley & Ortiz, 2017). Therefore, questions 4, 26, 27, and 28 were designed to explore Latinas' connections in the university, academic support they received, belongingness in the STEM program, and their family's response throughout the program.

Sense of belonging in Latinas may look somewhat different from typical belongingness among other groups (Ong et al., 2011). Latinas may need their family's support as well as tutoring, mentorship, and peer support networks as part of their social and academic support in order to achieve persistence in STEM education (Herrera & Hurtado, 2011; Ong et al., 2011). Further, they also may be motivated by feeling a sense of altruism in their community (Carlone & Johnson, 2007); contributing to the community may provide Latinas with encouragement to persist (Carlone & Johnson, 2007; Fuller & Meiners, 2005). Thus, sense of belonging for Latinas may entail connections with STEM peers, faculty, mentors, tutors, family, and community (Carlone & Johnson, 2007; Fuller & Meiners, 2005; Herrera & Hurtado, 2011; Ong et al., 2011).

Perception of curriculum. Lastly, Tinto's (2015) model of student motivation and persistence offers a third construct related to motivation, namely, perception of curriculum. In order for Hispanic students to be motivated, they may need to perceive that the information has great "utility-value" (Harackiewicz et al., 2016, p. 745). Therefore, the construct that directly affects motivation, namely, perception of curriculum (Tinto, 2015) is related to question 7. Further, question 20 inquires about how Latinas perceived their STEM curriculum during the program. It may be that Latinas found that the curriculum would be very useful in their daily tasks in the workforce, and the real-life utility of the curriculum would be a motivating factor.

Logistics. Data was collected after work hours and on weekends, since my participants are employed full time. I focused the interview around the central question, and the sub-questions. I conducted at least one one-hour interview with each of my participants.

Focus Groups

Focus groups are groups consisting of no more than 12 individuals, in which the researcher asks open-ended questions followed up with inductive probing of responses to gain understanding about the phenomenon (Guest, Namey, Taylor, Eley, & McKenna, 2017). Focus groups can stimulate discussion about information that one-on-one interviews may unable to because of the number of group members who can relate to the phenomenon (Guest et al., 2017).

There were several reasons to hold focus groups after individual interviews. First, I wanted to hear their individual voice before I listened to their collective voices. I also wanted to reflect on their experiences as they discuss their commonalities and differences and see if more thematic statements developed. Focus groups were an exciting endeavor where the participants partook in collaborative hermeneutic conversations and reflections (Van Manen, 1997). Gathering them for focus group meetings was important because I was able to "mobilize participants to reflect on their experiences…in order to determine the deeper meanings or themes of these experiences" (Van Manen, 1997, p. 99). The desired result was interpretive perspicacity or insight.

I held focus group meetings with at least two participants. They were aware that I recorded our conversation for the purpose of transcribing and reflecting on it. Their quotes appear in Chapter Four connected to their pseudonym and also in Appendix D.

I conducted two focus groups with five participants in one and two participants in the other. The one with five participants involved four participants over Google Hangouts and one in

my home. The next focus group was solely on Google Hangouts. I asked the questions listed in this section, promoted conversation among them, and ensured that everyone received a chance to speak.

Focus group meetings provided an occasion to record, moderate, and interact with several of my participants in the same conversation. I conducted focus groups because there may be commonalities among the Latinas' experiences in pursuing their STEM degrees, and these commonalities needed to be explored through discussion. I took the role of moderator, ensuring that each participant received a chance to convey her thoughts and perceptions. I sought to direct the conversation with "how," "what," and "why" questions, so that I could further discover and interpret the essence of their experiences which enabled them to persist in their STEM degree. This addressed the central question, which concerned the essence of Latinas' lived experiences persisting in STEM, and their experiences in the larger environment.

The questions asked during focus group meetings were open-ended. In order to glean a deeper meaning from their experiences, I promoted them to do most of the talking and interacting. For this reason, I asked fewer questions than I did during the personal interviews.

Focus Group Questions

1. What does a Latina considering a STEM degree need to know beforehand?
2. What do you feel high school educators need to know about recruiting and supporting Latinas in STEM classes at the high school level?
3. What role do peers play in motivating each other to persist at the college level?
4. What do you feel college administrators and faculty need to know or understand about the Latina experience in their STEM programs?
5. What does your culture need to do to better support Latinas in STEM?

6. What part of your cultural values, norms, or practices fostered your persistence?

Question 1 focused on helping the participants talk about their experiences by allowing them to consider the type of information that would be helpful to know before pursuing a degree in STEM (Wang, 2013). Question 2 focused on the type of support that Latinas can receive from teachers, administrators and other role models in high school concerning STEM classes. Question 3 targeted the sense of belonging aspect of their experiences and how much of a role it had on their persistence (Good, Rattan, & Dweck, 2012; Master, Cheryan, & Meltzoff, 2016).

Awareness of students' differences among educators may be key (Howe & Lisi, 2013). Therefore, questions 2 and 4 bridged the gap between their experiences and what educators needed to know about their experiences in order to persist. The Hispanic culture may also play a role in the participant's persistence (Torres & Solberg, 2001). Therefore, questions 5 and 6 addressed cultural issues within the concept of STEM. Question 5 addressed how cultural mindsets could change so that the Hispanic culture may enhance persistence among Latinas in STEM. Lastly, question 6 asked how the Hispanic culture, in their experience, helped foster persistence.

Letters of Advice

Finally, the last form of data collection was written letters of advice. I asked all of my participants to write a letter to a hypothetical Latina. I also asked my participants to determine the age of the recipient that they think would have been the most important age for the Latina to receive the letter of advice, and why.

I asked my participants to share in their letter their occupation, the support they were given in their journey, and how they stayed motivated to persist. I asked them to write the letter

of advice last as a way of allowing them to express their own points about goal setting, motivation, and persistence in STEM. They may also have desired to share their perception of their sense of belonging to STEM, STEM peers, STEM professors (Wang, 2013), and how they dealt with any feelings of alienation if that was part of their experience. Lastly, they were able to write about any other unforeseen obstacles that came in the way of persistence in a STEM degree. The prompt to their letter can be found in Appendix E. I sought to understand what they would advise other Latinas considering STEM education. The concept of speaking and encouraging the next generation of Latinas persisting in STEM may have been new to my participants. This new perspective allowed them to find fresh ways to communicate their ideas and advice using nonprofessional terminology.

This type of triangulation enabled me to consider the essence of the lived experiences of my participants. In addition to analyzing and triangulating this data with other sources to generate the essence of the Latina experience in STEM, I appended some of the letters of advice at the end of my dissertation, using their pseudonym, see Appendix F.

Data Analysis

I began to gather data immediately upon receiving IRB approval. The IRB-approved consent form can be found in Appendix G, and the IRB acceptance letter in Appendix I. Once I gathered information, I transcribed the recordings and conducted hermeneutic phenomenological reflection and interpretation as I interacted with the data gathered (Van Mannen, 1997).

The product of hermeneutic phenomenological reflection and interpretation was arrived at with thorough and deep thinking. First, it was important to transcribe the information shortly after gathering it. Second, throughout the data gathering phase, it was important to keep a self-

reflective journal. The third step involved thematic analysis. Lastly, I reflected on the data by discerning between incidental and essential themes.

Transcription

For the analysis portion of this study, I transcribed the interviews and focus groups myself so that I could richly grasp and immerse myself in the information. I took painful care to be precise when transcribing.

Self-reflective Journal

There was a lot of data to be gathered and analyzed, therefore, I needed to provide myself a way to create pathways and capture my thoughts and reactions. I tracked my ideas by utilizing a self-reflective journal. In this journal, I wrote thoughts, questions, and interpretations after conducting interviews, focus groups, and reading their letters.

The self-reflective journal allowed me to generate creative hermeneutic thought as I pondered the participants' words not only as a researcher, but also as an educator and a Latina. When I listened and reflected or thought back and reflected, I continuously asked myself about the significance of their experiences, or whether their experiences could be a theme in light of the central question (Van Manen, 1997). Please see appendix H for portions of my self-reflective journal.

Thematic Analysis

Uncovering thematic aspects is the step that follows transcription and the self-reflective journal. Thematic analysis is the process through which the investigator recovers themes that are embedded in the text (Van Manen, 1997). Themes did not spontaneously emerge from the data, but were identified and discerned by the researcher as they appeared throughout the text (Van Manen, 1997). A theme is an "element (motif, formula or device) which occurs frequently in the

text" (Van Manen, 1997, p. 78). A theme is the point of a passage and a simplification of the words and experiences of the participants (Van Manen, 1997).

However, maintaining order and organization of the data proved to be challenging. Therefore, in order to make the theme-searching process smoother, ensure salient themes, robust findings, and thematic organization, Nvivo was employed. This qualitative data analysis software (QDAS) supports coding, retrieving, and analyzing, which was otherwise more challenging (Woods, Paulus, Atkins, & MacKlin, 2016).

Throughout the analytic process, themes were examined, articulated, added, re-interpreted or reformulated (Van Manen, 1997). Therefore, as I used Nvivo to identify themes, I continuously reflected on whether the theme was relevant to most or all of my participants' experiences or just to a few. Interpretation is the basis of the hermeneutic thematic process, therefore, I approached the thematic analysis process as a Latina. This perspective enabled me to engage in "insightful invention, discovery, or disclosure – grasping and formulating a thematic understanding" (Van Manen, 1997, p. 79). Lastly, context was key for thematic formulations. Therefore, themes were written as phrases in order to provide context.

Thematic analysis pushed me to process the information in insightful invention and discovery as I considered the participants' perspectives as a Latina in STEM. Once themes were identified and discerned, I reflected on them in light of the central question.

The last step of hermeneutic phenomenological reflection and interpretation was to determine themes using free imaginative variation. This tool was utilized to ensure that themes were not socially, historically, or theoretically constructed and assumed (Van Manen, 1997). Free imaginative variation meant that I asked the question, "Is this phenomenon still the same if we imaginatively change or delete this theme from the phenomenon?" (Van Manen, 1997, p.

107) after extracting the themes. The purpose of free imaginative variation was to verify essential themes (Van Manen, 1997).

Lastly, to ensure credibility in my analysis, I conducted member checking. Member checking allowed me to share the final themes with my 2 of my participants and verify their approval of my interpretations (Carlson, 2010).

Trustworthiness

Trustworthiness was gained and maintained through implementing several steps to increase credibility, dependability, transferability, and confirmability. It is important for hermeneutic researchers to reflect on the data and realistically interpret the voices of the participants. Credibility, dependability, confirmability, and transferability were significant in the overall strength of the soundness and trustworthiness of the research inquiry.

Credibility

Establishing credibility in a qualitative study speaks to the strength of the inquiry (Creswell, 2013). Credibility pertains to generating an authentic description of the phenomenon and realistic claims (Liao & Hitchcock, 2018). In an attempt to establish credibility, I conducted member checking with 2 members, kept a self-reflective journal, and triangulated data sources.

First, member checking entailed sharing the interpretation with 2 of my participants (Liao & Hitchcock, 2018). Next, my self-reflective journal provided reflective commentary (Shenton, 2004). Finally, I triangulated the data by employing multiple methods of data collection (Carter, Bryant-Lukosius, DiCenso, Blythe & Neville, 2014). Establishing credibility through triangulation, reflective commentary, and member checking was important because it strengthened the case for trustworthiness in my study.

Trustworthiness was also gained by disclosing where key data was found in the transcripts and how the data was analyzed. In order to do this, I produced tables that created an audit trail of the reduction of data into each themes and subthemes, and stated how many times the subthemes appeared. I also provided pertinent parts of my personal and professional biography and educational journey, including my constructivist paradigm, all of which affected my reflection and interpretation.

Dependability and Confirmability

Dependability and confirmability in a research inquiry reveal the consistency of the research (Golafshani, 2003). Dependability refers to the consistency of both the process and the product of the research (Golafshani, 2003). Confirmability concerns researchers with the objectivity with which they interpret the data (Shenton, 2004).

In an effort to establish dependability, I provided a thorough, step-by-step view into the research design, data collection, and data analysis that I executed. This may serve as a prototype for future researchers to follow (Shenton, 2004) and as an audit trail for this study. As any researcher might, I brought certain assumptions to this study (Van Manen, 1997). I was clear about taking them into account when I conducted data analysis. For instance, as Van Manen (1997) affirmed, when the goal is to understand someone's experience on the essence of parenting, the researcher needs to recall his or her experiences as a parent. Lastly, to increase dependability and confirmability, I discussed my interpretations with another Latina. I asked for her feedback on my interpretation. This person was a self-identified Latina who has a bachelor's degree in a STEM field and is actively involved in the STEM field.

Transferability

Transferability entails being able to provide thick descriptions (Brown, 2015). Thick description can be defined as "giving enough detail so the readers can decide for themselves if the results are transferable to their own contexts" (Brown, 2015, p. 26). I provided thick descriptions of the data gathered so that readers could decide for themselves whether they deemed the findings applicable. Also, I sought variation in the sample by selecting Latinas from a variety of Latin-American countries and STEM degrees.

Additionally, I provided a sample consisting of a few pages of a transcript in Appendix D. Further, I also provided a few samples of the letters of advice written by the participants in Appendix F. I also offered a portion of my reflective journal in Appendix H. In addition, I provided the participants' pseudonyms, age, religion, country of heritage, length of degree, major, and type of university and housing arrangement in tabular form under Participants in Chapter Three. See Table 1 for details.

One delimitation in this study is that it did not include Latino males and other underrepresented female groups in STEM. Another delimitation involved whether Latinas entered the STEM workforce. Although women's behavior after earning a STEM degree has been the focus of much research (Beede et al., 2011; Diekman, Brown, Johnston, & Clark, 2010), the present study was limited to persistence until graduation. One limitation was that the participants may or may not choose to be honest and openly share their experiences. Another limitation was that research suggests that there is a difference in the type of people who volunteer their time versus those who do not (Brown, Meer, & Williams, 2018).

Ethical Considerations

When conducting a research study, it is important for researchers to deliberately state

their intentions concerning ethics. Therefore, in this section I discussed the manner in which I protected the identity of my participants, the ways in which I protected the information they disclosed, my perception of them during the data collection and data analysis process, the way I treated their stories, and finally, the manner in which I reacted to their stories.

First, in order to protect the identity of my participants, I asked them to choose a pseudonym. I used the pseudonym to refer to them in my study. Next, I protected the files that are dissertation-related with passwords, and paper files were scanned and either returned or shredded. The next ethical consideration to disclose was my role in each of my participants' lives, namely the fact that I had no supervisory authority over any of the participants. I did not view my participants as subjects or objects. Rather, I viewed them as people created in the image of God. I treated the disclosure of their stories with respect and dignity, and carefully examined my interpretation of their experiences in an effort to not twist or warp them. I endeavored to show empathy when appropriate as I encountered some of their most deeply held feelings and thoughts. Lastly, I had the ethic duty to release them and their story with gentleness, thanking them for opening up their life and sharing their experiences with me.

Summary

This research study proved to be a valuable and meaningful investigation involving reflective interpretation of the data surrounding Latinas who persisted in a STEM degree. The investigation was designed as a hermeneutic phenomenological study. This meant that I gathered data through interviews, focus groups, and letters of advice. Next, I analyzed the data by reflecting on it and then interpreted it. The result was a description of the essence of Latinas' lived experiences persisting in STEM. The data collected was the text of the Latinas' lives (Van Manen, 1997). Therefore, the text needed to be sifted in order to obtain the essence of the

Latinas' lived experiences persisting in STEM (Van Manen, 1997). My goal was to give a voice to Latinas who persist in a STEM degree (Crisp et al., 2009).

CHAPTER FOUR: FINDINGS

Overview

The purpose of this phenomenological study was to understand the lived experiences of Latinas who persisted in a STEM bachelor's degree in the United States. In this section, I addressed the participants' profiles, the steps taken to arrive at thematic analysis, and the themes and subthemes that were extracted from the analysis.

Participants

There were many factors to be considered when finding Latinas who qualified as participants in this study. For instance, potential participants must have persisted through their bachelor's degree in STEM in the United States. They had to have earned a degree that was in some way related to science, technology, engineering or mathematics. Lastly, they had to self-identify as Latina and be the descendant of someone from a Spanish-speaking country. This study focused on the lived experiences of 10 participants who fit those criteria.

Participant Profile

Part of the agreement in conducting research studying the experiences of Latinas persisting in a STEM degree was that their identity would be kept confidential. Therefore, pseudonyms were utilized to identify participants, colleges, universities, teachers, professors, coaches, advisors, and any other organizations referenced in this chapter. The following quotes were chosen because they revealed key aspects of the Latinas' unique behaviors, personal characteristics, or environmental influences that impacted their journey to persistence.

Dalia. The first child born to a pastor and his wife from Guatemala was their daughter, Dalia. In their country of heritage, Dalia's father's profession was accounting, and his wife was a teacher. When they migrated to the United States, Dalia's family did not have the same

advantages professionally as they had in their own country, since many of their professional credentials were not recognized in the United States.

Dalia aspires to become a doctor one day. She is bilingual, and sees that as a great advantage. Some of her earliest memories include asking her mother to perform surgery on a teddy bear, watching *telenovelas* and becoming captivated by the doctors in the *telenovelas,* and taking care of sick children at her Spanish-speaking church. In order to help the families of these sick children, she would write notes describing the child's symptoms in English, so that the family could take the child to the doctor and have a way to communicate their concern.

> So I was four years old when I realized I wanted to be a doctor. In church, I would interpret for church members. So in church I would write them a little note and be like 'they were coughing in class today, their mucus was yellow or green.' And I would literally write sketch notes for them and tell them 'you need to take your kid to the doctor'…I did that since I was a child.

Dalia has had a goal in mind as long as she can remember, and her goal is intricately intertwined with her bachelor's degree. Dalia became interested in biology because she wants to become a doctor. Although her Bachelor of Science in Biology degree was very difficult, it was not intended to be the end of her career as a student. She attended a school where she described not just a chilly climate, but an antagonistic climate, with older student-mentors who were unwilling to teach or help. However, she has fond memories of an Arabian student who became a role model, as he lived out his culture and his academic goals.

Some experiences that shaped Dalia's drive and determination in her STEM program came from her family and her community. First, she experienced firsthand how her mother, who did not speak English well at the time of this decision, one day created a goal to become a

medical interpreter. She accomplished her goal within one year. Also, once during Dalia's time in high school, she procrastinated in completing a project that would have cost her 40% of her grade in biology. When her mother found out that she had not worked on this project and that it would be due in two days, she did not allow her to quit. She stayed up and studied with her. They did nothing for 2 days except eat, sleep, go to work and school respectively, and work on this project. These experiences with her mother taught Dalia that she needed to value the opportunities presented, work hard, and persist.

There was also a woman in Dalia's church, Señora Teresa, who had cancer for 25 years. She was a fighter, and therefore, when she received the news that she had cancer, she became an expert in her type of cancer. She researched what it was, how it worked, how it spread, what she could do to help, and what her options were. She was not a passive cancer victim. Dalia was encouraged by this woman and learned that she needed to also be proactive about gaining knowledge and thinking independently. Finally, her father came alongside her and protected her from discouraging males within the Hispanic community who did not agree that Dalia should strive to become a doctor when she could be a nurse or a teacher. Her father respected and encouraged Dalia's goal from a very young age.

Dalia recalls a time during middle school where she was bullied by the popular girls because she would not conform to their appearance or behavior. She was a girl who was interested in science and that was not acceptable. She also recalled her high school biology course as a time where "the gospel was presented," that is, hearing her teacher's lectures about science, and how impacting these lectures were.

Another factor in her determination to become a doctor is that her father suffers from a herniated disc, and her mother suffers from diabetes. Although her family thrives in their love

and support for each other, there have been seasons of financial struggle. Although Dalia received a scholarship to attend her university, there was a lot of struggle with an intra-institutional culture that perpetuated haughty attitudes and competitiveness instead of affirmation and collaboration, values instilled in Dalia.

Elizabeth. Elizabeth is part of an intact family. She grew up in a household where she was loved and supported by her father, mother, and older sister. In El Salvador, her father was an accountant. He wanted to pass on the importance of financial responsibility to Elizabeth as she matured. Although he could not continue his profession once the family was established in the United States, he made sure to emphasize the value of the opportunities she had in America, namely the opportunity to get an education. Elizabeth has fond memories of growing up in America but also experiencing her country of heritage during vacations.

When Elizabeth visited her family in El Salvador during the summers, her aunts would bring her to school because they were teachers. The schools were set up as one-room school houses, with children of many different ages all taught in one room. She also has fond memories of exploring nature with her cousin, dissecting salamanders, and having a natural curiosity for the world around her.

