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A Qualitative Exploration of the Factors that Led Hispanic/Latina Middle School Students to Select a STEM High School Education in New York City

Maria Lopez

St. John Fisher College, mal07119@sjfc.edu

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A Qualitative Exploration of the Factors that Led Hispanic/Latina Middle School Students to Select a STEM High School Education in New York City

Abstract

There is a significant gender gap in science, technology, engineering, and mathematics (STEM) careers as well as in the STEM workforce that continues to expand, ultimately impacting the global economy. In response to this crisis, this qualitative study sought to identify the factors that led Hispanic/Latina middle school students to select a STEM high school education. For this study, a purposeful sample of twenty-five ninth-grade Hispanic/Latina students participated from two designated STEM private high schools located in a densely populated Hispanic/Latino area in the Bronx. Participants anonymously responded to The Middle to High School STEM Experience questionnaire (see Appendix A and Appendix B), with a Qualtrics instrument to supply the data. A qualitative analysis of the results followed. The results illuminated the essential roles that intrapersonal skills and external barriers play in the success of participants. In light of these results, there should be a greater focus on increased funding, early exposure to STEM, experiential learning, and the identification of role models for Hispanic/Latina students. Additionally, this study may help to advance the long overdue need to explore factors motivating young Hispanic/Latinas to enter STEM education and careers to achieve growing STEM workforce demands. Recommendations for further research include conducting a broader research project with a larger sample size that also involves public school students from the New York City Department of Education in order to make the findings more generalizable.

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A Qualitative Exploration of the Factors that Led Hispanic/Latina Middle School
Students to Select a STEM High School Education in New York City

By

Maria Lopez

Submitted in partial fulfillment
of the requirements for the degree
Ed.D. in Executive Leadership

Supervised by

Dr. Janice Kelly

Committee Member

Dr. Fran Wills

Ralph C. Wilson, Jr. School of Education

St. John Fisher College

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Dedication

I would like to dedicate this research, first and foremost, to God for giving me the strength to endure whatever came my way especially during the process of completing this degree. In the span of 13 months, I lost my sister, father, mother, and had my oldest son diagnosed with leukemia. However, my faith in the Lord led me to believe that these challenges were not setbacks but rather opportunities for professional, academic, and emotional growth.

I also want to dedicate this research to my dearest mother, Anita Heredia, who recently passed away on January 25, 2018. My mother was a smart, brave, strong Hispanic/Latina woman who instilled in me the value of education as a means to a better life. She enlightened me to the power and persistence of education, that once obtained could never be seized, regardless of my gender, race, or socioeconomic status.

My mother was my hero for her unconditional love, hard work, tenacity, strengths, consistency, and persistence. She was my inspiration, strength, role model, friend, guide, and cheerleader for everything and anything I wanted to accomplish. She instilled within me the most fundamental values to raise my four children Juan, Ana Maria, Virgilio, and Arlene. My mother would say, “Tatica (her endearing nickname for me), always put love, passion, and pride in anything you do. Stay focused and firm regardless of any adversity you may face, and most importantly be persistent, persistent, persistent, and even more persistent.”

This is for you, Mom, who started this journey with me but could not finish it. With all my love and mourning, as your *tesoro, vida, y adoración*, I dedicate this study to your memory and legacy because “it isn’t about how hard you hit. It is about how hard you can get hit and keep moving forward. That’s how winning is done.” – Rocky Balboa

I would also like to acknowledge my father and my pillar, Virgilio Heredia, who also recently passed away and who gave me the greatest gift anyone could give another person—confidence. He always believed in my goals, my abilities, and most importantly in me. He raised me on ethical principles and instilled within me his values of morality and integrity. He always told me, “Do things right and you’ll never have to look over your shoulder.” With that piece of guidance, I have lived my life, applying that counsel to all I do professionally and personally.

I feel I must also acknowledge my husband of 27 years, Juan Lopez, Jr. who has given me my four most precious diamonds, Juan III, Ana Maria, Virgilio, and Arlene.

To my four children Juan, Ana Maria, Virgilio, and Arlene, who in the face of adversity and trial became more united than ever, I am so proud of how you have become such strong and responsible young men and women. In confronting loss, sorrow, and illness, you four became my rock, grounding me to the Earth and motivating me to persevere during my most trying times. As one family unit, my four children nurtured, cared, supported, and encouraged me to continue this journey against all the odds.

In the thick of battling leukemia, my oldest son, Juan III (Bass the Beast), urged me onward to continue fighting the war together. His unending optimism and support uplifted me when I needed it most. He pushed me to complete my academic pursuit,

encouraging me to write and read at the foot of his hospital bed all while he expressed his emotions, pain, and sorrow through his gift from God—his words, voice, and music.

Then, there is my daughter Ana Maria, who not only had to deal with all the losses and illnesses that our family underwent, but also with the normal stresses that accompany the life of any medical student. Ana Maria, however, still had the time to encourage, support, and check in on me.

I cannot but thank my son, Virgilio, for how he used his business acumen to remind me that I am the leader and role model for my children. Quitting my academic career was and is not a choice I could make, at least not for the sake of my children. That understanding was vital to the completion of my degree.

And last but not least, there is my youngest daughter, Arlene (my baby), who always encouraged, supported, and nurtured me. Arlene spent numerous hours reading and reflecting on my papers, challenging my organization and ideas, and pushing my abilities as a scholar to the next level. Although she is now at the London School of Economics and Political Science pursuing her master's in international relations, her unending support persists even from more than 3,000 miles away.

I hope that this undertaking instills in you, my four most precious diamonds, the clear concept that with God, family, love, and persistence everything and anything is possible. I owe a massive part of this accomplishment to you four.

To my sisters, Angela, Francia, and Sonia (who recently passed away), thank you for the continued and consistent love and support you have given me all my life.

To my nieces—Scarlet, Francine, Frances, and Charlene—and nephews—Darwin, Joan, Peter, and Michael—and my entire family as well, I hope this journey

serves as inspiration for you all to continue the legacy of education in our family and your next career moves.

To my friends, Frank and Virginia-Ann, your unconditional emotional support and consistently wise and reliable guidance have played a pivotal role throughout this journey.

To my dissertation chair, Dr. Janice Kelly, who dedicated countless hours reflecting, reading, encouraging, and most of all demonstrating patience and understanding throughout the entire process, thank you for being an advisor, a mentor, and a role model to me. Without your support, this journey would not be impossible. Thank you to my committee member, Dr. Fran Wills for your support, encouragement, guidance, and insightful ideas. Thank you for taking the time to serve on my committee, despite your many other commitments.

To Dr. Moffett, thank you for your leadership, guidance, and support. I also would like to thank Donna and Sonia for your continued support and encouragement throughout the journey.

To my SJFC cohort members, the “Great 8,” it was my great satisfaction and pleasure to circumnavigate this process with you all. I hope that we all enjoy this new stage in our life with God, love, health, and our family.

With all my love,

Maria Lopez

Biographical Sketch

Maria Lopez is currently the Executive Director of School Technology Strategy at the New York City Department of Education. Mrs. Lopez attended Santo Domingo Institute of Technology and University-Santo Domingo in the Dominican Republic from 1982 to 1987 and graduated with a Bachelor of Science in Industrial Engineering degree in 1987. She attended City College of New York from 1992 to 1994 and graduated with a Master of Science degree in Bilingual (Spanish) Mathematics Education in 1994. Mrs. Lopez also attended City College of New York from 1996 to 1998 and graduated with a School Administration and Supervision Certificate & School District Administrator Certificate in 1998. She came to St. John Fisher College in the summer of 2017 and began doctoral studies in the Ed.D. Program in Executive Leadership. Mrs. Lopez pursued her research in *A Qualitative Exploration of the Factors that Led Hispanic/Latina Middle School Students to Select a STEM High School Education in New York City* under the direction of Dr. Janice Kelly and Dr. Fran Wills and received the Ed.D. degree in 2018.

Abstract

There is a significant gender gap in science, technology, engineering, and mathematics (STEM) careers as well as in the STEM workforce that continues to expand, ultimately impacting the global economy. In response to this crisis, this qualitative study sought to identify the factors that led Hispanic/Latina middle school students to select a STEM high school education. For this study, a purposeful sample of twenty-five ninth-grade Hispanic/Latina students participated from two designated STEM private high schools located in a densely populated Hispanic/Latino area in the Bronx. Participants anonymously responded to The Middle to High School STEM Experience questionnaire (see Appendix A and Appendix B), with a Qualtrics instrument to supply the data. A qualitative analysis of the results followed. The results illuminated the essential roles that intrapersonal skills and external barriers play in the success of participants. In light of these results, there should be a greater focus on increased funding, early exposure to STEM, experiential learning, and the identification of role models for Hispanic/Latina students. Additionally, this study may help to advance the long overdue need to explore factors motivating young Hispanic/Latinas to enter STEM education and careers to achieve growing STEM workforce demands. Recommendations for further research include conducting a broader research project with a larger sample size that also involves public school students from the New York City Department of Education in order to make the findings more generalizable.