> [In persisting through my Bachelors of Science degree in Community Health, I] was highly influenced my dad vocally. Throughout my family. My mom was a Montessori school teacher... My parents they did not come from highly educated backgrounds. I know that they also came up with the understanding that education is just beneficial for life. Also, all of my aunts on my mother's side are teachers. They're all teachers. So it's just in my family, that education is an important thing. Whether people have had the opportunity to continue education [in the United States] is a different story.

In addition, as an elementary student in the United States, Elizabeth was exposed to STEM. Based on her academic aptitude, she was chosen to do an enrichment program where she was exposed to architecture, gardening, rocket launches, mice dissection, electrical panels, and field trips to research centers. It was also around this time that Elizabeth made friends with a diverse group of school-oriented girls. This group became her sanctuary when the popular girls (who in her case happened to be Hispanic) ostracized her.

Elizabeth followed a medical careers track in high school and initially thought she wanted to become a nurse. Her father let her know that he would be willing to pay for half of her postsecondary degree if she paid for the other half. Although she did not have anyone in her family who graduated from a university, she did well enough in high school to earn a partial scholarship to attend a private Catholic university.

Although she aspired to attend this 4-year university, Elizabeth's hopes were dashed just a few weeks from the start of the school year. She was unable to attend this private Catholic university because a $12,000 scholarship was denied and her father refused to take out a loan. He told her she still needed to go to college. She was disappointed to have to attend the local community college. She became depressed and unmotivated to maintain a high GPA. Although she did not do well those first 2 years in the community college, she went through the motions because of her father. He would not allow her to quit. Eventually, after two years, she came out of her depression, decided she would make a goal, and went on to graduate with a Bachelor's of Science degree in Community Health.

Ada Lovelace. Ada is a welcoming and warm woman who was born and raised in Colombia. She is the youngest of three siblings, with a mother, stepfather, and a father, all of whom operate as a unit. Her mother, who is also her heroine, practiced law in Colombia during a

time when being a lawyer was dangerous because of the drug cartels. In addition, her father was a business man in Colombia. Ada's family moved to New York when she was six years old.

As Ada walked the streets of her Irish and Italian neighborhood, slurs were sometimes hurled at her. In response, Ada's mother taught her that their insults were their problem. She learned to be courageous from an early age and not to allow insults to become obstacles.

Ada animatedly recounted stories of growing up with a cell phone in her hand and being curious about how it worked. She reminisced about switching through apps and wanting to figure them out. Although socially she considered herself a floater and not really part of any one group in high school and college, her peers viewed her as tech savvy. She attended a high school that focused on the arts, and one of her hobbies became photography. She remembers having a teacher, Mrs. May, who asked the principal to allow Ada to take an extra photography class instead of another elective. In this class, Mrs. May taught Ada a lot about digital photography software.

> I grew up in a very progressive Latino household. So, my mom is a lawyer, my dad is an accountant… there wasn't any expectations to be anything…my mom always said just do the best at what you want to do. And then, I kinda' just fell in love with tech. and I'm a millennial, I grew up with a phone in my hand... Yea, and I didn't fall into it on purpose. My friends are coders, and they're all guys. And they're like, 'it's stuff we can just teach you.' And I was like, 'really?' They're like 'yea, you're the only person that's really excited to learn this, and you don't work in this environment.' 'Yea, but I just think it's cool. Because I open all these apps, I open all these websites, and it's so interesting to know how you made it.' So they started teaching me, they gave me resources, and now I'm taking classes that they legitimately fortify what I was just playing around with.

Ada wanted a typical college experience, therefore, after high school she took out loans to attend the Ivy League public university she was accepted at. However, due to her mother's health, she decided to attend a smaller, private university that was closer to home for her junior and senior year. Although she enjoyed the diversity her second college offered, she did not agree with certain policies. For instance, retaining adjuncts who were successful in their field should have been a priority. She realized that failure to retain adjuncts who were successful in the field meant that "crappy" professors were left. She felt like these policies made her and her peers' education suffer. Nevertheless, she is an active learner and does not believe that she needed a degree to learn what she needed to know in order to be a successful digital marketer.

Karlita. Karlita is a strongminded American woman with a Guatemalan heritage. Her mother and father love and support her and her younger sister. In elementary school, Karlita was identified with dyslexia and a speech impediment, and it was hard to learn English as a second language. She grew up with a mother who valued education and was relentless in ensuring that Karlita had the tools she needed to succeed. Her father demonstrated incredible resilience, resourcefulness, and work ethic. Although he is disabled, he works long hours, some weekends, and never makes an excuse to miss a day of work.

Although her parents do not have advanced degrees, they instilled in her character determination, a strong work ethic, and a value for education. Her strong character, which she attributes to her father, became something she really needed in middle and high school. For instance, she remembered a teacher and a counselor having conversations with her about how she would not be successful in earning a degree in chemical engineering because of having dyslexia. She was told that becoming a cook or a childcare worker would be a better fit for her.

> They said because there was a lot of numbers, and it's true, there was a lot of numbers. English was not my first language, that it would be quite difficult for me. And they were telling me, 'you know, I think you will be really good as a cook, because I think you're really good with the science, and I think you could be a math teacher, because you know Spanish and English, and we always need more teachers like you, child care development and stuff like that.' It didn't 'deraid' me. It made me want to push even farther to show people this is what I was supposed to do. But yea, it didn't really affect me much. I've been lucky, my father, you know my dad, he's really forceful. And because he didn't have any sons, for us it was always "no te dejas de nadie," –you do what you have to do, "no dejas que nadie dice no," –don't let anyone tell you 'no'. And I guess, just hearing him in the background is always "ok dad, I'm not going to let anyone tell me no!" it's really, it was a funny meeting, the others try to tell me something, and my mom was like, 'No, if she wants to do this that's it you know?'

Karlita was also stigmatized by some of her peers. In her formative education, she was put aside by the popular group. She did not like to dress like the popular girls, and she liked to read. She saw herself as different. She recalls that in her postsecondary degree, a male peer in her engineering classes said "you're the good statistic, you're the one that did not end up getting pregnant in high school." In summary, she had to persist against many negative forces pulling her away from her dream. The in-crowd, which happened to be Hispanic in her case, her high school counselor and teacher, the engineer students who stigmatized her, and her own dyslexia.

In middle school, she remembered Mrs. McGird, a science teacher who took notice of her and invited her to be part of a group of girls she was mentoring. This sparked an interest in STEM. In high school, she remembered one teacher who believed in her and invited her to do an

independent study in AP Chemistry. This was a time where she felt like she established herself as an independent learner who tackled college-level chemistry by herself. Thus, when she went on to college to earn her chemical engineering degree, she was very sure of her ability to calculate.

Lynn. Lynn is a beautiful and intelligent woman who grew up surrounded by Southern culture. Lynn's biological father is Colombian, and her mother was White and American. Until the age of six, she grew up with her biological mother in the US, and stayed in contact with her biological father. Although she did not live with him, she knows Spanish. However, after her mother died she lived with her aunt and uncle and was adopted by them.

Lynn's parents were good to her. Though they were not rich, they gave her a good upbringing and supported her the best they could. However, neither of them had graduated from college. Nevertheless, they pushed her to persist in anything she decided to take on. Quitting was never an option.

> I'm a first generation student, so I guess I didn't really have expectations from them to be in the field that I'm in, but, failure was not option. They knew I needed [education] to be successful. They knew I'd need it to be able to do the same things they did with the little bit of education that they had. They knew things were changing. They also knew that they couldn't pay for it. It was get good grades, get your scholarship, get through school. But as far as having a model, I didn't have a model to go after.

During her younger years of school, Lynn felt bullied and alienated. She recalls that her peers at school taunted her, asking her why she was not going to live with her biological father, why her skin was darker, why her nose was different, etc. Nevertheless, she went on to become very motivated in school, joined sports, competed in beauty pageants, and became very

interested in biology and even in becoming a doctor. She went on to do early college classes in high school, received scholarships, and after her salutatorian speech, decided to attend a smaller, private school that she could commute to. In college, she was a very dedicated student, and became very interested in research. She knew the town's police officer on a first-name basis, since he was the one to unlock the doors and lock them back up when she arrived at her lab early and after she stayed late.

Rosita. Rosita's family is from Mexico, but she grew up in different parts of the United States. She is reserved and private in nature, but is very close to her family. She described her mother's support style as sweet, and her father's support style as "tough love." Both, as a team, supported her as she persisted through her degree. For instance, her mother would meet Rosita at work with a packed meal. She also had relatives whom she was close to. For example, in middle and high school, she clung close to her cousins. From an early age, she remembered enjoying being helpful to her family by translating for them whenever they visited they doctor. In her experiences in postsecondary education, she was not close to any of her peers or professors, but her parents were her support team.

Rosita mentions that she worked very hard for her grades in high school and her degree in college. She had several obstacles that came up as she persisted through her Bachelor's degree in Kinesiology. Initially, as an 18 year-old and first-generation college student, she had to figure out how to fill out financial aid forms, loan information, and she felt like she did not have enough guidance during that time. She mentioned during the group interview that she was a first-generation college student, and that attending four different colleges over five years was not ideal for her.

Rosita remembered her experience as a translator and office assistant as her exposure into

the world of medical providers. Hired as an office administrator and translator when needed during her freshman year of college, she began to consider what it might like to be a medical provider for patients. Dr. Moses, one of the doctors in the practice, became her mentor. As she grew confident that the doctors trusted her and trusted her judgment about certain translations, she began to believe that she could offer health services as well.

Back in school, one struggle in Rosita's journey through postsecondary school was that she was a commuter, and she worked after school. She felt like she did not have time to invest in connecting with her peers or faculty. Although her lack of academic and social connections to the people in her degree did not deter her from persisting, she found that when she did have a question, she had to wait longer to receive an answer. Another struggle in school was finances. A lack of money meant that she could not graduate in four years. She persisted through four schools and five years of postsecondary education.

Rosita recalled having mixed feelings about her STEM classroom experience. As she looked around, she did not find neither many females nor many Hispanics. At times, this produced a feeling of accomplishment. At other times, she recalls feeling doubt, asking herself whether she really belonged.

> When I went to my university, I didn't see many Latinos there, so it made me feel accomplished. Like I'm one of a kind, kind of…Some days I would walk in there and I was just like, 'Wow, I earned my place here. This is what I'm working for.' Other days I would go in there and you know, I would question myself, 'Am I in the wrong field?' 'Is this where I need to be? It seems like not a lot of females or Hispanics are doing what I'm doing so, where do I need to be?' But it just depended, but I would get a mix of emotions.

Juliana. Juliana is a young woman whose native language is Spanish because she grew up in Paraguay until the age of 14. Although she did not grow up with her father, she had a loving mother who was a faithful Christian, clung close to her faith, and raised Juliana and her brother in the church. Her mother modeled a great work ethic, resilience, and persistence.

In school in Paraguay, Juliana was taught several subjects by her mother until the 6th grade. The schools were set up like one-room schoolhouses, and her mother was a teacher, thus, her mother was her teacher. Once she migrated to the United States, Juliana became the model student at her school. Only two years after migrating to the United States, she started competing in memorization competitions, her part was biology and medicine. Sometimes, Juliana and her team made it far into the competition against other schools. Juliana loves to do well in school because she saw her mother wake up and muster the energy to teach every single day, while having 2 children of her own.

> [My mother always] modeled sacrifice and perseverance. Because she raised my brother and I in a Third World country, and teachers are not paid well, and she always instilled in us values such as honesty, perseverance, and hard work. I like to work hard and do well in my studies, and in this case, it was biology.

In both Paraguay and in America, Juliana was very dedicated to her studies. She felt limited, however, in the high school she attended because it was a vocational school, and did not offer some of the courses she needed to earn her degree in biology. She enrolled in a medical services track, where she became a certified nurse assistant.

Although she received a full scholarship, Juliana also worked part-time as a certified nurse assistant to help her family. During enrollment into college, she did not feel that her high school counselors and advisors were helpful in transitioning her to college, and it was very

difficult without any background knowledge of the forms, and no counselors to help her.

Juliana is very open about growing up in poverty in a Third World country. In Paraguay, her mother's profession was teaching, and her wages were minimal. She does not recall seeing children sleeping in the street when she lived in Paraguay. However, when she went back to Paraguay on a mission trip in the last two years, she was shocked to find children living in the street. This shock made her realize that she felt called by God to become a pediatrician, and go back to Paraguay or another Third World country where she could help.

Mayra. Mayra's parents were Mexican, but she was born and raised in Texas. Her father died when she was young, and her mother was not part of her life until she became an adult, thus she lived with a grandmother who only spoke Spanish and a younger sister. She did not grow up in wealth. Her father died while he was serving in the military, thus they received a small pension until she graduated from high school. She remembers that when she was in middle and most of high school, her grandmother was supportive of her schooling and even going to a university. However, when she was close to graduating from high school, she found that her family wanted her to stay behind in high school for a fifth year because they wanted to continue receiving the pension. As she looks back, she is happy that neither she nor her sister listened to that advice. Mayra could not stand the thought of having nothing to do except work in something she did not enjoy.

> I had heard it all my life ['do something after you graduate from high school' my grandmother said], but then she said 'are you sure you want to do it? Maybe you should just work.' Yea, but I don't think they understood what that meant, and the intensity of not having really a life. 'Cuz the education and the background, you really have to study and dedicate yourself to it, especially to understand the material. So I found that very

> challenging with my grandmother not speaking English or not being able to help. I don't think my family – my sister kind of understood. But my family knew – they just knew I was going to school.

Thankfully, at that time, Mayra had a peer who had made the same decision she had, which was to go to college. Together they were determined to matriculate and attend a public university. She also married the love of her life shortly after graduating high school, at 18 years of age. Thus, although her family was not supportive of her decision to go to college, her husband was very supportive. He joined the army, and they became a traveling military family. One year after their marriage, they had their first son. Mayra's husband told her that it was important for her to have a degree in something she enjoyed in case anything ever happened to him.

There were two instances where she remembers exposure to technology in high school that were monumental, even though they were not in themselves out of the ordinary. Her first remembrance of technology was being placed in a common business-oriented language (COBOL) coding class. The only reason her counselor suggested that she enroll in this course was because she had a high enough GPA. She stumbled into it, in a way, as she had no prior knowledge or interest in it. Once she learned how it worked, she was highly motivated to work with it and test her code. She thoroughly enjoyed this class and looked forward to it. Her teacher, Mr. McCann, was a kind man who affirmed her interest.

The second instance happened around the same time, when she was 16 years old. She remembers playing Nintendo 64 with a boy whom her grandmother was babysitting. He would bring over the Nintendo set, and they would play. As they played, thoughts flooded her mind, such as "I bet I could make something like this," and "I wonder how this works."

As she spent time with friends and peers, Mayra would think about how much more fun it would be if they were playing video games instead of talking about drinking, smoking, or partying. She simply did not enjoy those things. She even wondered if something was wrong with her, since she did not enjoy the things everyone else around her enjoyed. At this point in high school she had already met the young man whom she would marry. Therefore, she knew that her interests and dislikes were shared by someone else. In fact, her husband went on to also earn a degree in the technology field.

Mayra's biggest challenge in earning her degree was the inability to stay in one place long enough to settle. Moving around made it really difficult to persist. The next challenge was her timeframe to finish school work. She remembers that the only time she could do schoolwork was from 10 p.m. to 3 a.m. Therefore, these factors slowed her progress. Nevertheless, knowing that this accomplishment would be something she would be proud of finishing, she chose to persist through the eight years that it took to complete her Bachelor's degree in Computer Science.

Alba. Alba is a sensational young woman with many gifts and abilities. Her family's country of heritage is Mexico. She was trained in the arts, and had her heart set on becoming a classical ballet dancer until the door closed. Although she was not able to continue her performances, that was not her only gifting. Alba's mother is a scientist, and her father is an artist, and it may be that she received abilities from both.

Alba's family lived in California and then moved to the Northeast United States when she was 11 years old. Upon matriculating to her new middle school, the school staff member realized that she had already completed all of the mathematics courses that were required, and there was no math courses she could take in the middle school building. Therefore, he told the family that

they could either drive her to the high school every day for her math classes, or she could skip a grade. They chose the latter. As she looked back on her reasons for pursuing mathematics, this experience stood out as one that gave her confidence that she would succeed.

During this time Alba also suffered from perfectionism. She recalled having "such high standards" for herself without recognizing that she was very busy "dancing 25 hours a week and… managing all of these courses." She felt like she sacrificed "sleep and wellbeing" without understanding that believing that she needed to be perfect and not meeting her standard impacted her self-esteem.

When she was 16 years old, Alba made the decision to pursue becoming a classical ballet dancer, but ultimately, her family did not support that decision. They wanted her to attend college. She submitted herself to their decision, but did have the opportunity to dance for an entire year after graduating from high school, and before entering college. Thus, once she returned to college, she was, at last, with her same-age peers. This released the pressure which constrained her during her formative years related having such high standards for herself and wanting to be perfect because of being younger than her peers but academically ahead of them. She spoke to her brother about considering earning a mathematics degree and he let her know that it would be very hard, her grades would suffer, and that she would not see the light of day. "Challenge accepted" was her response.

> I started as an economics major, and then environmental studies. Then I switched to econ and math, because I thought I wanted to do an econ PhD, and my brother was like 'you realize math is really hard, it's like, really, really freakin' hard. Your GPA is probably going to suffer and you won't see the sun'…I didn't see many women in my classes – ever. Things like that made me form close bonds with a lot of the women from my

> classes. My parents were like, we support you doing whatever you want, kind of…I definitely sensed that me working hard at school and like, just getting a fairly good GPA no matter what I did is what mattered at the end of the day.

Although it was very difficult to persist for personal reasons, Alba had her family's full support. She also found support from peers and professors. Along the way, she decided to also tackle economics. She graduated with a double major in mathematics and economics.

Jenny. Jenny is a smart young woman from Texas who is proud of her Mexican heritage. She comes from a humble background, as neither of her parents can read or write in English. She has accomplished so much, and all of her accomplishments, and even the help that her accomplishments entailed, were self-initiated.

Jenny enjoyed attending school and had many good teachers. In her predominantly Black and Hispanic school, Jenny was identified for gifted and talented classes from an early age. She was placed on this track throughout all of her formative schooling. She was very involved in school, and she enjoyed joining groups such as the marching band. She took a vocational course called Clinical Rotations in high school, which helped her to experience what it would be like to be in the community health field of a hospital or health center. She experienced what it would be like to work in family medicine or emergency room surgery while shadowing nurses, nurse practitioners, and even physicians. This very exposure inspired Jenny to become a doctor.

Jenny remembered several wonderful teachers that impacted her education positively and helped her enjoy understanding new concepts. She shared wonderful memories of Mr. Roof, her calculus teacher. He made her feel respected, and enabled her and her classmates to laugh and learn at the same time. When she was in high school, she started noticing how drawn she was to her mathematics and science courses and had a hard time deciphering whether she liked those

courses because of her teachers or because of the material itself.

> Every exam that we had, he would always play the 80s music, he always played Maroon 5, it was one of those. So it was just his personality, he was just this crazy funny old man. Well now he's old, before he was young. He is going to retire.

A high GPA and other high achievements made Jenny eligible for scholarships from different universities. She chose to visit one university far from her home, and had to take a flight to go on campus. That experience was her first time flying. She decided to attend that prestigious, Ivy League university. She knew she liked science and narrowed down her choice of degree to either chemistry or biology. As she considered her long-term goal of becoming a doctor, she decided that although she enjoyed chemistry, biology would be more practical. During college she formed many friendships and even started a chapter of a college group that united women in STEM fields.

Group Portraits

As a group, the Latinas were very family-oriented. Six were raised in intact homes, with their biological parents. Four of them had different dynamics. For instance, Juliana was raised by a single mother, Mayra was raised by her grandmother, Ada's parents were divorced, Lynn was raised by her aunt and uncle. The Latinas' struggles ranged from certain obstacles that were unique to some to more broadly experienced phenomena. For instance, there were some participants who struggled with eating disorders, psychiatric diagnoses, poverty, depression, insecurities, loneliness, stigmas, and impostor syndrome.

The Latinas came from very different socioeconomic backgrounds. There were a couple of participants who were higher on the socioeconomic scale, and considered themselves privileged. There were others who considered themselves disadvantaged. Some Latinas

considered themselves to have higher than average intellectual abilities, whereas others considered themselves average. No Latina considered herself unintelligent.

The parents set the standard for how the Latinas were raised as far as their cultural identity. Some Latinas spoke Spanish at home, and their parents did not speak English. Some parents were educated in their country of heritage and continued their education in the United States. Those who continued their education in the United States, benefitted economically from it. Other parents were educated in their country of heritage, migrated to the United States, and immediately worked. Additionally, there were other parents who were not educated in their country of heritage, migrated, and joined the labor force.