Keywords: *STEM, Latino, Hispanic, education, students, female*

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Chapter 1: Introduction

A lack of interest in the fields of science, technology, engineering, and mathematics (STEM) has become a matter of national concern, which has, in more recent years, been highly influential in shaping national policy (NISE, 2017; Strayhorn, 2015). Although there is often considerable overlap across definitions, no consensus exists as to what the STEM workforce entails. STEM professions may include information security, accounting, finance, management, civil and mechanical engineering, computer network architecture, psychology, information technology, environmental engineering, and software development (NISE, 2017). Therefore, caution should be used when comparing studies about STEM (Pew Research Center, 2018). Nonetheless, according to Pew Research Center (2018), STEM occupations have grown 79% since 1990, from 9.7 million to 17.3 million, outpacing overall U.S. job growth. However, Hispanic and Black workers continue to be underrepresented in the STEM workforce including jobs that require professional or doctoral degrees (Pew Research Center, 2018). Although Hispanic and Blacks make up 16% and 11% of the U.S. workforce overall, they only represent 7% and 9% of all the STEM workers (Pew Research, 2018).

Yet STEM fields are important because STEM degree holders working in STEM industries made 31% higher than those of non-STEM majors working in non-STEM fields (Noonan, 2017). Noonan (2017) also found that STEM degree holders enjoyed higher earnings, regardless of whether they worked in STEM or non-STEM because of their transferrable skills. STEM degrees opened the door to many other career

opportunities since more than two-thirds of all technology jobs existed outside the technology sector and 83% of STEM undergraduates could work outside of STEM fields (Noonan, 2017). Yet there are not enough domestically educated workers to benefit from these opportunities (Noonan, 2017).

Background of the Study

A variety of studies have shown that women and minority groups have been drastically underrepresented in the STEM fields, demonstrating that there is a significant gender gap in science, technology, engineering, and mathematics careers (Mayo, 2010). In describing patterns of enrollment in STEM majors, studies revealed that of all the undergraduate degrees in engineering awarded in the United States in 2015, 79.2% went to males as compared to 20.8% to females. One study by the American Society for Engineering Education (2017) found that of 11,702 doctoral degrees in engineering awarded in the United States in 2015, 76.9% went to males as compared to 23.3% to females.

According to Moss-Racusin, Dovidio, Brescoll, Graham, and Handelsman (2012), female students' preferences, participation, and performance in STEM resulted from many factors that originated in their early educational years and lasted until they began their careers. The National Science Foundation's (NSF, 2017a) *Women, Minorities, and Persons with Disabilities in Science and Engineering* report revealed that although females obtain more than half of all bachelor's degrees awarded in the United States, their representation in the scientific fields is limited. Additionally, The World Economic Forum's (2016) *Global Gender Gap Report* revealed that female students earn approximately 50% of all bachelor degrees in the United States while only 16% of all

female students graduated with STEM degrees as compared to 30% of all male students. According to a 2015 report published by McKinsey Global Institute (MGI), women comprised more than 20% of engineering school graduates. However, the report revealed that only 11% of practicing engineers were women (MGI, 2015). The report also indicated that, out of 100 female students working toward a bachelor's degree, only three would be working in STEM-related professions 10 years after graduation (MGI, 2015). Yoder (2016) indicated that although postsecondary education access is increasing, females lag behind males in engineering postsecondary attainment: respectively, 20.8%, 25.4%, and 23.4% of females have received a bachelor's, master's, or doctoral degree compared to 79.2%, 87.2%, and 75.8% of men.

The Department of Commerce (2011) reported on a national concern about the low number of females graduating with STEM degrees, which has resulted in a scarcity of women and minorities in the STEM workforce. Although women represent half the population, women hold only 28% of science and engineering jobs (The World Economic Forum, 2016). According to a report published by (MGI, 2015), women comprised almost 50% of the total workforce in the U.S. economy, but represented less than 25% of jobs in STEM professions, down from 35% in 1990. The McKinsey Global Institute (2015) suggested that the lack of females in STEM fields and careers is not only a persistent global issue with enormous ramifications for the lives and futures of girls and women but also detrimental for human development, labor markets, productivity, gross domestic product (GDP) growth, and equality due to the demand for STEM labor. This report also revealed that adopting gender parity would benefit everyone, given the high and increasing demand for workers with computing skills (MGI, 2015). After all,

advancing women's equality and adding more women to the STEM workplace, including in leadership roles, could not only add \$12 trillion to the gross domestic product (GDP) but by 2025, it could also lead to a more diverse exchange of ideas (MGI, 2015).

Statement of the Problem

Growing concerns regarding the ability of the United States to compete in the global economy have produced demands for national efforts to increase the number and diversity of students pursuing degrees and careers in STEM fields (National Research Council, 2012). Previous researchers have emphasized the urgent need for Americans to ensure that future generations can compete with the other countries currently excelling in mathematics and technology (Moss-Racusin et al., 2012). According to the National Alliance for Partnerships in Equity (NAPE) (2016), an even larger cause for concern within the United States is the major gender gap that already exists in newly developing STEM fields where jobs are expected to grow.

Despite the recent increases in science and engineering (S&E) participation by women and by racial and ethnic minorities, these groups remain underrepresented in S&E compared to their overall labor force participation (National Science Board, 2016). For example, women account for less than one-third of all workers employed in S&E occupations in the United States despite representing half of the college-educated workforce (NSB, 2016). Furthermore, women of color are underrepresented in the STEM workforce, lagging White men, men of color, and White women (McKinsey Women in the Workplace, 2015).

Moss-Racusin et al. (2012) indicated that, to address these 21st-century problems, cultivating a new generation of resilient and creative problem solvers, including women

of color, will be required. Ensuring that young girls—especially young girls of color—have the proper environment and support to lead them into promising STEM fields is essential to guarantee the success not only of American girls but also the success of the country (NAPE, 2016). Yet attracting and retaining Latinas in STEM fields has continued to be a problem despite the existence of interventions and curricula designed to address those issues.

Although theorists and researchers have provided substantial evidence for the existence of the gender gap in the STEM fields at college and career levels (Beede et al., 2011; DuBow et al., 2017; NAPE, 2016), no researcher has examined the even larger gap existing in STEM for Latinas. Researchers know very little about the factors—such as their culture, socioeconomic status, and possible language barriers—leading to such limited number of Latinas in STEM field education and career majors. In response to this gap, this qualitative phenomenological study will focus on the factors that led middle school Hispanic/Latina students to select a high school education focused on STEM in New York City.

Theoretical Rationale

This study will incorporate the use of two theories to examine the influences that have possibly caused Latinas to select STEM programs. Bandura's (1977a) social cognitive theory (SCT) and Gilligan's (1982) moral development theory will form the theoretical framework to investigate factors that support rather than derail Latina students in pursuit of STEM education in high school.

Social learning theory. In the 1960s, Bandura (1977b) developed the framework of social learning theory (SLT), which involves self-efficacy, personal goals, and learned

behavior. Albert Bandura is a psychologist well-known for his work on identifying the critical factors affecting learning and self-efficacy. The fundamental principle of SLT is that individuals learn not only from their own experiences but also through the observation of others, a process called observational learning or modeling (Bandura, 2013). The primary aspects of SLT comprise observational knowledge, reinforcement, self-control, and self-efficacy (Bandura, 2013). Bandura (1977b) proposed that nearly all learning phenomena result from living experiences such as observing role models or other people's behavior. Social learning theory emphasizes the notion that individuals learn from one another through collaboration, personal interactions in society, and instruction.

This theory applies to Hispanic/Latina students engaged in problem-solving, hands-on, group, and individual activities in science, technology, engineering, and mathematics and who will learn from role models not only in the STEM fields but also in STEM courses. According to Bandura (1977b), learning through social interaction leads to cognitive growth and knowledge acquisition. For example, Hispanic/Latina students exposed to STEM instructions, use prior knowledge of science, technology, engineering, and mathematics to construct new experience in STEM education (Bandura, 1977b). DuBow et al.'s (2017) study also related to Bandura's model of reciprocal determinism (MRD) since the researchers suggested that females who surrounded themselves with friends who were also involved in computing had higher chances of selecting and remaining in STEM fields.