Regardless of their circumstance, the Latinas received emotional support at home and relied on their teachers, peers, mentors, and counselors to open doors for them that their parents may not have been able to. If they came from disadvantaged backgrounds and sought help, the advisors and teachers of these Latinas played pivotal roles to their success. They suggested which scholarships to apply for, encouraged them to take harder classes, reviewed their papers, waived application and other fees, and helped them navigate the pathways to college. However, not every participant sought help.

Results

The semi-structured interview questions were aptly tailored to develop understanding of the experiences of Latinas who persisted through the completion of a bachelor's degree in STEM. There were times where the interview became a natural dialogue, and I talked with participants about different things that might interest them. It was in those side conversations that I received a more holistic understanding of who they were and their experiences in earning their STEM degree. The focus groups were intriguing, in that they provided an outlet for Latinas to

reflect upon their experiences and critique the systems that impacted them. Lastly, the letters of advice were the Latinas' heartfelt advice to younger Latinas about working hard and staying focused.

Theme Development

Finding willing participants and transcribing the conversations were no easy tasks. These tasks entailed time and intentionality. At last, once the data gathering process was finished, the words from the interviews, focus groups, and letters of advice were uploaded to Nvivo 12, I was able to begin the collective thematic analysis. Uncovering "structures of meaning, or themes" (Van Manen, 1997, p. 78) was a task that required careful thought and exploration. I searched for elements in the text that occurred frequently as evidenced throughout the text, as well as constantly considering the essence of Latinas' experience persisting through a STEM degree.

Steps. Discerning the pedagogy of themes involved pondering my participants' experiences as a person who can teach biology, and as a Latina. Discerning whether certain aspects of their experiences were particular or universal entailed careful reflection upon the deeper meaning of their statements. For example, at times I would ask a certain question and the answer I received was not the answer to the question, but the participant was revealing something deeper. Once I reflected on their experiences, I was able to find the collective themes that reoccurred in each participant's lived experiences.

Writing themes in their appropriate context was vital. Considering the fact that themes must be kept in context, I listened to the texts, transcribed them, and highlighted them in Nvivo. I created general themes and highlighted phrases that fit under those themes. When new notions arose, I simplified the general structure, and created a new theme. Lastly, once I felt sure about the subthemes that arose, and those subthemes were evidenced throughout the texts, I used free

imaginative variation to determine the essential, universal themes. I pondered each of the subthemes that surfaced and asked myself whether Latinas' experience in STEM the same without this subtheme. Lastly, I conducted member checking with 2 of my participants. The following table contains a summary of themes and subthemes.

Table 2

Analysis table

Subthemes	Amount of times subtheme appeared	Percentage of participants subtheme pertained to	Themes
Family supported education	39	100%	Supportive Relationships
Teachers or mentors who made an impact	25	100%	
Peers who made an impact	45	90%	
Intrinsic Motivation	30	100%	Personal Interest
Exposure prior to college	19	100%	
Goal setting	10	100%	
STEM identity was developed before graduating from	13	70%	

college			Self-perception
High academic identity in high school	11	60%	
Cultural identity	22	100%	
	14	80%	Disadvantage

Table 2. Themes and subthemes

After much deliberation as to how to analyze and organize the participants' words, I came up with four main subthemes: supportive relationships, personal interest, self-perception, and disadvantage. Under supportive relationships, I identified that the Latinas had family who supported and protected their intrinsic motivation in academics, that they had teachers or mentors that made an impact in their lives, and they believed that peers had made an impact in their persistence. Under personal interest, I extracted three subthemes: intrinsic motivation, exposure prior to college, and goal setting. Lastly, the self-perception theme yielded three subthemes: STEM identity was developed before graduating from college, high academic identity in high school, and cultural identity.

Supportive relationships. Participants were very clear about the people who affected them the most during the formative years before starting their postsecondary studies. From their narratives, I identified that family, teachers or mentors, and peers had an impact in their persistence. The Latinas had systems of support in the institution and outside of it. These types of supportive relationships were essential to their persistence in STEM.

The Latinas believed that their families encouraged academic persistence. In congruence with this idea, Jenny wrote to her younger Latina advice about how to persist through a STEM

degree. She counseled her to seek help and reach out to mentors, friends, and family. She also advised her to surround herself with a supportive community of friends.

> As you pursue a major and career in STEM, always believe in yourself and ask for help from mentors, friends, and family for support… At the same time, my family has always provided unconditional emotional support that has pushed me through the most challenging situations. Having the willingness to reach out to mentors and peers for help has been crucial to my success. I have also surrounded myself with a supportive community of friends that always motivate me to overcome personal and academic hurdles.

Similarly, Mayra reiterated the importance of a support system in her letter of advice to a 14 year-old Latina.

> Women are still underrepresented in the field. Latina women specifically could easily be intimidated when not encouraged to pursue a traditional expected role or when pursuing an academic study that is unfamiliar to family. Even more so, a support system was the understanding of my husband and children and the flexibility of my professors.

The Latinas' family mainly consisted first of the people who brought them up, in addition to the extended family, as well as some close friends. For example, Mayra considered the grandmother who raised her, her mother. Further, Lynn considered the aunt and uncle who raised her, her mother and father. On each account, the Latinas recalled feeling provided for and encouraged by their family during the time that they were living at home with them. Thus, each family encouraged natural exploration and intrinsic motivation among their Latina daughters. For example, when Karlita told her parents that she wanted to be a chemical engineer, they did not inherently understand. Further, she did not know how to explain it to them in Spanish, their

home language. Therefore, she looked for the definition in a book.

> They didn't know what that was. To be completely honest they were like '*¿Que*?' And I actually had to find a book describing what I wanted to do. They were like, 'are you sure?' And I was like 'Yea, this exactly what I want to do!' They were like, that's-you-not-me type of situation.

Similarly, Dalia experienced strong family support when it came to continuing her education. She recalls that her parents continued their education in Guatemala before migrating to the United States.

> So my family has always considered that for us, my sister and I, we had to go to college. So, for them it wasn't a choice of whether you wanted to or not, it was very much like, they had the opportunity to study. My mom was a teacher in Guatemala, and my dad went to college as an accountant. So for them it was something like, 'we persisted in our education, but we weren't able to do that here, so we want you all to have that opportunity to persist.' Also, my sister and I loved reading. We were very much into books, very much into learning. So it made sense for us to want to continue that. So for them it wasn't so much as pushing us towards a goal as helping us along in something they already knew we wanted to do.

Juliana was educated in one-room school houses until she was in sixth grade, with her mother as her teacher. Unfortunately, teachers earned minimum wages in the Third World country of Paraguay. Further, although her mother was a single mother providing for two children, she put forth a lot of effort into teaching. Juliana saw how hardworking her mother was and felt very encouraged to pursue a career that excited her.

> From childhood I told her that I wanted to follow medicine, and she said – she is a teacher and she wanted me to pursue the same profession. She did not tell me 'My daughter, you need to follow the same profession as me' but she would give me little steps for me to follow her profession, but I did not want to. I don't have the patience. [Upon telling her that I wanted to pursue medicine], she supported me, supported me a lot. She supported me in my studies. In no way did she tell me to change my career or anything like that – it was mostly support.

Rosita was encouraged to work very hard for her grades. She experienced different approaches from each parent. She qualified in more detail the type of support she experienced from each parent.

> My mom would say '*mi'ja, héchale ganas.*' Or when I got home and it was maybe a bad test grade, she would say "*hay más, lo puedes reemplazar después."* She would just try to find the words that she could in order to make me feel better… My dad… would be like 'well, what did everybody else get? Why are you getting a 50 when everyone else is getting 100?' You know, you need to work harder. 'What did you not do yesterday that made you get this grade?' So he was that tough love that pushed me a little harder. It hurt at first, but at the end of the line it's his words to help me.

Latinas ultimately perceived that they were supported in their motivation to persist through their formative schooling by their family. However, the support they experienced during their postsecondary education varied depending on their situation.

To explain what type of support and encouragement the Latinas received from their Hispanic families during their educational career, the type of support they *did not* receive must be mentioned. Latinas received tangible support and emotional support from their families.

Moreover, most of the Latinas did not receive help with their school work from their parents. In the following quote, Karlita explained how her mother encouraged her through a difficult project.

> So, a lot of the kids who were engineers, they already had parents who were professionals. So, whenever they had a question, they could always go to their parents in certain places and ask them. I didn't have that. Certain classes, they were difficult, I remember some people were like 'My dad told me this, my mom told me this, my uncle told me this.' I would say, 'Well my book told me this.' I guess it was during that time I realized that it would have been great if I had someone to talk to about certain things so I wouldn't feel alone. 'Cuz, I would try to call my mom and tell her things, but she didn't understand. I remember my freshman year I called her crying because we were doing welding, and we had to make a canyon, a little canyon with aluminum, I was getting frustrated because I was never taught how to use a tool and stuff like that, and I remember calling her crying. And she didn't know what to say, she said, 'mi'ja, I'm sorry, I don't know what to say, just try harder.' I guess what I wanted was someone to say, 'No just do it like this, think about it this way.' So, I guess it was that, I wish I had someone who was older, who I could speak to and voice my concerns and they would be able to say 'Oh no, everyone is going through that.' 'Cuz talking to my fellow engineers, it was one thing, but I wish I had someone a little older, you know, wiser, that I was able to talk to.

In contrast, the support Latinas experienced through their postsecondary education from their families depended on many factors. Five Latinas lived on campus, while the other five commuted to their university. Two Latinas chose to attend community colleges before

graduating from their state school (see Table 1 for details). Mayra was married within a year after her high school graduation, and had her first son at 19 years of age. Lastly, 2 of the participants considered themselves privileged, while eight felt like they came from somewhat disadvantaged backgrounds.

The Latinas felt pressured at times to do more than they felt they could during their STEM bachelor's degree. Elizabeth felt like a "triple standard that you're going to get educated, but you're going to have a family, and kids, and you're going to take care of your family" was imposed on Latinas. Some of the Latinas who lived at home and commuted to their university had trouble feeling like they could escape their family's expectations, as Elizabeth commented during her focus group.

> And [my mother] does bring it up, and she does run me through my guilt trip of, 'You haven't' called me, and I was going to call you but she probably doesn't want to talk to me.' And I'm like 'Mom you know I'm busy, I have this assignment, you know.' But she knows. But there is this cultural expectation that nonetheless you have to run through that guilt trip. And … I get it, but at the same time for the Latina, it's …an unreachable standard, it's an everything standard, that you're going to meet all this in time. You're getting your medical degree, their parents are going to be like, '*¿Bueno, y la familia*?'

Although Jenny and Elizabeth never met, Jenny expressed during her focus group that she experienced these same expectations.

The Latinas who commuted to college experienced more parental support through their postsecondary education than the ones who lived on campus. For instance, Rosita remembers her mother's support during the busy years of going to school and working.

> [My parents] were my network of support for my whole college career. So, after school I would go to work, and you know, do the late shift. So I would get off at night. So my mom would always make sure I had lunch, so she would always bring my lunch to work. Or dinner.

Similarly, when Ada came back to live at home and commute to her university during her last 2 years of college, she experienced the same type of encouragement. Not the academic type, but other tangible types of support.

> Something as silly as, I was staying late one day coding for a class, for a website to promote an app for one of my classes, and I just couldn't figure out this one thing. And I was frustrated, and I stayed up until three in the morning, and just to come home and my mom was like 'oh, I made you food.' Because I didn't eat all day. So it was not the literal support it was more like emotional life support.

In speaking of familial support, Mayra's situation was unique. She grew up with her grandmother and her sister, and frequently visited her father's side of the family in Mexico. Her grandmother was supportive through her formative years and even expressed an expectation that she needed to do something once she graduated high school. Thus, as she was finishing high school and figured out her next steps, she was somewhat surprised to find that her family wasn't very supportive after all. Questions casting doubt on her decision to enroll in college entered her home. Although Mayra struggled because her grandmother could not help her with school work during her formative schooling, her she still encouraged Mayra to attend a university. Exactly at the time that her grandmother's encouragement to pursue postsecondary education ended, Mayra found a friend and together they helped each other enroll in their choice university.

> I just wanted to quickly finish [high school] as soon as possible. Yea, I didn't have encouragement. And when I wanted to go to school … my family kept asking 'how are you going to get there? How are you going to get there?' And I said, 'I'll just take the bus.' It wasn't very encouraging. I had no support, they didn't drive me. What school I wanted to go to, how I would pay for it, I had to do it all on my own, get on the bus or driving over there, going with a friend, and just looking into it. My friend and I enrolled together and we just supported each other and we just give ourselves kudos. We said, we can do this, we can totally do this!

At last, during that first year of college, Mayra got married. Her husband, who became her new family, was very supportive of her pursuing a degree in whatever she liked, and finishing. As her family grew, she mentioned in her letter of advice that her children also became a support to her. Thus, it was relationships all along, which encouraged Mayra's enrollment and persistence in her college career at such a critical time.

Teachers or mentors who made an impact. Teachers and advisors opened the doors of opportunity for many Latinas. Both Ada and Karlita had a teacher invite them to do an independent study. This means that each lady was the only one in their entire school taking a certain course at a certain time. Both felt that their particular teacher was invested. Rosita did not recall a teacher who was memorable, but she remembers always translating for her mother when they were at the doctor's office. Then, when she went on to work at a doctor's office, she felt like she gained a mentor, Dr. Moses. The doctors whom she translated for allowed her to have the perspective of a medical provider. This formative experience changed her outlook on her career and her interests.

Similarly for Jenny, she enjoyed school very much, and saw her school as an enjoyable

place.

> [The teachers] were super engaging. You just really liked them. It was hard for you to even tell whether you liked the material or whether you just liked them so much… there were times, like for example Mr. Roof, he was there five days a week in the evening, and sometimes we would just go in there, it was to do homework, but sometimes it was just to laugh and de-stress for a while.

When asked what type of role Mr. Roof played in her life, Jenny did not perceive him as a mentor, but as someone who was invested in his students and provided her with opportunities.

> I'd say he more opened a door for me. But definitely, I would say he teaches you to…treat students with [the] respect and dignity that everyone deserves, and I think it's something that just speaks to people, that you should just be respectful of others and to… just be nice, be open, be willing to hear someone else's story before you kinda' make rash decisions about people.

Additionally, Elizabeth had a teacher who put her in charge of delegating jobs when they were doing community health events. She loved feeling like a responsible leader among her peers.

> I had 2 professors at [my university] that I became very close with. … [One was Dr. Kace], I had been close with her because of all the school events, and I worked with her on a lot of those. She just relied on me and knew that I would get things done. She would count on me a lot of times, she would let me take the lead… she would say 'Just go ask Elizabeth what you need to do.' And I would say 'Go do this.'

Mayra had a high school teacher for two years who taught her COBOL, the computer programming language in a class with other students.

> I would always talk to my teacher about the Nintendo. And he actually sparked that idea too. You know, there is this movie, Tron, they base the game out of that... He showed it to us in class. But I was just so amazed, 'Wow, this is great! This will be so fun!' We were so intrigued. All of us. So that movie and what he said, probably subconsciously stuck to me. [Also] playing those games just made me realize, that was probably something I would like to pursue.

Although many Latinas in some superior roles may choose to encourage younger Latinas in their endeavors, there are those who may discourage them. For example, during a focus group, Jenny described a situation in which she felt unsupported and discouraged from her dream to become a doctor by an older Latina who was a physician. Jenny explained,

> I could tell you that the Latinas that I've met that are physicians in particularly, they're 50 [years old], they always gave me that impression by what they say and the way they carry out their own life, they tell me I wouldn't be able to do both [have a family and a career]. I remember in an interview, I met this physician, she's Latina and you know, I walked into this thinking, 'This is my person! We're culturally related. I'll be able to relate to her more.' But I just felt so unsupported by that person. She just didn't give me a good feeling. I know it was a hard decision to say 'I'm not having a partner, not having a child' and for me, it gave me that feeling that that's what you have to do also in order to be successful. And if I didn't do that, things weren't going to work out. I'd have to be at work all the time, that you couldn't have this work-life balance.

Lastly, Alba remembers experiencing a crisis during her senior year, and needing medical intervention. This was also during the time that she was writing her thesis. She felt really supported by her mentor through it, the person who was guiding her cutting edge research.

> So I wrote a report on Network Theory ... [It was] something that was really interesting that he was supportive, and at the time I was going through [a personal struggle]. Later he was like, 'I'm so sorry about that!' It's just interesting that [though] it was bad, he was just a really supportive. He really opened my eyes in terms of the way we can push the frontier in terms of math and math research and apply it to other disciplines. Like he's so interdisciplinary always collaborating with other professors in political science, and econ, and everything you could think of, and in neuroscience. And I think that what I appreciated is how multidisciplinary he was. I think I pride myself in being a multidisciplinary person, and being around someone like that was like, awesome. He was also so communicative and [an] amazing teacher. It's so rare to have someone who is an amazing researcher and also incredibly compassionate as a teacher and a mentor, all of those things.

In conclusion, faculty and mentor support and encouragement was pivotal for Latinas' persistence in their STEM bachelor's degree. The faculty and mentors who supported Latinas introduced them to their STEM degree and opened the door to more opportunities in ways that their family could not. Relationships developed with these mentors and faculty became conduits of interest and learning, increased academic identity, and increased motivation.

Peers who made an impact. The Latinas' relationships with their peers varied in impact and intensity. Some peers opened doors for their Latina friends, and others worked to exclude them from social circles. Nevertheless, the peer relations that Latinas formed, or were excluded from, often proved to be providentially beneficial.

Some peers positively encouraged Latina achievement. Ada mentions how one of her peers from her early years in college was honest with her about how he entered the technology market.

> He kinda got into my head and was like, 'Can I be honest with you? These kids that I work with paid hundreds and thousands of dollars for their degree, and I paid all of my internet subscription, and I make as much as they do, if not more'… It's true, if you think about all of the coders and all of the IT people, before it was a thing to get this degree, a lot of people were just playing around.

Mayra spoke of growing up socioeconomically disadvantaged, with her grandmother who could not read or write in English. She recalled that her peers were not school oriented. However, she liked school, and on her own, she separated herself from them. In fact, it was through overhearing students in her COBOL class talk about where they were going to college that she realized she wanted to go to college. Although they were not talking to her directly, she was inspired by their conversation. In this sense, being in a class with students who did well in school and were college-bound benefitted her greatly.

> There was several of us in that class, and I would say that a lot of them in that class had an advantage. They came from families where they had both of their parents, they had cars, [and] they had more of an advantage point. But I overheard them say, 'Yea, we're going to enroll at UXC. They have this great program.' And that is how I found out that I wanted to pursue school.

Elizabeth mentions that she was blessed to experience a deep, life-long friendship with five other girls. They were a diverse group, and each one became a first-generation college student. Elizabeth had an experience in elementary school that caused her to be rejected by the

majority of Latinos in her school through elementary and middle school. Thus, her friendship with her core group was academically and socially life-saving. She mentions, "I have a strong network of close friends…we also had the same mindset [to graduate from college]. I think, I couldn't be the one to not meet that expectation either."

Jenny had great experiences persisting from elementary through high school. From early in her academic experience she was enrolled in gifted and talented classes. Thus, since elementary school, her community of friends was academically high-achieving. However, this was not the majority of the school.

> Essentially within the school, the top 10% to the top 100 students were "high achieving" so they were taking the AP courses together, all the dual-credit courses together, which means in a community college credit, and receiving college credits, so you're all in these classes together, so you bond over that and outside you're likely to meet other students, and you take electives, you are in the organization, you're mostly with that group of students all your four years… I know those started for me since I was in elementary school. And the advanced courses continued all the way throughout, all the way to high school.

Juliana recalled classmates who impacted her along the way. From her youth, she had decided to become a doctor. She followed that pursuit even here when she migrated to the United States as a teenager. As a first-generation college student in the United States with a single parent, she did not always know the pathways to college. Although she recalled that a lot of students graduated in five years, she was determined not to. She felt confident that she could graduate from college in four years. Her method was to compare herself to her peers and that's how she figured out how to stay on track.

> I was so confident that I would graduate because I would compare myself with other students in the school, and I would say 'if they enroll in this class -because usually one follows the steps of the other with the career that one follows-' and I said to myself 'if they graduate in four years, I can also graduate in four years.'

Finally, Alba also indicated receiving a certain degree of affirmation in mathematics from people as she went through school. Therefore, as she decided upon a major, their affirmation came to mind.

> I was interested in [a lot of different subjects, like] philosophy, and things like that and I felt like if I had studied philosophy my parents would have been equally supportive of me, as long as I was good at it. I think it was for me stuff felt like …while I had gotten outside affirmation, in the grand scheme of things there was some affirmation that I got from the outside world that I was not horrible at it [math].

Not every Latina who participated in this study received affirmation from her peers. Some Latinas struggled through many years of isolation, ostracism, or even bullying. For instance, Dalia spoke of a time in middle school where her peers rejected her early decision to pursue science as a Latina.