Moral development theory. Gilligan's (1982) moral development theory focused on how a patriarchal environment influences female moral values and prevents women

from developing the full capacity of their intellect. Gilligan, Brown, and Rogers (1990) have proposed that some of the main factors that impact the lack of females at all levels of education and career pipelines in STEM fields are internal factors—such as self-concept theory and self-esteem—and external factors, such as the influence that parents, schools, media, institutions, and educators have on girls (Cooper & Heaverlo, 2013; Gilligan et al., 1990; Ing, 2014; Jolly, 2009; Rosicka, 2016). For example, 75% of global unpaid work such as cooking, cleaning, collecting water and firewood, home maintenance, gardening, caring for children and aging relatives are performed by women whether those are done willingly and contribute to personal and family well-being (MGI, 2015).

Bandura and Gilligan's theoretical frameworks guided this researcher's development of the survey utilized in this study. Both approaches established an initial set of factors of interest for this study, which are Bandura's concepts of *performance accomplishments, indirect experiences, verbal encouragement, and psychological states*, and Gilligan's factors of *self-concept* and *self-esteem*. Considering these dimensions through a critical feministic lens reveals how the broader social discourse regarding young women of color, interacts with their STEM interests.

Statement of the Purpose

The purpose of this qualitative study is to examine the factors that contribute to middle school, Hispanic/Latina students selecting a high school education focused on STEM in New York City. Despite their growing numbers, Latinas are not largely selecting or identifying with STEM careers (Ginorio & Huston, 2001). Pew Research Center (2017) claimed that 14.6 million of all Hispanics identified as

millennials and that Latino graduation rates remain the lowest of all major ethnic groups in the United States.

The rationale for selecting this population is based on reports from The National Science Foundation (NSF) (2017b), which revealed that Latinas are not only less likely than Whites and Asians to graduate from high school but are also less likely to enroll in college and earn college degrees. In addition, The U.S. Department of Education's National Center for Educational Statistics (2016) reported that Latinas had a dropout rate of 8.4% compared to their White female counterparts at 4.1% and Black female counterparts at 6.5%. Even more alarming is the fact that while the dropout rates for other groups have been decreasing, the dropout rate for Latinas has remained steady (National Center for Education Statistics, 2016).

According to a report from the Institute for Women's Policy Research (2017), nearly 2.1 million students or 11% of all undergraduates are single mothers, the majority of whom are women of color. The report also indicated that close to half, or 44%, attended community colleges and of those attending community colleges, 43% said that they would be likely to drop out due to financial obstacles and struggles balancing care for their families with school obligations (Institute for Women's Policy Research, 2017). The Pew Research Center (2017) reported that Latinos have the lowest educational attainment level of any group in the United States. According to the National Center for Education Statistics (2016), Latinos earned only 7.3% of all bachelor's degrees in the United States compared to White, non-Hispanics who received 65.1%. In addition, only 3.5% of degrees awarded in STEM went to Latinas (U.S. Department of Education, 2015). Yoder (2016) revealed that Latinos earned only 10.7%, 7.7%, and 3.2%,

respectively, of all bachelor's, master's, and doctoral degrees in engineering awarded in the United States compared to 64.9%, 60.2%, and 62.9%, respectively, that White, non-Hispanics received.

The need for early exposure and implementation of STEM curriculum in primary school years is crucial to encourage the continuation of STEM-focused high school education (Morgan, Farkas, Hillemeier, & Maczuga, 2016). Primary school is a crucial time to address STEM knowledge and understanding (Ainley, Kos, & Nicholas, 2008; Becker & Park, 2011; Blackley & Howell, 2015; English & King, 2015; Grant et al., 2015; Marginson, Tytler, Freeman, & Roberts, 2013; Morgan et al., 2016; Tomas, Jackson, & Carlisle, 2014). Marginson et al. (2013) proposed that students who engage in STEM education during their primary education are more likely to participate in STEM curricula in secondary school. Kier, Blanchard, Osborne, & Albert (2014) suggested that efforts to interest students in STEM majors and careers should begin at the middle school level, since this is the time when students are developing their career interests and recognizing their academic strengths.

Furthermore, Sanders (2009) indicated that if STEM curricula are successfully implemented in K–12 education, more students may have access to STEM knowledge, and the percentage of students interested in STEM subjects and careers may increase. However, for Latina students, in particular, approaches that do not critically discuss the effects of racist and sexist stereotypes and other developmentally challenging social realities will not be practical. This study seeks to illuminate the combination of factors, both academic and social-emotional, that support the pursuit of STEM study by ninth grade Latina students in New York City.

Research Question

The study will address one essential research question: What factors led middle school, Hispanic/Latina students to select a STEM-focused high school education in New York City?

Potential Significance of the Study

The country is facing a significant gender gap in STEM career and education that could negatively impact the economics of every industry in the nation.

Underrepresentation of women is not only a pressing moral and social issue but also a critical economic challenge (McKinsey Global Institute [MGI], 2015). MGI suggested that if women, who account for half of the world's working-age population, do not achieve their full economic potential, the global economy will suffer (MGI, 2015). The problem with that underrepresentation is important because Latinas have comprised the largest female minority group in the United States, reaching a total of 8% of the entire U.S. population in 2001 (Ginorio & Huston, 2001). The underrepresentation of Latinas in STEM fields is even more important because Latinas are the fastest growing group in the country; therefore, Latinas' underrepresentation put the country at risk.

The findings from this study could benefit (a) educators at all levels to provide girls with the social, educational, and emotional support needed to increase Latina participation in STEM; (b) policymakers to address the national concern over having too few females enrolling and persisting in STEM fields and careers; and (c) the scholarly literature on STEM. In addition, the findings may also be of high interest to STEM educators and policymakers because the results could provide them with a deeper

understanding of the factors that motivate Hispanic/Latina students to select and remain in STEM-focused fields and careers.

Definitions of Terms

The following definitions are applicable to this study:

Cognitive – mental processes of perception, memory, judgment, and reasoning (Bandura, 1977a).

Gender Gap – the lack of participation of a gender of human being. In this study, the term refers to a lack of females (English & King, 2015).

Hispanic – People of Spanish-speaking descent (U.S. Census Bureau, 2017).

Language Barriers – A limit or boundary due to a dearth of language proficiency (Cooper & Heaverlo, 2013).

Latinas – Women of Latin American descent (U.S. Census Bureau, 2017).

Minority – a racial, ethnic, religious, or social subdivision of a society that is subordinate to the dominant group in political, financial, or social power regardless of the size of those groups (Robert, 2013).

Patriarchal – a male-dominated family, tribe, community, church, etc. (Gilligan, 1982).

Racist – the doctrine that one's own racial group is superior to others or that a racial group is inferior to the others (Gilligan, 1982).

Self-Efficacy – beliefs and thoughts held by individuals about their abilities to attain goals and succeed (Bandura, 1977a).

Sexist – attitudes and behavior toward someone based on the person's gender, such as being male chauvinist (Gilligan, 1982).

Social Emotional – emotion produced by society rather than reason (Gilligan, 1982).

STEM – an acronym for the fields of science, technology, engineering, and mathematics (Rosicka, 2016).

STEM Field – A field in the science, technology, engineering, and mathematics is defined by some federal agencies, such as the NSF, as a broader definition of STEM that includes psychology and the social science (i.e., political science and economics) as well as the so-called core sciences and engineering (i.e., physics, chemistry, mathematics). Seven others, including the Department of Homeland Security and the U.S. Immigration and Customs Enforcement, use a narrower definition that generally excludes social sciences and focuses on mathematics, chemistry, physics, computer and information sciences, and engineering. Some analysts have argued that field-specific definitions such as these are too static and that definitions of STEM should be interdisciplinary (America Competitors Reauthorization Act of 2010; Moon & Singer, 2012; U.S. Department of Homeland Security, Immigration and Customers and Enforcement, 2012).

Stereotype – A distorted image of a group, such as “women are not intelligent” (Bian, Leslie, and Cimpian, 2017).