> I went to a middle school where I got bullied quite a bit for being both Latina and wanting to go into science. It was kind of a strange concept with the people I was around, those people just wanted to be teachers or be an astronaut. Most of my male friends wanted to go into science, but none of my female friends did. So, I was kind of like, the odd ball out. [For instance,] I had girls who would write letters to me and send them to me and tell me how I would never make it and different things like that… I had to actually go to the principals' office. I had one girl who told me that if I did not conform

> to the ways of the popular girls were and kind of left that whole science thing – I never understood why it was the science portion of it.

While mentioning her negative experiences of being rejected in elementary and middle school by the popular social crowd, Elizabeth recalled that academically, there were low-achieving groups, and high achieving groups. Thankfully, she was rejected by the low-achieving social group.

> There were different groups of people, I think the route I ended up having was because of my start in middle school, because I ended up having to hang out with a whole different crowd, um, and that group of kids was in the AP math class, or the AP lit class, and those were just the people I hung out with because the other group wasn't talking to me… I ended up with the kids in all these advanced placement classes, and I just clung on for dear life.

In a focus group, Lynn and Jenny mentioned that through their experiences persisting, they met a lot of Hispanics who physically looked like them. However, it was the people who knew them at the core regardless of race who really were the ones whose words of encouragement weighed the heaviest. For Lynn, listening to her and offering their emotional support was what was important. In response to Lynn, Jenny agreed and mentioned that in her opinion, it's not about ethnicity or race, but rather, it's about having developed good friendships through the years.

> My core group of high school friends [made up of three Chicanas and one German girl], definitely we continue supporting each other to this day… they've always been there, even throughout college…I think it was that emotional support that was really useful, at least from my experiences. They were people who could relate to me … [Even when I

went away to college,] I met [Hispanics] who were very similar to me academically….

But for me I always felt the most… [comradery with] people who were from home.

Through this quote, Jenny revealed that her long-lasting friendship with her core groups of school-oriented friends – 3 of whom were Chicanas, and one was German – was important in providing emotional support through college. However, their high academic identity as a group of close friends encouraged her persistence. This was also the case for Karlita and Elizabeth.

In conclusion, the theme, supportive relationships, was a key theme among Latinas. Latinas needed their family, in addition to others to enhance their persistence in STEM. The Latinas needed their family support and encouragement. However, they also needed others to open doors and allow them to see what STEM fields were like. Latinas' mentors, professors, teachers, and advisors were often pivotal in the Latinas' realization that the STEM field that they were interested in could become a career pursuit. Lastly, some Latinas benefitted from being friends with high achieving peers, and in addition, others benefited from being friends with peers who were involved in a STEM field.

Personal interest. Personal interest is the second theme extracted from the voices of the Latinas, and intrinsic motivation, exposure to STEM prior to college, and goal-setting were subthemes that were identified under this theme. One of the Latinas' greatest asset to their persistence in their STEM degree may be their natural curiosity and desire to explore their choice subject. Each one of these Latinas was motivated by their own drive to understand their zone of interest.

Intrinsic motivation. Many of the Latinas had an experience where they listened to or saw something very interesting and decided that it was something worth exploring. Rosita mentioned that anatomy was a very engaging topic to her.

> In high school I was just interested in biology class and we did have anatomy and we would dissect, but that was very interesting to me.

Lynn indicated in her interview that she loved biology. From youth, she thought she wanted to become a doctor. As she persisted through school, she decided not to pursue that dream. Life worked out in a way that she became a professor. Nevertheless, learning biology in itself was what she wanted.

> It was my stuff, my language at heart, my brain worked that way. If I didn't get the grade, it was because I didn't do all of the homework, I got lazy. But, as far as understanding, I knew. And I knew I wanted the rest of my life to involve those things. It was knowing what capacity, but I knew that's what I wanted to be with.

For Juliana, Dalia, and Jenny, becoming a doctor motivated them to pursue biology. They viewed their degree in biology as a stepping stone to becoming a doctor. It is a difficult degree to persist through, but their motivation to achieve their long-term goal was key in their persistence. In addition, Juliana saw her mother's perseverance each day, and decided she would also pursue a career that she loved.

> [The thing that motivated me to stay focused on the sciences was] my passion for wanting to pursue medicine, because medicine is mainly biology, physics, and chemistry. And that was an area that with my single mother, I saw the effort that she made for us and then that instilled in me a desire to push forward with a career that excited me. And that implies biology.

Jenny was very motivated to graduate from college because she enjoyed the journey. However, when she entered her university, she was undecided about which major to pursue: biology or chemistry. She equally enjoyed both but also she knew that if she pursued her goal of

becoming a doctor, she would benefit more from a degree in biology.

> [The thing that motivated me to finish was that] I enjoyed everything. I liked learning everything that I was learning. I knew long-term if I wanted to apply to med school I needed to get my bachelor's [in biology], so that's a big long-term motivation.

Exposure prior to college. The next subtheme under personal interest was exposure prior to college. For Latinas from disadvantaged backgrounds, adequate resources to STEM exposure is limited. Thus, the exposure that these Latinas did have were quintessential to knowing what was available to them. The other Latinas who did not come from disadvantaged backgrounds still mentioned a point in their lives where they realized how much they liked and excelled in their subject. Ada mentions how she interested she was, from a young age, in technology.

> So, once we moved [to the United States], the one thing I really loved about my public school… is that my school gave us computer classes. It was really silly, actually, typing classes. And I thought typing classes were so interesting – the fact that you could type things to produce things, and a lot of coding is typing without looking at your hands. So that made me more interested in computers, and in college I took IT business classes.

In contrast to Ada, Alba's STEM degree in college was not her main interest throughout most of her life. Thus, when she entered college, she had a plethora of paths to choose from, and she was undecided about what to pursue. Fortunately, as she approached her sophomore year, she remembered one experience gave her confidence that mathematics may be a good path to follow. She remembers being around 11 years old when her family moved from the east coast to the west coast. As she was enrolled into a new school and her transcripts were reviewed, it was found that the middle school did not have the next mathematics class that she needed. This caused her to skip a grade.

> I definite never saw myself doing what I'm doing now. It's never really crossed my mind once, but something that was really interesting [happened when I went]… into seventh grade and I realized that when I was in my math class I had done all of the math … and I had also done all of the history. So then we talked to the school principal, and he said, 'Well, your parents can start driving you to the high school for your math classes or in your history classes, or you can skip a grade, because you're new anyway and no one is going to notice.' So that's what ended up happening.

Jenny's exposure to the life of medical providers happened when she was in high school. As she moved forward in her gifted and talented track, she took a vocational course called Clinical Rotations, where she was exposed to different services in the health field, ranging from family practice to the emergency room.

> So the program that got me interested in medicine was [the] Clinical Rotations program. And the school has lots of technical stuff, so I did a clinical rotations program where you're partnered with the community. We essentially rotate a class in different areas in the health community hospital or health center. So you get to see a little bit of family medicine, you see a little bit of emergency room surgery, and it gets students exposed to medicine… That's where [my desire to become a doctor] all started.

Surprisingly, Juliana's first remembrance of ever wanting to become a doctor was when she was exposed to a farm. This came about because her mother was hired to teach in different areas, and they would have to move. One of the places where her mother accepted work was in a school that had a farm in it. Being around the animals made Juliana think she wanted to become a veterinarian. However, through a different need that she came to know, she later decided she wanted to help children heal. Thus, she aspired to become a pediatrician.

> From childhood I wanted to become a veterinarian. My mother was a teacher, so each time she got a job, we had to move. At one point she had to teach at a school that had a farm. I really liked the animals and that made me think I wanted to become a veterinarian. And then, I liked children, so I decided to change to become a pediatrician, so I changed.

When Karlita came to her exposure experience, she was a little older than Juliana, but nevertheless experienced the exposure event before college. When Karlita was in 7th grade, she was invited by her science teacher to join a club. This teacher, Mrs. McRay, was African American, and she hosted a club where she mentored several other African American young ladies. Although Karlita was not African American, they gladly welcomed her. In a field trip that they embarked on, Karlita watched a presentation that a young African American woman gave, and she became interested in the engineering sciences.

> We went to this seminar [that highlighted African Americans in the sciences]. And during that, they were doing presentations of engineers, and things like that. And I was interested in this one, she made ice cream from liquid nitrogen. 'Wow!' [was my reaction]. It was one of those things that propelled me to see what exactly engineering was.

During our time in the second focus group, Jenny mentioned something truly insightful. The comment was her self-reflection on why Latinos do not aspire for more achievements in life. This may be the reality of the importance of exposure and role models.

> I think most students who are Latinos in general may not have family members who are college-educated, and because of that, you don't have mentors surrounding you, you have your teachers who are guiding you. You will never have known at this moment "what

> does it mean to be a… physician, or [to be in] higher education?" Because you're not used to seeing people like that around you, but also in your own community. For example, my parents work in construction, work in housekeeping. So you never really think of aspiring. Lots of students don't think of aspiring for something that big. Because there is not people around them who have those kinds of degrees and careers.

Goal setting. The Latinas created their goals either in high school or in college either for a career or for a STEM degree and pursued them. Although not every Latina had a long-term goal prior to starting her college career, the ones who did have a goal in mind made their degree choice based on their commitment to that goal. For instance, in the cases of Juliana, Jenny, and Dalia, becoming a doctor was the driving force behind attaining a bachelor's degree in biology. Dalia and Juliana declared their biology major early on, but Jenny was undecided between chemistry and biology. She chose biology because of her long-term goal of becoming a doctor. Each one of these women also enjoyed the material and challenge. Similarly, Rosita hoped to become a physician assistant, and decided that earning her degree was a good way to pursue that dream.

However, for some Latinas, the goal was the degree. For instance, Mayra's goal was to graduate. She loved technology and her goal was to finish. She knew what she wanted to declare when she started college, she never changed her mind. However, many obstacles came in her direction as she pursued her degree. She remembers that moving her entire family and belongings and resettling every few years was chief among them.

> I knew for sure no matter if it took 20 years that I would graduate. I was not going to give up. It was something that deep down inside I wanted. The grit of wanting something pushed me to do it. I was not going to give up. I had so many obstacles against me. The

> environment, the moving. But deep down inside it's something I wanted to do, and I wanted to finish. It was inside me somehow. I had to. It was a decision I had made a long time ago and I had to pursue it.

Self-perception. Each participant was willing to work hard for her degree. Most of them had seen hard work modeled in their families and communities throughout their lives. Possessing this important quality enabled many participants to push through disadvantage, limited resources, and limited homework help at home. Thus, understanding what it means to be hardworking and translating that to their education helped many Latinas succeed. Further, when asked questions about race in their field, many Latinas expressed that they were mostly alone in their identity as Latinas but not as women. Many of them felt that they connected better with other women, and the ones who were older also connected with older students.

Alba considers herself privileged. Both of her parents have graduate degrees, thus she is not the first to work hard in pursuing academics. Nevertheless, when asked about how it felt to be a Latina in college taking mathematics courses, Alba mentioned that she felt "really lonely,"

> I definitely got super well along with Latinas that had were international students from all over Latin America... I don't know why, it was just like their authenticity and the way they understood me, things that I really identified with, and I, throughout college [and] actually still today find it not as easy to connect with blue-blooded Americans. I once had to talk to my parents about this, 'Why can't I?' First generation people, no matter where they are from they are usually the easiest for me to get along with. Or immigrants.

Juliana mentioned a similar feeling when she was persisting in her STEM degree. She spoke with a heavy Spanish accent when speaking English, because she lived in Paraguay most of her life. Thus, without having anyone like her in her laboratory, she came across some

insecurities.

> In the laboratory, there were no Latino people, I believe I was the only Latina. And then I believe that I didn't really feel like part of the group... I know that the accent has nothing to do with it, but even then with the accent, it was more noticeable. Like I'm not part of a specific group. So, I don't know, a little like I didn't belong to the group.

Similarly, Karlita recalls the same feeling after leaving her predominantly-minority inner city high school. She visited several college campuses and made her decision based on her perceptions. She visited a certain university and was partnered with a Latina, and said that everywhere she went there were Hispanics, "and they were smart, they were so inviting." During the time that she was visiting, she perceived a warm campus climate.

> I [visited the university I attended], and I think they did this on purpose. The person who was with me was a Latina, and every person that I saw on campus were Latinos… and I actually felt like a community, there was no White people. I did not see any White people when I was there those 2-3 days [visiting. But then when I visited other campuses, I did not see any] minorities … I just felt, I was so alone, like, I didn't like it.

However, when her family dropped her off the following fall semester, they found that her initial perception of the campus the previous spring was not the reality the following fall.

> Researcher: And was it like that when you went, full of minorities?
>
> Karlita: NO! Absolutely not. I was so lied to! I walk into campus, and I was like, where's all the Latinos? My mom was like, '*oye voz, eres la única Latina.'* (Hey, you're the only Latina) I was like, 'no dude, I know they're here.' They lied to me!

A lot of the times, the Latinas found themselves in male-dominated programs among the faculty and the students in their courses. This was not the experience of the Latinas who

persisted in a degree in biology, however, it was the case for the Latinas who persisted in computer science, engineering, and mathematics. The Latinas in male-dominated programs recall bonding with one other woman in the program. They recall how helpful this woman was in their success in the program.

For instance, in a sea of male students, Karlita found one Caucasian girl that she bonded with, Tracy. Tracy became her friend throughout the program at her university, until her internship during her junior year.

> I've been very lucky, I have to say, God has been very good to me. 'Cuz, in all my life I've always found one or two people that I got along really well because of them, I was able to go out and meet other people. Or be in the right group… [For example,] Tracy, and she – and she was loud. You could hear her from a mile away. And it was because of her personality, and because we were always together, people were like 'Oh, it's Tracy and Karlita.'

Along the way, Karlita found that when she worked with some male students, that they did not perceive her as a credible source.

> Researcher: How did being a Latina in a STEM program make you feel? How did people respond to you?
>
> Karlita: So most people didn't believe me (They didn't believe that she was good at engineering). [There is a certain class, it]'s called p-chem. It's a disgusting course. It's disgusting. They try to teach you math and science and technology all in one. It doesn't make sense, but I was pretty good at it. I remember this one guy, he was White, he was really smart… But this one problem [I told him] 'you're doing it wrong cause of this.' And he did not believe me. And it wasn't until one of my friends intervened, her name

> was Tracy, the one who I said was my study buddy…And she's like, 'No, she knows what she's doing, just pay attention.' And then he's like, 'Oh, you are [right].' And then, I think after that people started taking me a little more seriously.

Finding that one other woman persisting in a male-dominated environment was significant for Alba as well. She remembers that she met her best friend in a class and, like Karlita, they started studying together. For Alba, being a woman and having another woman to relate to was significant during her senior year and after college.

> Researcher: What about, I haven't heard you talk about any of your classmates in math.
>
> Alba: I feel like I didn't really have that many, except for – I actually met my best friend in my Differential Equations course. My sophomore year of college. She was one of three other women in this course in this class of 35 people… in that class we sat next to each other, we did all our work together. I think it was my senior year we just started talking about our friends on campus and we became super close and we did our problem steps together and she became my best friend in college… It's neat to kind of form friendships with people that you identified with when everyone else is not like you.

Likewise, when asked about friendships that were formed, Mayra remembers one girl, Cindy, who was specially kind and helpful. Because Mayra moved around so much, she was not physically there to study with her, but Cindy liked Mayra and was happy to help.

> Cindy and I actually kept in touch with for a long time, but then she got married and started her family. She was not a Latina, but she was one of the best programmers that I knew. She was one of my resources when I would get stuck on something, she would say, 'read this,' or 'try downloading this.' …She was very knowledgeable in what she did.

High academic identity in high school. In addition to being hard workers, many of the Latinas considered themselves to be intelligent. However, having a high academic identity is not the same as being very intelligent. Academic identity is the effort of doing one's best in school, according to one's abilities (Flores-González, 1999). Some Latinas may handle larger amounts of information, while others may not. Alba remembers skipping a grade in middle school and feeling like being ahead was a burdensome expectation and a blessing at the same time.

> I felt like it happened sometimes in high school because I kept very much under wraps that I was younger than everyone else, but when people figured out how old I was they kinda' were like 'holy Molly,' because I basically graduated out of high school when I was 16, so it was just like when people figured that out, because I also looked young anyways, people kinda' started recognizing that I was ahead of my tide.

Alba accomplished a lot in four years, double majoring in mathematics and economics. However, she realized that although she was intellectually curious, had a propensity for mathematical concepts and problem-solving, she was not first in her class.

> I wasn't that great at math in high school. But I was still in the highest levels but I wasn't going past it with flying colors, there were people who were a lot better than me. I was not [on the] Math PhD track when I was in high school. But I still enjoyed the challenge.

Similarly, Jenny had a natural curiosity for the sciences, liked problem solving, and worked hard. She had a high academic identity because she was invested in school. When she was undecided about her degree choice, she resolved it by taking more courses and reflecting on her long-term goal.

> So I just took a lot of courses coming in. I was good at chemistry, I really liked the problem solving aspect of it, beyond that I didn't see how it was applicable to what I

> wanted to do, directly applicable to my long-term interest. I was more interested in biology than chemistry when I took courses, even though I really liked the problem-solving aspect of chemistry. It just felt more applicable to me.

Rosita explains her perspective concerning her abilities. She did her best academically, however, she felt like she was average as far as her scholarly abilities were concerned.

> I always considered myself average. I never thought I was valedictorian-type or in the bottom of the line. I always realized that I had to work hard for my good grades, just overall average.

Lynn had wonderful insight when she reflected on her experiences talking to her counselor. She acknowledges that her counselor continuously opened opportunities for her. Lynn had created this warm environment about her, in which, when she came to others, she was well-received.

> Me? I had a wonderful high school counselor. She has since retired. She saw something in me, that's the only thing. She was friends with my mom, at the time my mom was uneducated, and that could have helped. She saw that I was bright, she saw that I was driven. And she kinda' poured into me, and I still keep in touch with her to this day.

STEM identity was developed before graduating from college. Most Latinas' identity in STEM blossomed near the end of their college career. The events, people, and behaviors that fostered the development of a STEM identity for the Latinas can be explored through their own words. Dalia recalled that having researched with someone who was well-respected in biology made her peers respect Dalia. Additionally, her preparation before class became as superior knowledge during class discussions.

> My peers really considered me a science person [because]… I knew [Dr. Hatmore], and she was considered to be one of the top people in the biology department. And they were like 'wow! How were you able to work with her?' … [Also during class,] we had to do peer reviews … every week, because essentially we were teaching the material that was going on in the article. And I was ready. I was always ready with my input in what was going on. And I always had students asking me questions, how do I explain this.

Juliana's STEM identity developed gradually throughout her biology degree. She took several years of laboratories, and realized at the end of her senior year during her final lab experience that she thought of herself as a scientist.

> I had the opportunity to be in my first laboratory my junior year, in the beginning of the year. It's because the people who apply to med school need to have an exposure for the laboratories, so I decided to enroll in the laboratory program. And from my junior year until the end of my senior year I was in a laboratory, in three labs: one in the summer, and I was in one lab for a year and a half, and then, I went to a [zebrafish] lab at the end of my senior year and stayed for a year…I believe I started to feel like a scientist then [because I worked with animals doing a more independent exploration].

Karlita remembers clearly the moment she felt like she was an engineer. She was doing her internship at a nuclear power plant the year before her senior year, when an incident happened where the manager had to intervene.

> I'm studying, I'm learning this stuff, ok cool. It wasn't something I was like 'Oh I'm an engineer'…I remember [during my internship], I had to go check on a turbine. A turbine is like a machine that turns air. And there was something wrong with it. The guy who was working it was telling me this. So I actually took a look at the manual. So I started telling

> him… why it was wrong. And he's like, 'How do you know?' I said, 'Oh because I studied this.' And he wasn't trying to pay attention to me. He thought I was there to study under him, but in reality, I was the one in charge of him. And it was an older gentleman, and I was like, 'No, it's this way. This is the calculation. I am right. Punch in this number and it will start working.' And he refused. So then he had to call my boss. So my boss came down, and said, 'What's going on?' [I said], 'This is it, this is the calculation to start the turbine, to get it into motion.' And the guy, my boss, saw the calculations and said [to the older gentleman], 'Why didn't you pay attention to her?' And he said, 'She's working for me,' and [my boss] said, 'No, no, no, no, she's the engineer, you're working for her.' And I was like, 'I'm an engineer!'

***Cultural identity*.** The Latinas mentioned that they were willing to work very hard to make their aspirations a reality. Moreover, most of them said that they had seen this modeled by their family. Jenny mentioned that her mother and father worked in jobs where they had to work very hard to earn their wages. They worked in cleaning and construction, respectively. Thus, every cent earned was gained by great effort in honest work.