Chapter Summary

This chapter illustrates the persistence of a considerable gender gap in STEM fields and traces its origins to profoundly rooted gender biases that affect women learners in STEM fields. Although theorists and researchers have provided substantial evidence for the existence of the gender gap in the STEM fields at college and career levels, no researcher has examined the even larger gap existing in STEM for Latinas (Beede et al.,

2011; DuBow et al., 2017; NAPE, 2016). Researchers have also not identified factors that are responsible for that gap (Beede et al., 2011; DuBow et al., 2017; NAPE, 2016). The lack of research in this area is surprising for several reasons. First, previous researchers have generally indicated an urgent need for more women and minorities in the STEM workforce (Shapiro et al., 2015). Second, out of the 15% of U.S. college students that graduated with degrees in STEM fields, only 6.7% of STEM graduates were women, with Latinas being disproportionately underrepresented when compared to the general population (Mayo, 2010).

This study will be organized into five chapters. Chapter 1 includes the statement of the problem, the theoretical rationale, the statement of purpose, the research question, the potential significance of the study, and the definition of terms used in this study. Chapter 2 provides a study of the literature germane to the research problem. Chapter 3 outlines the research methodology for the study. Chapter 4 provides data analysis, and Chapter 5 covers the implications of the research and recommendations for the future.

Chapter 2: Review of the Literature

Introduction and Purpose

The United States lags behind other countries in STEM student performance. For example, the 2015 Program for International Student Assessment (PISA) ranked the United States 36th out of 69 countries in mathematics (Bybee, 2013; Institute of Education Sciences, 2016). According to Becker and Park (2011), and English and King (2015), the top percentage of students performing at Level 5 or above were Singapore (35%), China (28%), and Japan (20%) while the United States had a mere 6%. Morgan et al. (2016) proposed that addressing gaps in achievement and STEM knowledge at an early age increases the probability that students select STEM-focused education in high school. This early educational foundation becomes an important factor in motivating students to enter into STEM fields. In addition, Hill et al. (2010) indicated that most girls' positive view of technology emerges between ages 11 and 12 and vanishes by roughly 50% by the time girls turn 15 years old. As a result, different institutions began to implement technology programs to inspire girls' interests in technology and to increase the needed digital workforces.

This section examines how increasing student performance and maintaining girls' interest in STEM is imperative to successfully compete with other countries. Several sub-headings emerged from the analysis of the literature reviews, such as (a) gender gap in STEM fields; (b) gender bias in STEM fields; (c) factors that motivate, attract, recruit, and retain females to pursue and persist in STEM fields; and (d) instructional curriculum

in STEM. This section will also examine the need to develop and implement factors that motivate middle school girls to engage and stay in STEM fields as well as encouraging some institutions to implement STEM programs to address STEM instruction at an early age.

Gender Gap in STEM Fields

Beede et al. (2011) argued that the STEM workforce is crucial to America's innovative capacity as well as its ability to compete globally. However, women are underrepresented in STEM jobs and among STEM degrees in colleges and universities. Beede et al. found that although females represented almost 50% of the U.S. workforce, they held less than 25% of STEM jobs. In addition, the authors suggested that women with STEM degrees are less likely than their male counterparts to work in the STEM field, and are instead more likely to work in education and healthcare. Moss-Racusin et al. (2012) also proposed that, regardless of efforts to recruit and retain more women in STEM, inequality continued within the sciences. Consequently, the United States must invest in attracting and retaining females to STEM fields in order to close the gender gap, increase the workforce, and achieve the competitiveness needed to maintain industrial and educational leadership in STEM fields (Atkinson & Mayo, 2010; Becker & Park, 2011; Beede et al., 2011; Bybee, 2013; Crenshaw, 1989; English & King, 2015; Hyde, Lindberg, Linn, Ellis, & Williams, 2008; IES, 2016; Mayo, 2010; Roberts, 2012; Stephens & Sen, 2014; World Economic Forum, 2016). Moreover, Beede et al. proposed that providing female role models, addressing gender stereotyping, and providing a more family-friendly environment may inspire females to apply and stay in STEM fields. Although Beede et al. provided possible solutions to closing the gender gap in STEM, the

researchers failed to address the underlying reasons for the existence of gender differences in STEM.

The National Alliance for Partnerships in Equity (NAPE) (2016) argued that the United States must develop a large qualified workforce in STEM in order to prosper in this technology-driven global economy. The U.S. Department of Labor, Bureau of Labor Statistics (2014) projected an increase of one-million employment opportunities in STEM between 2012 and 2022. To address the rapid job growth, recruitment of underrepresented professionals is needed. Moreover, a strategic and effective well-planned K-12 program needs to be implemented (NAPE, 2016).