> [M]ost of us come from very hard work-ethic, driven families. At least in my experience we are taught not to take things for granted. And to work for what you want, and I think it's something that definitely [has] driven me throughout the whole time.

The notion of witnessing hard work in the families of the participants could be evidenced throughout each of their narratives. Mayra affirmed this cultural value when she stated, "We're taught… [to work hard] early when holding any job and [it] certainly applies when completing your studies. She worked very hard in school, paid for it as she progressed, had a family of her

own, and with much perseverance doing her work when the rest of her family slept, she went on to graduate eight years after she started.

In Alba's letter of advice to her younger Latina, she chooses to highlight how important it is to work hard. She believes that working hard will have a greater effect on her success than natural talent.

> Trust that your good, dedicated and smart work will take you further than any hidden talent that could have been bestowed upon you. The best remedy to insecurity is good and hard work. You'll surprise yourself in myriad ways and it'll be the most beautiful thing to recognize that you're stronger and more capable than you think.

Juliana believes that endurance and hard work are part of a cultural identity she shares with other Hispanics.

> Researcher: What part of your culture helped you finish your bachelor's degree?
>
> Juliana: Being that I grew up in a single family household, perseverance. Seeing my mother, she is a teacher. Being a… teacher in Paraguay, raising 2 kids, [earning a] minimum wage [of] $300 per month. And seeing that endurance and hard work. It's a part of the Latino-American culture…strength, and … perseverance. [These] values grew strong in me.

Elizabeth, Stephanie, and Dalia spoke to each other in a focus groups about an ideal in Hispanic culture that helped them persist, and that was the optimistic idea that strong work ethic will pay off.

> Dalia: I think for me it's also the idea of optimism. My dad is very much like, everywhere can be green, but you have to look at it as green… So being a hard worker, being persistent, be optimistic.

Tanya: I like the optimism. I agree with that wholly because there are some norms of getting up and dusting yourself off. It's a new day and we're going to work hard if not harder.

Karlita: Like I said I was first-generation, but my father got into a really bad accident and became a paraplegic when I was four years old. And that really impacted our dynamics. My mother had to be the bread winner and my father was looking for work. So seeing my mother working so hard like she did, it made me want to work hard, so when there's times where I'm like I can't do this. I'm like woman! Like, your parents did this, and they did amazing. My father before the accident was a painter, and he was making very good money, then after he got into his accident, he started working at the church, because that's the only place they would let him work.

In her letter of advice, Juliana counsels her younger Latina to work hard and persevere. She does not want her Latina to expect it to be easy, but she needs to remain consistent and keep the goal in mind.

Throughout my years in school, I soon realized that in order to achieve this passion of becoming a vet, I had to work hard and be consistent throughout… Given this goal I pursued a major in Biology in college and was part of a lab that worked with zebrafish. Again, this was not easy because I had to work a part-time job, study for my classes and work in the lab, but with hard-work, persistency and seeing the big picture and goal which was to become a good doctor, I tried my best as I am sure you will do too!

In conclusion, the Latinas believed that possessing a strong work ethic an important attribute shared by the Hispanic culture. They were optimistic that hard work would pay off, and that it was more important to practice that discipline than to possess unharvested talents.

Disadvantage. The eight Latinas who disadvantaged during their formative years felt like it affected many aspects of their lives. In fact, many of them felt like being disadvantaged had far-reaching impacts in their life. Although most Hispanics are not privileged, being raised in a working-class family is not a Hispanic attribute.

The things that parents can provide for their children often are limited by what they can afford. The two Latinas who expressed that they had privileged homes lived with parents who had degrees in their country of heritage, immigrated to the United States, and earned more degrees in the United States. These Latinas appreciated academics and art to a great degree. In fact, both of them could have pursued a degree in the field of art, but did not. Neither of these Latinas mentioned choosing their university institution based on scholarships.

However, the Latinas from disadvantaged backgrounds were more attuned to making choices based on financial availability. In other words, they based their initial decision upon which schools provided more funding for their postsecondary education. Jenny, Juliana, and Dalia decided to attend schools where they would be the recipients of full scholarships, while Lynn and Karlita decided which school to attend based on which one would give them the most funding. Lynn mentions her decision to not attend one school because more funding was available in another.

> I applied and got accepted to six other schools, and I was within giving a housing deposit to one university. But I got more money back from Freeway University… and I said I'd be a fool to put myself in debt this early.

Accordingly, Elizabeth's father was a very responsible man who did not believe in debt. He did not want to go into debt during the university process. Thus, when Elizabeth's $12,000 scholarship was denied at her 4-year university 3 weeks before classes started, the family did not

have that money and she could not attend that university. She quickly enrolled in a community college, where she and her father each paid for every class, and then she transferred to a state college. She was a commuter, and she was older than some of her peers when she graduated, but she graduated debt-free.

Jenny recounted that during the summers, she would apply to medically-related internships. Since she was not making money at the time, and came from a disadvantaged family, she only attended institutions that offered paid internships.

> So the first year I did this [medically-related internship] program called XVP, which is an enrichment program for underrepresented students. In addition to that, I just mostly did different research internships that were also at least for underrepresented students, but for me it was important that if I was going to a new institutions that they provide the funding for this.

Although Juliana was able to secure a full scholarship to her university, she lived at home and felt like she needed to help her mom financially, since she was a single mom.

> I had a full scholarship in my college because of my good grades in high school, and they also gave me financial aid. I would take that money because I still had things I had to pay for, and with the money they gave me, I would help my Mom, in addition to working [25 hours a week] as a CNA [certified nurse assistant]. It was not easy.

A Theme that Did Not Fit

Providence was not verbalized by each of the participants, but was nominally answered when the participants addressed the questions in the demographic survey. Since most of the participants did not mention this theme in their interviews, it was not included in the analysis table, but it can be found in their demographic table. However, four of the participants did

include it in their interview narrative, or in the focus group. I call this code, "Providence." This is related to the participants' religion and the way they view God's providence in their life. In the demographic interview, nine out of the 10 participants stated that they were Christian; either Protestant or Catholic. More specifically, Dalia, and Lynn, Alba, and Juliana stated that they followed Protestantism, while Elizabeth, Rosita, Karlita, Mayra, and Jenny stated that they followed Catholicism. Ada considers herself agnostic.

Although most of the participants stated that they ascribed to a religion at least nominally, only four mentioned the hand of Providence in their life. During the group interview, Dalia mentioned that encouragement from the Bible plays a big role in her day-to-day persistence. Along the same lines, Karlita mentioned that religion helps her to see the big picture. She believes that there is more to life than what she feels or sees.

> I'm Catholic, and that plays a big role in my life. Whenever I get sad or depressed I just go to church… and realize that there is more to life than all these messes that I'm thinking about.

In addition, she goes on to mention particular ways in which God has helped her persist in her goals. She believes that along the way God has provided friendships when she needed them.

> I guess the group that I had, they were very social. I got along with a lot of people in my group... I've been very lucky, I have to say, God has been very good to me.

Similarly, although Elizabeth did not mention religion specifically in any of her answers, she does mention several times that when she does not know what to do next, the next step is revealed: "I got into it honestly I would say, through my, again, I felt that the next step has always appeared to me."

Lastly, Juliana was very outright about her faith and how she actively pursues God and asks Him to reveal His will for her.

> I believe this is a calling for me, because… I always prayed to God and [still] now I pray to God…I do not want to take the way that I believe is good for me. Instead, I want to know what way He has for me, and that I would be able to see that way.

Research Questions

The first research question I sought to answer was, "What formative experiences motivate Latinas to begin a STEM postsecondary degree?" There are many different formative experiences that each particular Latina lived through. However, upon reflecting on the collective voice, disadvantage and personal interest were themes that were evidenced throughout the text in their formative experiences. The theme, personal interest, contained the subthemes, exposure prior to college, intrinsic motivation, and goal setting.

First, each Latina benefitted from an exposure to their STEM field prior to college enrollment. Although this seems like an obvious requirement, one must also consider the fact that some of the Latinas come from very disadvantaged backgrounds, and Latinas may not have been around people in the community who worked in STEM fields. During the same time in the Latinas' upbringing, disadvantage also had an impact. Disadvantaged families may not have been able to afford an exposure in their field, or work in a field where they could naturally offer that exposure to them. Thus, the formative experiences experienced by participants, which included watching doctors perform surgeries in *telenovelas*, launching rockets, dissecting animals, visiting research centers, watching formal presentations, and translating for medical providers were valuable, even life changing.

Next, Latinas needed to be intrinsically motivated to explore their STEM field. They had

to have a curiosity for it and desire to find out more about it. Intrinsic motivation was a unique factor that was evidenced throughout the Latinas' narratives. The Latinas were motivated to finish by their enjoyment of the subject. This intrinsic motivation was encouraged by their families at critical points. Then, during college, the Latinas persisted in what they were passionate about. Lastly, Latinas had to set their goal, which, in many cases, was declaring their major. None of the Latinas declared their major any later than sophomore year.

The next research question delved into the practicality of the curriculum. More specifically, the question stated, "What are Latinas' perceptions of the curricula based on their experiences in their STEM degree program?" For the Latinas who knew they wanted to become physicians, they knew that they needed a degree in biology because they believed that the same information would be taught again, in their future medical school. For Rosita and Elizabeth, both of whom transferred from community colleges to state schools, earning their degree was what they wanted because of goals that they set for themselves in college. For most of the rest of the participants, having a career in mind was certainly a driving factor in earning their degree. The only one who did not have a career in mind in particular was Ada. She was the epitome of an intrinsically motivated individual when it came to which classes to take to earn her degree.

Through reflection, it was captured that 2 participants did not view their curriculum as pragmatic any longer during their senior year. Karlita and Ada believed that they knew what they needed to know to work or could learn it on the internet, and this undermined their persistence.

Research question 3 inquires about the connections that Latinas made during their time in their university institution. To be exact, the question states, "How do Latinas describe the sense of belonging they experienced during their 4-year postsecondary institution?" Latinas' sense of belonging was affected by the relationships they were in. Family, teachers, and peers played

front-and-center roles in the Latinas' persistence. No Latina was an island. Each one was able to accomplish what she did in part because of the support received from parents, teachers, and/or peers.

Research question 4 states, "How does Latinas' self-identity motivate their persistence in their STEM degree?" The Latinas' identity is multifaceted. They have a dynamic identity that intersects their formative experiences, their college experience, and their culture. Specifically, they were hard working and studious and had a high academic identity through their K-12th experience. Then, once they began college and had more opportunities for hands-on experiences towards the end of their degree, they also developed a STEM identity. This came about after putting to practice what they had studied. Throughout, their cultural identity was intertwined in their formative and college experiences because they believe that having a strong work ethic is a trait encouraged by Hispanic culture. Thus, their families expected them to work hard at what they endeavor to do.

Summary

The data analysis proved to be an exercise that yielded rich findings as it pertained to the experiences of Latinas persisting in a STEM bachelor's degree. The analysis table included 4 themes. The first theme was supportive relationships, which meant that each Latina was supported by their family in addition to mentors, teachers, professors, or peers.

The first subtheme under it was, family supported education. This support extended throughout the Latinas' formative experiences. The second subtheme entailed teachers or mentors who made an impact. In this realm, it was found that in order to foster persistence, the Latinas needed a person in the STEM community to allow them to explore what it would be like to pursue STEM. Peers who made an impact was the final subtheme under the theme, supportive

relationships. Thus, most peers made a positive impact on the Latinas, but some unwittingly. Some Latinas became more acquainted with STEM because of peers who were already in STEM, in addition to mentors, teachers, or professors. However, others befriended high achieving peers because they were ostracized, rejected, or bullied by popular groups that were not high achieving during their formative years in school.

The second theme is personal interest, which includes the following subthemes: intrinsic motivation, exposure prior to college, and goal setting. The Latinas were motivated by their own sense of curiosity and discovery to explore their STEM field, it was not forced. The Latinas had an exposure to STEM prior to college, however, they may not have made the goal to graduate from college with a bachelor's degree in STEM until they were in college.

The third theme is self-perception, and the subthemes in this category were cultural identity, high academic identity in high school, and STEM identity was developed before graduating from college. First, the Latinas perceived that their culture conveyed the message that they needed to be optimistic about working hard, and the Latinas translated that view of work ethic into academics. Consequently, because of their strong work ethic in school, the Latinas developed a high academic identity that spanned through their formative years. Finally, after many years of possessing a strong academic identity and developing a high academic identity, they developed a STEM identity before they graduated from college. The last theme is disadvantage, which had a deep impact on the Latinas in many areas of their lives.

CHAPTER FIVE: CONCLUSION

Overview

The purpose of this hermeneutic phenomenological study is to understand the lived experiences of Latinas who persisted to graduate with a STEM bachelor's degree in the United States to understand the lived experiences of Latinas persisting in a degree in a STEM field. This final chapter presents a summary of the findings, the implications of the findings grounded in the empirical and theoretical literature, practical and methodological implications, the study's limitations and delimitations, and lastly, recommendations for future research.

Summary of Findings

The 10 Latinas who participated in this study gave clear depictions and representations of answers to the research questions. The first research question was, "What formative experiences motivate Latinas to begin a STEM postsecondary degree?" Two themes surfaced in answer to this question. First, exposure to their STEM field prior to college enrollment was key. Latinas had to be intrinsically motivated to explore this STEM field, and they also needed to set their goal, even if it was as late as their sophomore year of college. Disadvantage also played a role in the Latinas' formative experiences.

The next research question stated, "What are Latinas' perceptions of the curricula based on their experiences in their STEM degree program?" The answer to this question varied for each Latina, but the construct was nevertheless impactful. Each of the Latinas thoroughly enjoyed the challenge that they undertook, even though graduating was a hard task to accomplish. Many of the participants affirmed that they thought they followed a high quality curriculum. However, not having that perception undermined persistence.

The third research question was “how do Latinas describe the sense of belonging they experienced during their 4-year postsecondary institution?” Most of the Latinas had one or two female friends through college that encouraged and fostered their success through working toward the same goal and studying together. They felt socially and academically integrated. However, the one who neither pursued nor received social and academic integration in the institution had a strong family support and a mentor outside of the institution. Teachers and mentors’ role was to open the door of opportunity, guide while challenging them, and encourage them to reach their full potential in learning.

Lastly, question number 4 states, “How does Latinas’ self-identity motivate their persistence in their STEM degree?” First, the Hispanics in their family and community modeled hard work for them, and thus the Latinas believed working hard was part of their cultural identity. Thus, they channeled their work ethic into academics. Because of their strong work ethic in school during their formative years, they had a strong academic identity. Lastly, they possessed a STEM identity, through which they perceived themselves to be scientists, engineers, IT women, or mathematicians. A STEM identity only came near the end of their college career. Possessing a STEM identity was more of a rite of passage than a factor fostering persistence.

Discussion of Findings

My goal in performing this investigation was to describe the essence of the lived experiences of Latinas who persisted to graduate with an undergraduate degree in a STEM field. Therefore, in this important chapter, I discuss the findings in light of the empirical and theoretical literature presented in Chapter Two.

Relevant Empirical Findings

Several research topics surfaced in the Related Literature section of Chapter Two. This section discusses the topics in scholarly literature in light of the findings in this study. The topics discussed are sense of belonging, disadvantage, cultural identity, exposure, gender role, intrinsic motivation, academic identity, tracking, goal setting, male dominated STEM classrooms, commuting, curriculum, and STEM identity. Lastly, the essence of the experiences of Latinas who persisted in a bachelor's degree in STEM is also provided.

Sense of belonging. Tinto (2015) suggests that sense of belonging has an impact on persistence. It was found that most of the Latinas did not feel isolated throughout their entire degree, as may be the case for African American women in STEM (Charleston, Adserias, Lang, & Jackson, 2014; Charleston, George, Jackson, Berhanu, & Amechi, 2014; Ong et al., 2018; Joseph, 2012). The Latinas who lived on campus were willing to form relationships mostly with the few other women in their classes, as well as enjoy being part of larger communities outside of their degree. Once they found their friend, they felt academically and socially integrated, and supported in their STEM program.

The Latinas who commuted were comfortable with smaller social circles in college. They still enjoyed the one person in some of their classes, but did not have the larger community outside of their degree. Their larger support network came from their family. There was one Latina who chose not to have any connections in college. This was found to be a negative factor in retention, just as Tinto (2015) suggested. This Latina attended four different colleges, signaling that she switched colleges every school year. She persisted, but it took five years.

The Latinas perceived academic integration from experiencing teachers and mentors' guidance. This finding was supported by scholarship (Ladson-Billings, 2014). The Latinas were

offered opportunities where they could attain more education than others. The Latinas took full advantage of those opportunities. In the cases of Karlita and Ada, for example, each was invited to take an independent study with a high school teacher. This independent study had a direct impact on their self-efficacy in their STEM field in college. In both of these cases, the teachers were the ones who initiated the idea of having an independent study. This finding extends the existing literature which states that with the proper tools and educational environment, anyone can attain academic achievement (Hubbard, 2010).

The Latinas perceived that the teachers, mentors, or counselors who offered them opportunities noticed something different about them. This difference may have been a higher GPA, greater interest, greater effort, or a skill that earned them a job where they were mentored, such as medical translation. It could also have been developing relationships with mentors which created opportunities to conduct cutting-edge research. The Latinas perceived that the environment created by their hard work, respectfulness, responsibility, and motivation impacted others in a way that those whom they came into contact with were led to open doors of opportunity. This finding correlates with Bandura's (2001) social cognitive theory, which states that one person has as much effect on her environment as it has on her (Bandura, 2001).

The Latinas reported feelings of loneliness and self-doubt during the beginning of their degree. However, as they persisted, they experienced more academic and social integration. One of the Latinas did report not having any relationships in the university, but she was intentional about not forming any; she was unique in that she solely relied on her family to provide her support and encouragement as she persisted.

Culture. The environment that the Latinas grew up in was greatly impacted by their culture. Possessing a strong work ethic and *familismo*, were two concepts that were key as stated

by the literature (Bureau of Labor Statistics, 2016; Bureau of Labor Statistics, 2017; Falicov, 2001). Possessing a strong work ethic as a requirement to persist in a STEM degree was a character trait that was mentioned in every interview, focus group, and letter of advice. This character trait was part of the cultural identity of the Latinas who participated in this study. They stated that hard work was encouraged in their Hispanic community, across Latin American countries. When their Hispanics parents migrated, it was with the optimistic hope that they would provide better for the family and give their children a better future. Thus, *familismo* and work ethic were inseparable in their function; Hispanics work hard so that they can provide for their families, and put their families first, as already established in previous research (Carlone & Johnson, 2007; Cobb, 2004; Galanti, 2003; Falicov, 2001; Parker, 2014; Sayman, 2013)

Within the framework of *familismo*, it was found that each one of the Latinas' families protected them from criticisms from the community pertaining to their academic identity and degree attainment. This is a deviation from traditional gender role expectation among Hispanics (Harris & Firestone, 1998). Nevertheless, the Latinas reported that their families also guilt-tripped them when they did not call or come home for a family gathering once the Latinas were in college. Thus, although families protected and fostered Latinas' curiosity, intrinsic motivation, interest, as well as encouraged their academic endeavors and protected them from criticisms from the Hispanic community during their kindergarten through 12th grade education, most families expected a certain level of duty to the family. This created tension for participants between academic commitments and familial commitments, as suggested by previous research (Calzada et al., 2010).

In scholarship, it was found that there is an intra-cultural expectation that Latinas will get married, bear children young, and take care of the family (Purdy & Arguello, 1992). Although it

was mentioned how difficult it was to be guilt-tripped because they may have failed to call as often as their mothers wished during their busy days in college, attend their grandmother's birthday party when they had an exam to study for, or put their computer away when they did attend the *quinceañera*, none of the immediate families of the participants expected them to be caretakers of children or elderly while fulfilling the requirements of their bachelor's degree.

Some mentioned that educated women in the Hispanic community received criticism because they did not serve their husband or male partner meals, however none experienced this personally because none of them were married or had children except for one, Mayra. In fact, her husband diverged from traditional views on gender norms, and encouraged Mayra to earn a degree in something she loved (Harris & Firestone, 1998). Mayra also had children while she was completing her bachelor's degree. They were paying for her university tuition out-of-pocket, and thus she took longer to finish her degree.

Disadvantage. The impact that parental occupation had was recognized by the Latinas. The Latinas who were disadvantaged recognized that they did not live in communities where they had professionals as role models to follow. Many of the participants had parents who did not earn much. Among parental areas of occupation were food services, childcare, construction, and private school teacher. This finding correlated with the low-paying occupations that the majority of Hispanics often fill (Gonzalez, 2008; Passel & Cohn, 2015). Regardless of whether the parents worked in low-paying jobs or high paying jobs, the Latinas perceived that their parents worked very hard.

Eight out of the ten Latinas considered themselves disadvantaged in comparison to other students. This finding corroborated with earlier statistics which state that Latinas are the poorest gender and race/ethnicity intersection (Gonzales, 2008; Solis & Galvin, 2012). This disadvantage

included their status socioeconomically, but also for some, knowing whom to ask for help concerning scholarships, postsecondary pathways, degrees, career paths, and options (Parker, 2014; Schwartz et al., 2016; Talley & Ortiz, 2017). In fact, five of the Latinas indicated that they did not know a lot of information or knew Hispanics who did not know the pathways to success in college.

The disadvantaged Latinas perceived that they attended schools where the academic quality was lower. This correlates with studies that suggest that Latinas may experience lackluster educational opportunities that thwart their motivation in education (Fallis & Opotow, 2003). Although some of the Latinas reported not attending high quality schools, they compensated for this by exerting enough academic effort to be placed in honors classes, AP courses, higher tracks, gifted and talented tracks, vocational programs, independent studies, and early enrollment into college. Thus, the Latinas in this study did not receive a lackluster education because they either sought higher level courses or they were identified for gifted and talented courses.

It is worth mentioning that the disadvantaged Latinas who asked for help did so because of family members who pushed them to find people who had answers. This resulted in receiving more information than others. Some of the Latinas mentioned that they did not ask for help and perceived that it was ineffective and disadvantageous. This finding corroborates with Badura's (2001) social cognitive theory, which states that people affect their environment (Bandura, 2001). If the Latinas take the time to find the people who have answers, and ask for help, they were more likely to find it.

The literature suggested that there is a difference between the experiences of people who grew up in poverty versus the ones who grew up in wealth (Gracia, 2015; Reay, Davies, David,

& Ball, 2001). Since not all Latinas are poor, I did not include this finding in the analysis table. However, being poor had an impact on those who were. Scholarship suggested that parental educational achievement impacted their children's experiences (Gracia, 2015; Noble, et al., 2015). This finding is extended by this study, since it was found pertinent to several of the Latinas in this study.

Specifically, in conjunction to the literature, I found that the 2 Latinas who were more privileged did not report having difficulty transitioning into the university, filling out the forms, or feeling like their family had unrealistic expectations of prioritizing the family over their degree, as did the disadvantaged Latinas. The privileged Latinas were raised by parents who had earned degrees in their country of heritage, and continued their education with more degrees in the United States. Although the privileged Latinas were not receiving homework help, they perceived that they mothers paved a way for them. Both considered their mothers their role models in many ways, including education-attainment, career-pursuit, and work ethic. These Latinas felt supported emotionally and in other tangible ways. However, the eight Latinas who did not know anyone in their community whom they could emulate in their career had people whose character they could emulate.

The character trait that was demonstrated and emulated was hard work, or a strong work ethic. Hard work was a theme that appeared in every one of the interviews, focus groups, and letters of advice. This correlates with the literature finding that though Hispanic males earn the least of all the different races/ethnicities of males, they work the longest hours. In a similar manner, Latinas earn the least of all the different races/ethnicities of females (Bureau of Labor Statistics, 2016; Bureau of Labor Statistics, 2017). See Figure 4 for details. This study corroborates with other research in that it affirms that Latinas are directly impacted by their

parents' occupation, available time, and income (Cole & Espinoza, 2008; Talley & Ortiz, 2017). The Latinas in this study were affected by the family's resources and the information they received. Unfortunately, the Latinas who did not live in communities surrounded by professionals had less opportunities to gain familiarity in STEM as they decided whom to emulate, what to pursue, and how to go about it.

Early exposure to STEM. Scholarly literature suggested that early exposure to STEM fields may enable more students to become interested in STEM fields (DeJarnette, 2012; Moakler & Kim, 2014; Simpson, 2001). Thus, the Latinas had watershed moments in STEM in their experiences from kindergarten through 12th grade. Some of these moments of exposure came when the Latinas were in elementary school, and some were in middle school. Few were in high school. As I asked these Latinas to look back on their formative experiences, each one of them had at least one meaningful exposure to their STEM field before they graduated from high school.

The reason this exposure before graduating from high school is pivotal is because knowing their interest before graduating high school meant there was one less thing to figure out, since many of the first generation Latinas report feeling stress from having to figure out the pathway to college without help from their parents (Talley & Ortiz, 2017). The first-generation, underprivileged Latinas benefitted from knowing the general field they wanted to graduate in before their freshman year. However, the Latinas who were not first-generation college students, who were also not underprivileged both decided as sophomores what degree they would pursue.

Intrinsic motivation. Scholarship suggests that intrinsic and extrinsic motivation is important while earning a degree (Bybee, 2013; STEM Education Caucus, 2017). However, nine out of the 10 Latinas mentioned that they were intrinsically motivated to enroll in college and

pursue a degree in STEM. Only one of the Latinas mentioned that she was intrinsically and extrinsically motivated. Karlita mentioned that in 7th grade, she knew she wanted to pursue engineering because she has dyslexia and enjoys working with numbers, not necessarily letters, but she was also excited about earning high wages. All of the Latinas enjoyed their STEM field, and that was why they wanted to pursue it. Their family wanted them to receive a postsecondary education, thus they had the opportunity. Their curiosity and desire for exploration in this field came about early, and was fostered by the family in conjunction with teachers, professors, or mentors. Their intrinsic motivation and strong work ethic enhanced their academic identity. Therefore, Ladson-Billings (1995) is wise in advising that teachers who impact minorities need to be culturally aware of their surroundings.

Tracking. Tracking refers to the practice of putting students in classes with other students who are alike in aptitude. For instance, there are gifted and talented tracks, and there are also lower tracks (Betts, 2011). The scholarly literature suggests that putting Latinas in lower tracks has negative effects on Latinas' education because lackluster education is unavoidable (Barnes, 2012; Fallis & Opotow, 2003; NCES, 2017a; Ong et al., 2011). However, these findings were not evidenced in this study. None of the Latinas in this study were placed in lower tracks. In fact, two Latinas benefitted from higher tracking, as they were placed in gifted and talented tracks from a young age. My research suggests that placing Latinas in higher tracks has a positive academic effect on Latinas.

Goal setting. The literature suggests that goal setting motivates Latinas to persist in a STEM degree (DeJarnette, 2012; Moakler & Kim, 2014; Simpson, 2001; Tinto, 2015). This study corroborated with those findings. The Latinas had goals, and when they were focused on their goals, they were able to achieve them. Most of the time, the goal was defined by the

declaration of their degree. Some Latinas enrolled in college without deciding what degree they would attain. Nevertheless, all of the Latinas declared their major no later than sophomore year of college.

Pathway to college. Enrolling in college was a huge hurdle for some Latinas, as suggested by previous research (Parker, 2014; Schwartz et al., 2016; Talley & Ortiz, 2017). For some Latinas, the transition brought the stress of filling out paperwork, asking for scholarships, knowing what scholarships they qualified for, figuring out housing or transportation, rearranging work hours to accommodate their new schedule, or vising colleges for the first time. This finding corroborated with previous research (Parker, 2014; Schwartz et al., 2016; Talley & Ortiz, 2017). However, it was only applicable to the disadvantaged Latinas.

Commuting to college. Research suggests that almost half of Hispanics who seek postsecondary education enroll in community colleges and live at home while attending school (Krogstad, 2016). While enrolling in a community college was the case only for 2 of the 10 participants, half of them lived at home and commuted to the university campus. This finding correlated with previous research (Krogstad, 2016).

Male-dominated STEM classroom. Next, it was found that most of the Latinas' experiences included attending STEM classrooms that were male-dominated among students and faculty, as was previously suggested by researchers (Crisp, et al., 2009; NCES, 2017a). This notion was not as pronounced for the Latinas pursuing a degree in biology as it was for the ones pursuing engineering, math, and technology. The Latinas in this study who pursued biology perceived that the gender ratio in their classrooms were even among peers. However, the Latinas whose classroom was male-dominated reported that they fought against outright disrespect, stigmatism, and intimidation, as has been suggested by previous research (Carlone & Johnson,

2007; Lester, 2010; Pittman, 2010). Findings revealed that the Latinas in male-dominated STEM classrooms temporarily struggled with feelings of isolation until they found another woman who came alongside them. This was different than previous scholarship which discusses women's lack of sense of belonging in the STEM classroom (Charleston, Adserias, Lang, & Jackson, 2014; Charleston, George, Jackson, Berhanu, & Amechi, 2014; Johnson, 2012; Ong et al., 2018; Joseph, 2012). In feeling isolated, none of the Latinas reported that the males were outright purposefully isolating them. A few Latinas mentioned befriending males in their classes based on interests, off campus status, or age.

Curriculum. Tinto (2015) suggests that students' perception of curriculum has an impact in their persistence. However, the decision to attend a certain college was not based on the perception of the curriculum among any of the Latinas except for one. This particular Latina overheard that one particular school close to her "had a great program" from two classmates in her technology class. Besides this, the decision was based on funding for the Latinas who were not privileged, and an experience for the Latinas that were privileged.

Throughout their program, the Latinas perceived that they followed a good curriculum. However the motivation of the two Latinas who perceived that the senior-year curriculum was not useful was undermined. This finding corroborated with previous research (Johnson, 2012, Tinto, 2015) These Latinas believed that they did not need to finish the curriculum as outlined by their degree completion plan to be able to perform duties in their future career, however they finished the degree because they wanted the credential.

STEM identity. This study correlated with prior research that students gradually develop a STEM identity as they progress through their program (Betz & Schifano, 2000). The Latinas' STEM identity development was gradual, as most Latinas did not feel like scientists, engineers,

mathematicians, or technologists until the very end of their degree. It was also affirmed that STEM identity was achieved through informal communication with professors or mentors in STEM research (Graham et al., 2013; Moakler & Kim, 2014). Some Latinas also considered themselves as STEM people because others thought of them as such. Some needed to hear someone say, "You are the engineer," or "you are the IT girl" before feeling like they personified that ideal. Other ones needed to reach a certain part of their university program, such as an internship, or work in the STEM setting for a certain amount of time doing independent, hands-on work.

Therefore, the Latinas viewed their STEM identity as more of a final milestone in their bachelor's degree than a factor that affected their persistence. Meaning that, by the time they considered themselves scientists, engineers, mathematicians, or technologists, they had already persisted through much of their bachelor's degree. Latinas' development of their STEM identity was similar to other groups' (Graham et al., 2013).

The essence. The essence of the experiences of the Latinas who persisted through their undergraduate degree in STEM began first with the exposure experience to their STEM field, then becoming interested and intrinsically motivated to explore their field. Next, they set a goal and worked hard to persist in their STEM degree, and through the entire process they needed to be supported in their relationships. Latinas who were supported by peers, faculty, and mentors received guidance that their family could not provide. Thus, exposure affected interest, interest affected goals, goals affected hard work, and hard work affected persistence. But, none of this could have come about or at any point continued without supportive relationships. Please see Figure 5 for more details.

Exposure > Interest > Goal > Hard work > Persistence

>>>>>>>> Relational Support >>>>>>>>>>

Figure 5. Persistence framework for Latinas in STEM

Summary. In conclusion, the present study extends scholarly literature by identifying factors that affect Latinas as well as other students. Through research, it was found that sense of belonging, disadvantage, culture, exposure, intrinsic motivation, tracking, goal setting, male-dominated STEM classrooms, commuting to college, curriculum, and their STEM identity had an impact on Latinas' persistence in a bachelor's degree in the United States. However, the effect was not the same as it was in other cultures. In order for Latinas to persist, they needed their family's support, mostly in addition to social and academic integration. It was also found that not all Latinas struggle with the pathways to college because they are not all disadvantaged. Additionally, an interesting finding was that the Latinas' family often protected them from gender role criticisms in the Hispanic community.

Relevant Theoretical Findings

Although critical race theory (CRT) was not used as a theory undergirding this study, many researchers who study minorities use CRT. This study diverged from certain aspects of critical race theory. Critical race theorists assert that there needs to be an integration of the culture within the institution in order to aid persistence in postsecondary degree attainment. In regards to this, some theorize that institutions must meet additional demands for minority groups to thrive (Museus, 2014; Rendon, Jalomo, & Nora, 2000; Riegle-Crumb, King, Grodsky, & Muller, 2012; Swail, 2003). Some of these further needs were related to institutions' insensitivity to students' cultures, and institutions' lack of financial support (Olivas, 2009; Perez, 2010).

However, none of the Latinas mentioned that experiencing cultural acknowledgment from the institution aided in persistence. Many of them perceived that the type of encouragement

that fostered persistence was academic support, social integration, and personal acceptance from peers and faculty within the institution. The reason this finding diverged from previous research on intra-institutional cultural integration is because of the nature of each of these STEM degrees. Each of these STEM degrees was difficult for the Latina who pursued it. Even if the degree itself was not known for its rigor, such as a Bachelor's degree in Kinesiology or a Bachelor's degree in Community Health, the Latinas who pursued these degrees were going to classes during the day but also working in the evenings to pay for their school. The little free time that these Latinas had was spent doing homework.

Academic success was a top priority for the Latinas. The Latinas needed to stay focused during their bachelor's degree. None of the Latinas mentioned attending functions that focused on diversity unless it was related to STEM. Thus, this study corroborates that the Latinas did not invest their time attending non-academic diversity functions because it risked lowering their GPA (Cole & Espinoza, 2008). Lastly, CRT theorists claim that institutions need to offer more financial support to Latinas (Olivas, 2009; Perez, 2010). This claim was supported by the findings in this study.

The reason that finances was supported by the study but cultural celebration was not as a factor in persistence is explained by Maslow's (1943) Hierarchy of Needs. Within the timeframes that the Latinas had during their time in the university, they needed finances to continue their education, which qualified as a basic need as far as the existence of their degree. If they were working part time to fulfill that basic need, they usually only had time for courses and homework, which qualifies as a psychological need (Maslow, 1943). Thus, time for cultural acknowledgement eluded them, which would qualify as self-fulfillment (Maslow, 1943)

Tinto's model of student motivation and persistence. Tinto's (2015) model of student motivation and persistence was the contextual framework used in this study. In this model, goals affect motivation, and motivation affects persistence. The three constructs that affect motivation are self-efficacy, sense of belonging, and perception of curriculum**.**

Goals. Tinto (2015) mentioned that setting a goal was imperative and led to motivation. The goal for most of them was not enrolling in college, but declaring their major. Many of the Latinas were led to enroll in postsecondary education because their parents believed that education was important. The parents believed that their daughter needed to earn a degree in a university. Many of the Latinas knew that they wanted to do something related to the field that they chose before they enrolled in college, but not all of them. Therefore, preparation was important to their goal setting, as suggested by previous research (Moakler & Kim, 2014; Simpson, 2001). Moreover, four of the Latinas did not have a clear goal of what degree to pursue when they entered college. For these Latinas, one became depressed when her scholarship was denied and did not maintain her previously high GPA until she developed a clear goal, but the other 3 maintained their high GPA while taking general classes. Nevertheless, having a goal fostered persistence.

Self-efficacy. Tinto (2015) indicates that self-efficacy affects motivation. Self-efficacy in relation to Latinas' persistence in STEM means that Latinas' expectations, goals, decisions, motivations, and beliefs are central to their accomplishments (Bandura, 1989). The Latinas suffered from self-doubt and lack of confidence but gradually became more efficacious in their degree. This self-efficacy was developed as they grew in knowledge and experience. However, Latinas needed to know that they were at least somewhat efficacious in the STEM field of their choice before declaring their major.

In Chapter Two, I questioned if self-efficacy was needed as a subconstruct to goal-setting. It was found that the Latinas needed a certain amount of self-efficacy to set the goal. The Latinas needed to believe they could accomplish their goal before setting their goal. This finding diverged from Tinto's (2015) model of student motivation and persistence.

Sense of belonging. Tinto (2015) stated that sense of belonging is important in student persistence. The Latinas experienced a sense of belonging within their family that spanned across many years, not just their STEM degree. Beyond that, the Latinas experienced varying degrees of belonging within the university setting.

This study correlated with previous investigations' findings in that sense of belonging is an important factor in persistence (Carlone & Johnson, 2007; Graham et al., 2013). The Latinas who commuted relied more heavily on their family for support. Some also relied on few friends within the STEM field. However, the Latinas who lived on campus relied more on friends from the STEM field for mutual company, help, and encouragement. As such, this study correlated with previous research that the intra-institutional sense of belonging that on campus Latinas in STEM sought did not emanate from a cultural sense of belonging within the greater institution, but instead, from an academic sense of belonging within their STEM program (Graham et al, 2013). Having a sense of belonging within their STEM program allowed them to maximize STEM learning and to develop a scientific identity (Carlone & Johnson, 2007; Graham et al., 2013).

Sense of belonging was a construct that surfaced, but not in the way that Tinto (2015) suspected. Tinto (2015) stated that students need social and academic integration into the life of the institution. I argued in Chapter Two that a cultural aspect among Latinos is *familismo,* or prioritizing the family, and that this is a powerful motivator for persistence among Latinas. All of

the Latinas who participated mentioned how supportive their family was during their persistence in STEM. Specifically, they highlighted the emotional support that they received from their family.

In addition, most of the participants also experienced at least 1-2 special friendships that encouraged them and supported them through mutually helping each other study the material or figuring out problems. For the Latinas, this was perceived as academic and social integration, which were suggested to be needful (Tinto, 2015). Finally, all of the Latinas mentioned a professor, advisor, mentor, or counselor during their time in college with whom they had a meaningful relationship who was particularly impactful in a positive manner. This correlates with Tinto's (2015) implications of sense of belonging.

However, if meaningful relationships with teachers, advisors, mentors, or counselors is expanded to include their time during high school, then it must be stated that all 10 of the Latinas mentioned meaningful connections with key people in the school system. Therefore, the Latinas' experience persisting in their STEM degree cannot be divorced from their experiences in K-12th school. It is a continuum. In essence, the relationships that the Latinas built during high school and college fostered persistence in their STEM degree.

Perception of curriculum. Most Latinas mentioned that the curriculum in their university was good. One Latina mentioned that she was naïve because the reason she enrolled in a university was because she overheard classmates, whom she perceived to be more advantaged, say that there was a great program there. However, two Latinas perceived that the curriculum in their degree was a waste of their time and this perception undermined their motivation. One mentioned that she believed she could learn everything she needed to know to get a job through the internet. Another Latina mentioned that after she worked in an internship for a year between

her junior and senior year, she considered not finishing her degree because she felt like she was already proficient at what she did. However, each finished because she knew that her skills would be recognized more with an official credential.

Motivation. The Latinas were motivated by different factors. First, they found personal satisfaction from being curious about and exploring their STEM field. Further, most of the participants mentioned that they were motivated by serving the Latino community, since they spoke Spanish and their degree benefitted the community in general. For the six Latinas in the sciences, knowing the impact that they would have on society was important. This finding correlated with previous research (Carlone & Johnson, 2007; Diekman et al., 2017 Ong, Wright, Espinosa, & Orfield, 2011; Ong, Phinney, & Dennis, 2006; Peralta et al., 2013). However, the Latinas in technology, mathematics, and engineering did not convey this perspective.

In summary, Tinto's (2015) model of student motivation and persistence provided a general framework through which to guide my study. However, it was not perfect in every way. My study confirms that Latinas in STEM require a certain level of self-efficacy, goal setting, and sense of belonging in addition to having a positive perception of the curriculum. Nonetheless, self-efficacy came about after years of hard work. Thus, their hard work at school during their formative years evolved into a high academic identity and pinnacled at a STEM identity near the end. The Latinas' shared values and beliefs in their culture enabled them to be resilient, promoted hard work, and capacitated them to persist through obstacles. Their family provided them with encouragement and emotional support. Peers and faculty were also irreplaceable in developing meaningful support for the Latinas, and opening the doors of opportunity to them. Most of the Latinas experienced both academic and social integration in their STEM program, in addition to the support their family provided.

Perseverance. In summary, the Latinas persevered because of the meaningful exposure experience during their formative years, their own interest and intrinsic motivation, academic and social integration they experienced in their STEM program, the support and protection of their family, goal setting, self-efficacy, and their work ethic.

Implications

As the study concludes, implications for stakeholders desiring to research the experiences of Latinas or other minorities in STEM are discussed.

Methodological Implications

One methodological implication in hermeneutic phenomenology is that researchers seeking to understand the experiences of Latinas persisting in STEM in bachelor's degrees need to be Latinas with some knowledge of the STEM climate. However, if this study was done as a transcendental phenomenology, the investigator should bracket out their experiences, become more of an instrument, and would thus not need to be a Latina.

Theoretical Implications

Tinto's (2015) model of student motivation and persistence was found to be a very adequate framework through which to understand the experiences of Latinas persisting in a STEM bachelor's degree, and may aptly be considered to be used in other studies investigating the experiences of women or minorities persisting in STEM degrees. Models that focus on cultural integration fall short of the experiences of Latinas persisting in STEM degrees, since they must focus on the material. However, if culture was integrated into STEM persistence, by acknowledging and celebrating minorities in STEM fields, it will likely encourage motivation.

Empirical Implications

The present study explained the factors that fostered persistence among Latinas in a bachelor's degree in STEM. Thus, the topics raised in Chapter Two were discussed in Chapter Five. I expounded upon experiences in the Latinas' lives, which included sense of belonging, disadvantage, exposure experiences, intrinsic motivation, goal setting, low-quality education, tracking, and culture played a part. It was found that the Latinas' persistence was enhanced by teachers, mentors, and advisors who invested in them. It was also found that not all Latinas experience disadvantage, however, the transition to college is more difficult for the ones that do.

The Latinas' exposure experience enabled them to become interested in their STEM field, and set their goal to attain a bachelor's degree in the STEM field of their choice. It was found that higher tracking had a positive impact on Latinas' persistence in STEM, and that the Latinas who attended low quality schools avoided low-quality education by enrolling in honors, AP, and dual enrollment classes. The Latinas benefitted from sharing a cultural identity that believed that hard work pays off. Lastly, the Latinas had families that protected them from static gender roles and criticisms within the Hispanic community. Sense of belonging was important in Latinas' persistence, as all 10 Latinas had at least one support system made up of people who encouraged them.

Practical Implications

The practical implications in this study are aimed at Hispanic families, the Hispanic community, educators, mentors, and the Latinas themselves.

Families. Families are encouraged to find out what their Latinas natural abilities and interests are, and to protect and foster their growth. Families are encouraged to work with the school to ensure that their Latinas' desires are respected and that they are being challenged

academically. Families are encouraged to not hold their daughters to traditional gender roles. Families must remind their daughters that the better they do in school, the more opportunities and options they will have to access a better job, earn more, and provide more for their families. They are encouraged to see a STEM degree as an investment that will reap rewards in the Latinas' life. They must be reminded that when Latinas are pursuing a degree in STEM, their availability will be limited, and they cannot be expected to regularly take part in family events, phone calls, and visits, especially when deadlines are upon them.

Hispanic community. The Hispanic community is encouraged not to criticize Latinas for desiring to pursue a STEM degree. It is encouraged that the community accept and encourage these Latinas to achieve their goal, even if it is outside of traditional female jobs. Expecting Latinas to fulfill traditional gender roles when they do not desire to will stifle their options in life. It is encouraged that the Latinas be respected for their decision to continue their education.

Mentors. Older, more accomplished Latinas can make wonderful role models to look up to for younger Latinas. However, if it is assumed that a person of the same gender and race/ethnicity will be helpful to someone like them, then the assumption is unfounded. Older Latinas may not all be helpful in encouraging younger Latinas' dreams, as it was found in this study. Thus, the Latinas need a community of helpful people who will support them, some of whom may not be Hispanic. As the Latinas enter places of work, they will change the face of STEM. Finding power in numbers, younger Latinas will be inspired to achieve more educationally because they know people in their community or in their family who are professionals. With their family's support, the current for the next generation of Latinas may flow toward academic achievement (Griffith, 2010; Peralta et al., 2013; Zerquera & Gross, 2015).

Therefore, professionals, including educators and STEM workers, are encouraged to seek out formal or informal mentorship opportunities to broaden Latinas' horizon and support student achievement. One suggestion would be to create mentorship groups and attend presentations where Latinas are exposed to STEM. No race or ethnicity or even pedagogical strategy can replace a caring, approachable, and understanding mentor.

Latinas. The practical suggestion for younger Latinas is to find out what they love. They can find out what they are naturally curious about, what they want to discover. Also, they can reflect on which classes they cannot wait to attend, and seek out a few friends who are going in the same direction as them, friends who are academically oriented. Once they know what they love, they should find out what career fits their interest, and what is needed to do to get there. They must find people who will be on their side. Finding people who can tell them how to get there and how to find scholarships will be beneficial. It is important for them to talk to their family about their dreams, and show them how their educational achievement benefits the whole family and community.

Teachers. Teachers are encouraged to reach out to Latinas and get to know them. Becoming familiar with their potential, abilities, and interests will enable them to speak into the Latina's lives. Using this opportunity, teachers will be able to encourage Latinas to ponder upon a goal or a desire that they would like to accomplish. Thus, teachers will be able to offer guidance as to how to accomplish this dream. Teachers may encourage Latinas to take certain higher level courses, visit a key person who is familiar with access to funding, and affirm them that their dream is valid, and they belong there as much as anyone else.

Professors. Professors are advised to take special care when communicating with Latinas. The fact that they are in the STEM classroom speaks volumes, therefore, it is advised

that their names be remembered, that information about tutoring be made available, and lastly, that they are encouraged to persist. Creating hands-on opportunities will help Latinas put their knowledge to work and develop their STEM identity, thus enhancing persistence. These opportunities could be in the form of community service, internship opportunities, missions work, research groups, or study groups.

Advisors. It is suggested that advisors be more of a presence around the school. Latinas may not know who to go to in order to find out about scholarship opportunities unique to them, and even the schools that they may need to apply to. It is important that Latinas know who their advisors are and what they do. It is suggested that the advisor role be more publicized so that Latinas know who to talk to in order to make the pathway to the university less stressful.

University. Universities can make the process to seek financial aid more intuitive for Latinas by having a contact person for them. Universities should have scholarships reserved for underserved, underprivileged, and first-generation minorities. Universities should foster Latinas' perseverance by providing professional development for their faculty and teaching assistants to become aware of the ways they discourage, stigmatize, and alienate double minorities. In addition, they can replace those bad actions with learning ways to encourage, strength, and integrate Latinas into the STEM classroom environment.

Delimitations and Limitations

Delimitations refers to the boundaries that I set as to what would be explored in this study. However, limitations are items outside of the scope of this study that were not in the researcher's control.

Delimitations

One of the boundaries of this study was that no males were included. Thus their experiences persisting in a bachelor's degree in STEM were not explored. Another delimitation was that exploring Latinas' experience working in a STEM field after graduating from a STEM degree was outside of the scope of this study. A third delimitation was that the criteria for taking part in this study is that the participants had to identify as Latinas and be the descendant of someone from a Spanish-speaking country. However, those qualifiers did not guarantee that the Latinas were culturally Latinas.

Limitations

Every study has limitations. One limitation in this study was related to the small sample size. Another limitation was related to the amount of Latinas with degrees in science, technology, engineering and mathematics in this study, namely, that I was only able to secure one Latina in the field of engineering, and one in the field of mathematics.

Recommendations for Future Research

While this study provides an important first step in giving a voice to Latinas who persisted to earn STEM undergraduate degree, there are many ways this research can be further extended. One recommendation is that Latinas' persistence in STEM be investigated as a case study. The Latinas and their families were a unit, and peers and faculty were also important. Thus, each party should be researched. The perspectives of mentors, teachers, professors, and advisors that impacted the Latinas should be explored as well. Additionally, it would also be advantageous to look at this study though the lens of a grounded theory, since this would allow the investigator to search for a new theory pertaining to the experiences of Latinas persisting in a STEM degree in the United States.

Some of the participants found that they were interested in STEM as early as elementary school. Thus, researchers are encouraged to find out how being exposed to STEM in elementary school impacts Latinas in a longitudinal sense. Also, it is suggested that summer STEM camps be offered for girls only and data collected as to whether their self-efficacy in the STEM field was impacted. It would be interesting also to find out whether Latinas being taught by teachers who have STEM certifications in elementary school impacts their perception of STEM.

It is also suggested that researchers conduct investigations on other underrepresented minority groups persisting in STEM fields, such as African women, women of Middle Eastern descent, women from Appalachian backgrounds and Roma women.

Further, researchers should take painful care to ensure that the Latinas being researched represent one socioeconomic status, since experiences may vary wildly based on the lifestyle of the family. Similarly, it is encouraged that researchers study first-generation Latinas separately.

Also, it would be stimulating to conduct a comparative analysis on Latinas who earned their STEM degree in a Latin-American country. Lastly, it would be very thought-provoking to conduct a longitudinal analysis on the Latinas in this study, which would then include their experiences working in their STEM field.

Summary

The purpose of this hermeneutic phenomenological study was to understand the lived experiences of Latinas who persisted in a STEM bachelor's degree in the United States. It is my hope to have deciphered the incredibly complex subject of their persistence into manageable themes and subthemes.

Findings suggested that the supportive relationships that Latinas were a part of fostered and, at critical times, protected their intrinsic motivation to persist in STEM. They translated

their family and cultural value of possessing a strong work ethic to academics, and thus developed a high academic identity throughout their formative years and into college. As they persisted in their degree, they developed a STEM identity, a self-perception that they were able to integrate to their cultural identity, and academic identity.

The general succession that I interpreted from their voices is that STEM exposure led to intrinsic motivation in their STEM field in the forms of exploration and curiosity, while developing a high academic identity during their formative years because of their strong work ethic in academics. They then set their goal and worked hard until they graduated. Throughout the process, they were recipients of several types of encouragement and support, which included family, professionals or faculty, and peers.

Jenny's authentic and insightful voice will close the study and offer the insight of a high achieving, first generation, disadvantaged Latina who attended an Ivy League school on a full scholarship.

> So my parents both didn't go to college, both emigrated from Mexico. And for them, they always emphasized… [that in the United] States, students [can]… go to school for free or get their tuition paid for…Opportunities that for them, in Mexico, they wouldn't be able to receive unless they were wealthy... So for them, education was always a big stress, especially from my Dad. He's always out in the sun. [He wanted me] to have better opportunities, better job offers, to do something that [I]… really want to do.

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APPENDIX A

List of STEM Education Degrees

Acoustics
Actuarial Science
Aeronautical/Aerospace
Engineering Technology/Technician
Aeronautics/Aviation/Aerospace
Science and Technology, General.
Aerospace, Aeronautical and
Astronautical/Space Engineering
Agricultural and Horticultural Plant
Breeding
Agricultural Animal Breeding
Agricultural Engineering
Agroecology and Sustainable Agriculture.
Agronomy and Crop Science
Anatomy
Animal Health
Animal Nutrition
Animal Physiology
Animal Sciences, General
Animal Sciences, Other.
Animation, Interactive Technology, Video Graphics and Special
Archeology.
Architectural and Building Sciences/Technology.
Architectural Drafting and
Architectural CAD/CADD
Architectural Engineering
Architectural Engineering
Technology/Technician
Artificial Intelligence
Atomic/Molecular Physics
Automation Engineer
Technology/Technician
Automotive Engineering
Technology/Technician
Biochemical Engineering
Biochemistry
Biochemistry and Molecular
Biology

Biochemistry, Biophysics and Molecular Biology, Other.
Bioengineering and Biomedical Engineering
Biological/Biosystems Engineering
Biology Technician/Biotechnology Laboratory Technician
Biology/Biological Sciences, General
Biomedical Sciences, General
Biomedical Technology/Technician
Biophysics
Botany/Plant Biology
Botany/Plant Biology, Other.
Business Statistics
CAD/CADD Drafting and/or Design Technology/Technician
Cell Biology and Anatomy
Cell/Cellular and Molecular Biology
Cell/Cellular Biology and Anatomical Sciences, Other.
Cell/Cellular Biology and Histology
Ceramic Sciences and Engineering
Chemical and Biomolecular Engineering
Chemical Engineering
Chemical Engineering Technology/Technician
Chemical Engineering, Other.
Chemical Physics
Chemical Process Technology
Chemical Technology/Technician
Chemistry, Other.
Civil Drafting and Civil Engineering CAD/CADD
Civil Engineering Technology/Technician
Civil Engineering, General
Civil Engineering, Other.
Clinical and Industrial Drug Development.
Clinical Laboratory Science/Medical Technology/Technologist.

Cognitive Psychology and Psycholinguistics
Comparative Psychology
Computer and Information Sciences, General
Computer and Information Sciences, Other.
Computer and Information Systems Security/Information Assurance
Computer Engineering Technologies/Technicians, Other.
Computer Engineering Technology/Technician
Computer Engineering, General
Computer Engineering, Other.
Computer Graphics
Computer Hardware Engineering
Computer Hardware Technology/Technician
Computer Programming, Other.
Computer Programming, Specific Applications
Computer Programming, Vendor/Product Certification
Computer Programming/Programmer, General
Computer Science
Computer Software and Media Applications, Other.
Computer Software Engineering
Computer Software Technology/Technician
Computer Support Specialist
Computer Systems Analysis/Analyst
Computer Systems Networking and Telecommunications
Computer Technology/Computer Systems Technology
Computer/Information Technology Services Administration and Management, Other.
Condensed Matter and Materials Physics
Construction Engineering

Construction Engineering
Technology/Technician
Cyber/Computer Forensics and
Counterterrorism.
Cytotechnology/Cytotechnologist.
Dairy Science
Data Modeling/Warehousing and
Database Administration
Data Processing and Data
Processing Technology/Technician
Developmental and Child
Psychology
Developmental Biology and
Embryology
Digital Communication and Media/Multimedia
Drafting and Design
Technology/Technician, General
Drafting/Design Engineering
Technologies/Technicians, Other.
Econometrics and Quantitative
Economics.
Educational Evaluation and
Research.
Educational Statistics and Research
Methods
Educational/Instructional
Technology.
Effects
Electrical and Electronic
Engineering
Technologies/Technicians, Other.
Electrical and Electronics
Engineering
Electrical, Electronic and
Communications Engineering
Electrical, Electronics and
Communications Engineering,
Other.
Electrical/Electronics Drafting and
Electrical/Electronics CAD/CADD
Electromechanical and
Instrumentation and Maintenance
Technologies/Technicians, Other.
Electromechanical Engineering

Electromechanical
Technology/Electromechanical
Engineering
Elementary Particle Physics
Energy Management and Systems
Technology/Technician
Engineering Chemistry
Engineering Design
Engineering Mechanics
Engineering Physics/Applied
Physics
Engineering Science
Engineering Technologies and
Engineering-Related Fields, Other.
Engineering Technology, General
Engineering, General
Engineering, Other.
Engineering/Industrial Management
Engineering-Related Fields, Other.
Engineering-Related Technologies,
Other.
Entomology
Environmental Chemistry
Environmental Control
Technologies/Technicians, Other.
Environmental Engineering
Technology/Environmental
Technology
Environmental Health.
Environmental Science
Environmental Studies.
Environmental/Environmental
Health Engineering
Experimental Psychology
Food Science
Food Science and Technology,
Other.
Food Technology and Processing
Forensic Chemistry
Forensic Science and Technology
Forest Engineering
Forest Sciences and Biology
Geochemistry
Geochemistry and Petrology

Geographic Information Science
and Cartography
Geological and Earth
Sciences/Geosciences, Other.
Geological/Geophysical
Engineering
Geology/Earth Science, General
Geophysics and Seismology
Geotechnical and Geoenvironmental
Engineering
Hazardous Materials Information
Systems Technology/Technician
Hazardous Materials Management
and Waste Technology/Technician
Health/Medical Physics.
Heating, Ventilation, Air
Conditioning and Refrigeration
Engineering
Horticultural Science
Hydraulics and Fluid Power
Technology/Technician
Hydrology and Water Resources
Science
Immunology
Industrial and Physical Pharmacy
and Cosmetic Sciences.
Industrial Engineering
Industrial Production
Technologies/Technicians, Other.
Industrial Radiologic
Technology/Technician
Industrial Safety
Technology/Technician
Industrial Technology/Technician
Informatics
Information Science/Studies
Information Technology
Information Technology Project
Management
Instrumentation
Technology/Technician
Integrated Circuit Design
Laser and Optical Engineering
Laser and Optical
Technology/Technician

Livestock Management
Management Science
Management Science and
Quantitative Methods, Other
Manufacturing Engineering
Manufacturing Engineering
Technology/Technician
Materials Chemistry
Materials Engineering
Materials Science
Materials Sciences, Other.
Mechanical Drafting and
Mechanical Drafting CAD/CADD
Mechanical Engineering
Mechanical Engineering Related
Technologies/Technicians, Other.
Mechanical
Engineering/Mechanical
Technology/Technician
Mechatronics, Robotics, and
Automation Engineering
Medical Informatics
Medical Microbiology and
Bacteriology
Medical Scientist
Medicinal and Pharmaceutical
Chemistry
Metallurgical Engineering
Metallurgical
Technology/Technician
Microbiological Sciences and
Immunology, Other.
Microbiology and Immunology
Microbiology, General
Mining and Mineral Engineering
Mining and Petroleum
Technologies/Technicians, Other.
Mining Technology/Technician
Modeling, Virtual Environments
and Simulation
Molecular Biochemistry
Molecular Biology
Molecular Biophysics
Mycology
Nanotechnology

Natural Products Chemistry and Pharmacognosy
Natural Resources/Conservation, General.
Naval Architecture and Marine Engineering
Network and System Administration/Administrator
Nuclear and Industrial Radiologic Technologies/Technicians, Other.
Nuclear Engineering
Nuclear Engineering Technology/Technician
Nuclear Physics
Nuclear/Nuclear Power Technology/Technician
Occupational Safety and Health Technology/Technician
Ocean Engineering
Oceanography, Chemical and Physical
Operations Research
Optics/Optical Sciences
Organic Chemistry
Packaging Science
Paleontology
Paper Science and Engineering
Parasitology
Personality Psychology
Petroleum Engineering
Petroleum Technology/Technician
Pharmaceutical Sciences.
Pharmaceutics and Drug Design
Pharmacoeconomics/Pharmaceutical Economics.
Photobiology
Physical Chemistry
Physical Science Technologies/Technicians, Other.
Physical Sciences, Other.
Physics, General
Physics, Other.
Physiological Psychology/Psychobiology
Plant Molecular Biology

Plant Pathology/Phytopathology
Plant Physiology
Plant Protection and Integrated Pest Management
Plant Sciences, General
Plant Sciences, Other.
Plasma and High-Temperature Physics
Plastics and Polymer Engineering Technology/Technician
Polymer Chemistry
Polymer/Plastics Engineering
Poultry Science
Pre-Engineering
Psychometrics and Quantitative Psychology
Psychopharmacology
Quality Control and Safety Technologies/Technicians, Other.
Quality Control Technology/Technician
Radiation Biology/Radiobiology
Range Science and Management
Research and Experimental Psychology, Other.
Robotics Technology/Technician
Science Technologies/Technicians, General
Science Technologies/Technicians, Other.
Semiconductor Manufacturing Technology
Social Psychology
Soil Chemistry and Physics
Soil Microbiology
Soil Science and Agronomy, General
Soil Sciences, Other.
Solar Energy Technology/Technician.
Structural Biology
Structural Engineering
Surveying Engineering
Surveying Technology/Surveying

System, Networking, and
LAN/WAN Management/Manager
Systems Engineering
Technology/Technician
Telecommunications Engineering
Telecommunications
Technology/Technician
Textile Sciences and Engineering
Theoretical and Mathematical
Physics
Theoretical Chemistry
Transportation and Highway
Engineering
Urban Forestry.
Veterinary Anatomy
Veterinary Infectious Diseases
Veterinary Microbiology and
Immunobiology
Veterinary Pathology and
Pathobiology
Veterinary Physiology
Veterinary Preventive Medicine
Epidemiology and Public Health
Veterinary Toxicology and
Pharmacology
Virology
Water Quality and Wastewater
Treatment Management and
Recycling
Water Resources Engineering
Web Page, Digital/Multimedia and
Information Resources Design
Web/Multimedia Management and
Webmaster
Welding Engineering
Technology/Technician
Wildlife, Fish and Wildlands Science and Management.
Wood Science and Wood Products/Pulp and Paper Technology
Zoology/Animal Biology

Reference (for Appendix A)

Immigration and Customs Enforcement. (2012). *STEM-Designated Degree Program List.*

Retrieved from https://www.ice.gov/doclib/sevis/pdf/stem-list.pdf

APPENDIX B

List of recommended math and science courses in high school to prepare for a STEM postsecondary degree:

Algebra 1

Geometry

Algebra 2/Trigonometry

Pre-Calculus

Calculus

Biology

Chemistry

Physics

Environmental science

Forensic science

Astronomy

APPENDIX C

Table A1. Reading Grade 4

Year	Jurisdiction	White		Black		Hispanic		Asian/Pacific Islander	
		Average scale score	Standard Error	Average scale score	Standard Error	Average scale score	Standard Error	Average scale score	Standard Error
2015	National	232	(0.3)	206	(0.5)	208	(0.8)	239	(1.4)
2013	National	232	(0.3)	206	(0.5)	207	(0.5)	235	(1.1)
2011	National	231	(0.2)	205	(0.5)	206	(0.5)	235	(1.2)
2009	National	230	(0.3)	205	(0.5)	205	(0.5)	235	(1.0)
2007	National	231	(0.2)	203	(0.4)	205	(0.5)	232	(1.0)
2005	National	229	(0.2)	200	(0.3)	203	(0.5)	229	(0.7)
2003	National	229	(0.2)	198	(0.4)	200	(0.6)	226	(1.2)
2002	National	229	(0.3)	199	(0.5)	201	(1.3)	224	(1.6)
2000	National	224	(1.1)	190	(1.8)	190	(2.9)	225	(5.2)
2000[1]	National	225	(1.1)	191	(1.7)	197	(2.1)	229	(4.7)
1998	National	225	(1.0)	193	(1.9)	193	(3.2)	215	(5.6)
1998[1]	National	226	(0.9)	193	(1.6)	195	(2.1)	221	(4.2)
1994[1]	National	224	(1.3)	185	(1.8)	188	(3.4)	220	(3.8)
1992[1]	National	224	(1.2)	192	(1.7)	197	(2.6)	216	(2.9)

Table A2. Reading Grade 8

Average scale scores for reading, grade 8 by race/ethnicity used to report trends, school-reported, year and jurisdiction: 2 2000, 1998, 1994, and 1992

Year	Jurisdiction	White		Black		Hispanic		Asian/Pacific Islander	
		Average scale score	Standard Error	Average scale score	Standard Error	Average scale score	Standard Error	Average scale score	Standard Error
2015	National	274	(0.2)	248	(0.5)	253	(0.4)	280	(1.3)
2013	National	276	(0.3)	250	(0.4)	256	(0.5)	280	(0.9)
2011	National	274	(0.2)	249	(0.5)	252	(0.5)	275	(1.0)
2009	National	273	(0.2)	246	(0.4)	249	(0.6)	274	(1.1)
2007	National	272	(0.2)	245	(0.4)	247	(0.4)	271	(1.1)
2005	National	271	(0.2)	243	(0.4)	246	(0.4)	271	(0.8)
2003	National	272	(0.2)	244	(0.5)	245	(0.7)	270	(1.1)
2000	National	—	(†)	—	(†)	—	(†)	—	(†)
2000[1]	National	—	(†)	—	(†)	—	(†)	—	(†)
1998	National	270	(0.9)	244	(1.2)	243	(1.7)	264	(7.1)
1998[1]	National	271	(0.9)	243	(1.6)	245	(2.5)	267	(5.0)
1994[1]	National	267	(1.0)	236	(1.8)	243	(1.2)	265	(3.0)
1992[1]	National	267	(1.1)	237	(1.7)	241	(1.6)	268	(3.9)

Table A3. Reading Grade 12

Year	Jurisdiction	White		Black		Hispanic		Asian/Pacific Islander	
		Average scale score	Standard Error	Average scale score	Standard Error	Average scale score	Standard Error	Average scale score	Standard Error
2015	National	295	(0.7)	266	(1.1)	276	(0.9)	297	(2.1)
2013	National	297	(0.6)	268	(0.9)	276	(0.9)	296	(1.9)
2009	National	296	(0.6)	269	(1.1)	274	(1.0)	298	(2.4)
2005	National	293	(0.7)	267	(1.2)	272	(1.2)	287	(1.9)
2002	National	292	(0.7)	267	(1.3)	273	(1.5)	286	(2.0)
1998	National	297	(0.7)	269	(1.4)	275	(1.5)	287	(2.7)
1998[1]	National	297	(0.8)	271	(1.6)	276	(1.1)	288	(4.1)
1994[1]	National	293	(0.7)	265	(1.6)	270	(1.7)	278	(2.4)
1992[1]	National	297	(0.6)	273	(1.4)	279	(2.7)	290	(3.2)

Table A4. Mathematics Grade 4

Year	Jurisdiction	White		Black		Hispanic		Asian/Pacific Islander	
		Average scale score	Standard Error	Average scale score	Standard Error	Average scale score	Standard Error	Average scale score	Standard Erro
2015	National	248	(0.3)	224	(0.4)	230	(0.5)	257	(1.2)
	Puerto Rico	‡	(†)	‡	(†)	‡	(†)	‡	(†)
2013	National	250	(0.2)	224	(0.3)	231	(0.4)	258	(0.8)
	Puerto Rico	‡	(†)	‡	(†)	182	(0.9)	‡	(†)
2011	National	249	(0.2)	224	(0.4)	229	(0.3)	256	(1.0)
	Puerto Rico	‡	(†)	‡	(†)	182	(0.7)	‡	(†)
2009	National	248	(0.2)	222	(0.3)	227	(0.4)	255	(1.0)
	Puerto Rico	—	(†)	—	(†)	—	(†)	—	(†)
2007	National	248	(0.2)	222	(0.3)	227	(0.3)	253	(0.8)
	Puerto Rico	—	(†)	—	(†)	—	(†)	—	(†)
2005	National	246	(0.1)	220	(0.3)	226	(0.3)	251	(0.7)
	Puerto Rico	‡	(†)	‡	(†)	‡	(†)	‡	(†)
2003	National	243	(0.2)	216	(0.4)	222	(0.4)	246	(1.1)
	Puerto Rico	‡	(†)	‡	(†)	‡	(†)	‡	(†)
2000	National	234	(0.8)	203	(1.2)	208	(1.5)	‡	(†)
	Puerto Rico	—	(†)	—	(†)	—	(†)	—	(†)
2000[1]	National	235	(1.0)	204	(1.6)	209	(1.8)	‡	(†)
	Puerto Rico	—	(†)	—	(†)	—	(†)	—	(†)
1996	National	232	(1.0)	198	(1.6)	207	(1.9)	229	(4.2)
	Puerto Rico	—	(†)	—	(†)	—	(†)	—	(†)
1996[1]	National	231	(0.9)	199	(2.4)	205	(3.0)	226	(4.3)
	Puerto Rico	—	(†)	—	(†)	—	(†)	—	(†)
1992[1]	National	227	(0.8)	193	(1.4)	202	(1.5)	231	(2.1)
	Puerto Rico	—	(†)	—	(†)	—	(†)	—	(†)
1990[1]	National	220	(1.0)	188	(1.8)	200	(2.2)	225	(4.1)

Table A5. Mathematics Grade 8

Year	Jurisdiction	White		Black		Hispanic		Asian/Pacific Islander	
		Average scale score	Standard Error	Average scale score	Standard Error	Average scale score	Standard Error	Average scale score	Standard Error
2015	National	292	(0.3)	260	(0.5)	270	(0.5)	306	(1.5)
	Puerto Rico	‡	(†)	‡	(†)	‡	(†)	‡	(†)
2013	National	294	(0.3)	263	(0.4)	272	(0.5)	306	(1.1)
	Puerto Rico	‡	(†)	‡	(†)	218	(0.7)	‡	(†)
2011	National	293	(0.2)	262	(0.5)	270	(0.5)	303	(1.0)
	Puerto Rico	‡	(†)	‡	(†)	218	(0.8)	‡	(†)
2009	National	293	(0.3)	261	(0.5)	266	(0.6)	301	(1.2)
	Puerto Rico	—	(†)	—	(†)	—	(†)	—	(†)
2007	National	291	(0.3)	260	(0.4)	265	(0.4)	297	(0.9)
	Puerto Rico	—	(†)	—	(†)	—	(†)	—	(†)
2005	National	289	(0.2)	255	(0.4)	262	(0.4)	295	(0.9)
	Puerto Rico	‡	(†)	‡	(†)	‡	(†)	‡	(†)
2003	National	288	(0.3)	252	(0.5)	259	(0.6)	291	(1.3)
	Puerto Rico	‡	(†)	‡	(†)	‡	(†)	‡	(†)
2000	National	284	(0.8)	244	(1.2)	253	(1.3)	288	(3.5)
	Puerto Rico	—	(†)	—	(†)	—	(†)	—	(†)
2000[1]	National	285	(0.8)	246	(1.4)	253	(1.8)	287	(3.4)
	Puerto Rico	—	(†)	—	(†)	—	(†)	—	(†)
1996	National	281	(1.1)	240	(1.9)	251	(1.7)	‡	(†)
	Puerto Rico	—	(†)	—	(†)	—	(†)	—	(†)
1996[1]	National	281	(1.2)	242	(2.0)	251	(2.4)	‡	(†)
	Puerto Rico	—	(†)	—	(†)	—	(†)	—	(†)
1992[1]	National	277	(1.0)	237	(1.3)	249	(1.2)	290	(5.9)
	Puerto Rico	—	(†)	—	(†)	—	(†)	—	(†)
1990[1]	National	270	(1.3)	237	(2.7)	246	(4.3)	275	(5.0)

Table A6. Mathematics Grade 12

Average scale scores for mathematics, grade 12 by race/ethnicity used to report trends, school-reported, year and jurisdic

Year	Jurisdiction	White		Black		Hispanic		Asian/Pacific Islander	
		Average scale score	Standard Error	Average scale score	Standard Error	Average scale score	Standard Error	Average scale score	Standard Error
2015	National	160	(0.6)	130	(1.0)	139	(0.8)	170	(2.0)
2013	National	162	(0.6)	132	(0.8)	141	(0.8)	172	(1.3)
2009	National	161	(0.6)	131	(0.8)	138	(0.8)	175	(2.7)
2005	National	157	(0.6)	127	(1.1)	133	(1.3)	163	(2.0)

NOTE: Black includes African American, Hispanic includes Latino, and Pacific Islander includes Native Hawaiian. Race categorie

APPENDIX D

Part of Mayra's interview:

Researcher: So thinking about high school, how did you feel about your abilities?

No, I did not feel like I was one of the smart kids. For some reason, although it came easy to me later, so we talked about the COBOL class, I didn't think I was going to pass it, I was like, how are these kids doing that? What do they go home and study? Like does someone help them? I was very challenged and it was very confusing. It wasn't until one we had 3 repetitive tasking. Then I started getting it. Understanding how it worked, but it wasn't until like senior mid year. But I didn't feel like one of the smart ones. I felt like people in class kind of got it, like they were ahead of me. And at the end of the year, I was helping some of them. I didn't feel like one of the smart ones, I felt very, very challenged. I was one of those who had to go home and study, and I felt like some of them just knew it. For practice I would write out the program and I didn't know how I could test it. It wasn't until the next day at school that I would find out I had errors, and I would say how am I going to fix it? So yea, unfortunately I felt at a disadvantage point.

Part of Alba's interview:

Yea, I'd say observing my mom's career and some of the struggles that she went through in grad school and otherwise I've learned more as an adult and understood more, I know she talked about those struggles with me when I was younger, but I don't think I actually emotionally understood what that meant and now I actually understand a lot more of what she went through with the career she built. And I think that it's definitely I'm like, I'm turning into my mother. I'm my mother's daughter. And I'm very proud of that, I ask her for work advice now, which is something really cool.

Researcher: Can you think of any mentor or teacher that affected you through school?

I feel like I had a really amazing English teacher, history teacher, math teachers, who were just like funny and supportive. I think I definitely pushed myself too hard in high school but they would like notice that and say 'you need to calm down" I think that it's hard to have that kind of foresight when you're a stupid teenager, was really nice that they were really great about that.

APPENDIX E

Prompt of letter of advice:

Please write a letter to an imaginary younger Latina who is capable and interested in a STEM degree. What age is she? Why did you choose that age?
Please include in your letter the bachelor's degree you earned. Also, tell her the support that was important to you during your persistence in your STEM degree, and how you stayed motivated to persist when you wanted to quit.

APPENDIX F

Letters of advice written by participants:

March 28, 2019

Greetings (14 year old Latina),

I understand that at this age your world is changing a lot. You are in high school or about to start high school. In addition, you may also be considering your future career. It may seem like a long time from now, but it is always good to prepare for the future. Achieving a STEM degree can open your door to a wide variety of options. For example, STEM degree includes computer science, engineering, biology, and ect.

At a young age I decided that I wanted to pursue in the STEM field. I saw I need for Spanish speaking people to be involved in the medical field. As a young girl, I also always translated for my mother when we went to doctor appointments. So it made me realize that a STEM degree was what I wanted. I started my career by earning an associate's degree in Exercise Science. After I realized that I enjoyed helping people and making a difference, I then continued and earned a bachelor's degree in Kinesiology. With my degree I have been able to educate the public on chronic diseases and how to improve quality of life. However, in my journey I also relieved that it was not going to be easy and that it was going to take a lot of my time. With the support I received from my family and determination I had within I was able to accomplish my goal. Because I was a first time generation college student in my family, I found myself lost a lot of the time and in many cases I found myself struggling and spending late nights studying, yet I did not give up and it was all worth it at the end. I also did not want to disappoint my family, so they kept me going because I knew they expected me to be successful The STEM field is made up of primarily white Caucasian males, but do not let that discourage you. You are making a path for other Latinas to come in, so consider yourself a leader and work hard.

Sincerely,

Rosita

Dear amazing, brilliant young woman,

I cannot adequately express my excitement and enthusiasm for the journey you are starting on. The fact that you have even considered starting down a path that so many people fear, and have shown up to a class is already a feat in itself, and you should be so proud of yourself. The path you are considering is not necessarily an easy one or one that might be considered trivial, but it is an extraordinarily beautiful and transformative one.

The world is your oyster, and oftentimes, the more difficult paths are the ones that will be the most exciting and worthwhile. Nothing in life that is worthwhile will be easy, and that perhaps makes it all the more valuable and exciting.

There might be moments when you're tempted to doubt your ability to do well on an exam, do well in a class, or understand a concept. It won't be a question of if that will happen (if it hasn't already) it is a question of when. We're imperfect, and the work we are learning to navigate is a difficult one that's made to challenge us in ways that may seem insurmountable at times. Trust that your good, dedicated and smart work will take you further than any hidden talent that could have been bestowed upon you. The best remedy to insecurity is good and hard work. You'll surprise yourself in myriad ways and it'll be the most beautiful thing to recognize that you're stronger and more capable than you think.

I have doubted myself and my own capabilities for decades now. I am 26 years old, and graduated with a BSc in Mathematics and a BA in Economics and work as a Software Engineer on Machine Learning pipelines. Real, blanket confidence that seems to come so easy to many white men has eluded me for decades. It's not easy to live in a world with spaces filled with people that do not look or necessarily think like you, but I can promise you it gets better.

I'll leave you with something that I've now started telling myself right before I feel my heartrate quickening, either getting nervous before an interview or a big speech or announcement: do not doubt for a single moment that you do not deserve to be here. You deserve every minute of this, and you deserve to be taking space and time. You have earned it.

With all the love and warm wishes I can muster,

Alba

APPENDIX G

The Liberty University Institutional
Review Board has approved
this document for use from
1/21/2019 to 1/20/2020
Protocol # 3622.012119

CONSENT FORM

The Voice of Latinas Persisting in Science, Technology, Engineering, and Mathematics: A Phenomenological Study

Patricia Meulemans
Liberty University
School of Education

You are invited to be in a research study on the experiences of Latinas persisting in a bachelor's degree in STEM. I am exploring the experiences of Latinas from anywhere in the US who finished a bachelor's degree in science, mathematics, engineering, or technology, or any related degree. You were selected as a possible participant because you finished a bachelors' degree in STEM within the last 10 years and you self-identify as a Latina and were born in or are a descendant of someone who was born in a Spanish-speaking country. Please read this form and ask any questions you may have before agreeing to be in the study. Patricia Meulemans, a doctoral candidate in the School of Education at Liberty University, is conducting this study.

Background Information: The purpose of this study is to explore the experiences of Latinas who persisted and finished a degree in STEM.

Procedures: If you agree to be in this study, I would ask you to do the following things:
1. Interviews – I would ask to interview you one time for about one to two hours, and I would record the audio of our conversation.
2. Focus groups – I would ask you to meet with me and two to three other participants for about 2 hours, and I would record the audio of our conversation.
3. Letter of advice – I would ask you to write a letter to a younger Latina in which you would offer some advice as to how to persist in a degree in STEM. This may take you 10-30 minutes.

Risks: The risks involved in this study are minimal, which means they are equal to the risks you would encounter in everyday life.

Benefits: Participants should not expect to receive a direct benefit from taking part in this study. However, your participation may generate more knowledge in society as to how to engage and motivate Latinas to persist in a STEM degree.

The Liberty University Institutional
Review Board has approved
this document for use from
1/21/2019 to 1/20/2020
Protocol # 3622.012119

Compensation: Participants will only be compensated for participating in this study upon completion.
No compensation will be granted if the participant does not finish the study. After completing an interview, a focus group, and a letter of advice, the participant will be compensated with a $25 gift card to the restaurant of their choice.

Confidentiality: The records of this study will be kept private. In any sort of report I might publish, I will not include any information that will make it possible to identify a subject. Research records will be stored securely, and only the researcher will have access to the records. I may share the data I collect from you for use in future research studies or with other researchers; if I share the data that I collect about you, I will remove any information that could identify you, if applicable, before I share the data.

• Participants will be assigned a pseudonym. I will conduct the interviews in a location where others will not easily overhear the conversation.
• Data will be stored on a password locked computer and may be used in future presentations. After three years, all electronic records will be deleted.
• Interviews and focus groups will be recorded and transcribed. Recordings will be stored on a password locked computer for three years and then erased. Only the researcher will have access to these recordings.
• I cannot assure participants that other members of the focus group will not share what was discussed with persons outside of the group.

Voluntary Nature of the Study: Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with Liberty University. If you decide to participate, you are free to not answer any question or withdraw at any time without affecting those relationships.

How to Withdraw from the Study: If you choose to withdraw from the study, please contact the researcher at the email address/phone number included in the next paragraph. Should you choose to withdraw, data collected from you, apart from focus group data, will be destroyed immediately and will not be included in this study. Focus group data will not be destroyed, but your contributions to the focus group will not be included in the study if you choose to withdraw.

Contacts and Questions: The researcher conducting this study is Patricia Meulemans. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact her at (540) 520-2940 or patricia.m.meulemans@gmail.com. You may also contact the researcher's faculty chair, Lucinda Spaulding, at lsspaulding@liberty.edu.

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher, **you are encouraged** to contact the Institutional Review Board, 1971 University Blvd., Green Hall Ste. 2845, Lynchburg, VA 24515 or email at irb@liberty.edu.

Please notify the researcher if you would like a copy of this information for your records.

Statement of Consent: I have read and understood the above information. I have asked questions and have received answers. I consent to participate in the study.
The researcher has my permission to audio-record me as part of my participation in this study.

Signature of Participant	Date
Signature of Investigator	Date

APPENDIX H

11/28/18

I do want to state my hunches and gut feelings about Latinas persisting in a STEM degree. I believe that if they are away from home, they will need great support from those around them, and not be isolated or excluded. If they are living at home, then they won't need as much inclusion in school, but maybe their level of sense of belonging that they need will depend on their motive. Are they persisting in STEM to help their family? Are they persisting in STEM because they got good grades in high school science?

2/16/19

Participant #2 was also full of good experiences. She loved exploring and was curious as a child. She also had a really involved and supportive dad, who was an accountant from El Salvador, and she had a strong early exposure to science. She had been accepted and had set her mind to go to Marymount University, however, one of her scholarships was denied and a few days before school started, she found out she could not attend. From the beginning of her collegiate career, she was depressed, and that depression continued for 2 whole years. This was demonstrated by her lack of effort during the years in the community college she attended. She finally got out of that depression, created a plan for herself to where she would be able to attend a university that honored her associate's degree, and she did it. She was not in a rigorous science degree, so she would say the biggest struggle for her was the motivation in the beginning, and having to work along with go to school, since her dad does not believe in debt. She felt very involved in her degree, though, and felt like she was seen as a leader in her classes, since her professors trusted and depended on her a lot for health fairs. She felt like the intra-institutional climate was warm and accepting. She does not have an accent, and has a high academic identity.

APPENDIX I

LIBERTY UNIVERSITY.
INSTITUTIONAL REVIEW BOARD

January 21, 2019

Patricia Meulemans
IRB Approval 3622.012119: The Voice of Latinas Persisting in Science, Technology, Engineering, and Mathematics: A Phenomenological Study

Dear Patricia Meulemans,

We are pleased to inform you that your study has been approved by the Liberty University IRB. This approval is extended to you for one year from the date provided above with your protocol number. If data collection proceeds past one year or if you make changes in the methodology as it pertains to human subjects, you must submit an appropriate update form to the IRB. The forms for these cases were attached to your approval email.

Your study falls under the expedited review category (45 CFR 46.110), which is applicable to specific, minimal risk studies and minor changes to approved studies for the following reason(s):

> 6. Collection of data from voice, video, digital, or image recordings made for research purposes.
>
> 7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies. (NOTE: Some research in this category may be exempt from the HHS regulations for the protection of human subjects. 45 CFR 46.101(b)(2) and (b)(3). This listing refers only to research that is not exempt.)

Thank you for your cooperation with the IRB, and we wish you well with your research project.