In the spring of 2015, the research consortium on STEM Career Pathways piloted a national survey of high school students in STEM classes (NAPE, 2016). The resulting data identified opportunities, challenges, and promising practices for leveraging equity to meet STEM workforce needs. The data from this sample was composed of 7,325 ethnically diverse students distributed almost equally across four graduating classes from 2015 to 2018 (49% female, 51% male; 45% White, 24% Black, 23% Hispanic, 13% Indigenous/Asian, and 9% unidentified). Student responses were gathered from an in-class survey distributed via mail and administered between March 2014 and May 2014 (NAPE, 2016). NAPE found that in order to attract and retain females in STEM fields and college degrees, the following factors should be considered: boosting STEM career confidence, increasing career aspirations, attracting and retaining racial/ethnic groups historically underrepresented in STEM, ensuring a strong curriculum in STEM, and addressing unique barriers. Two factors that promoted solutions to retain females were the incorporation of creative learning in all STEM classrooms, and ensuring

infrastructure equalities. These latter considerations could create STEM pipelines that could close the gender gap today and in the future. NAPE suggested that minority and underrepresented students, especially females, African Americans, Hispanics, and Native American males, suffer the greatest losses in the STEM pipelines, and that a quarter of individuals in these underrepresented groups do not so much as receive an algebra II or chemistry course throughout their entire education. Findings in this study indicated that most high school students perceive STEM courses as important solely for their careers. NAPE also found that underrepresented females not only have to compete with their male peers, but also with their White and Asian female counterparts.

Regardless of race or gender, NAPE recommended identifying and overcoming micro-messaging that threatens STEM confidence; addressing structural inequalities; designing strategies for the more complex challenges young underrepresented female minorities face; building resilient students who persist despite adversity; cultivating a desire to pursue STEM careers; implementing after-school clubs, teams, maker spaces; and creating camps that allow students to experiment with STEM concepts and explore their limitations can be factors that contribute to motivating girls to pursue STEM courses and fields closing the gender gap (NAPE, 2016).

NAPE (2016) identified challenges faced by females in historically underrepresented groups and recommended the implementation of creative learning in all STEM classrooms as well as frequent exposure to STEM courses. The authors also discussed the need to eliminate structural inequality to provide females, and other underrepresented groups, with strong post-secondary educations to prepare them for careers in STEM. However, the researchers failed to address the lack of sufficient

funding needed to provide schools with the necessary resources to implement STEM classrooms nationwide.

Beede et al. (2011) estimated that STEM careers would grow 17% by 2018, which is almost doubles the growth for non-STEM fields (Beede et al., 2011). The authors further projected that by 2018 the United States would have more than 1.2 million unfilled STEM vacancies due to the lack of certified employees and the low number of females entering STEM fields. The scarcity of females graduating with STEM degree programs thus negatively impacts the workforce, especially because females earn more than half of all bachelor's degrees.

Women remain underrepresented in STEM even though they currently obtain more degrees in STEM than in previous times (Dean & Fleckenstein, 2007; Hill et al., 2010; Liston, Peterson, & Ragan, 2008; Lufkin, Reha, & Harrison, 2009). Valian (2007) observed that some individuals are not interested in STEM regardless of encouragement and support, and suggested that women inherently lack an interest in STEM. However, Jolly, Campbell, and Perlman (2004) proposed that engagement, capacity, and continuity must be present collectively to ensure student success. Some researchers have argued that undesirable attitudes toward STEM and low self-efficacy negatively impact students' decisions to select professional and college careers involving STEM (Bandura, 1977a). Although theorists and researchers have provided strong evidence for the existence of the gender gap in the STEM field at college and career levels as well as identified responsible factors for that gap, no researcher has examined the even larger gap existing in STEM for Latinas (Beede et al., 2011; DuBow et al., 2017; NAPE, 2016). This is surprising for several reasons. First, previous researchers have generally indicated an

urgent need for more women and minorities in the STEM workforce (Shapiro et al., 2015). Second, out of the 15% of U.S. college students that graduate with a degree in a STEM field, only 6.7% of STEM graduates are women, with Latinas being disproportionately underrepresented when compared to the general population (Mayo, 2010).

Gender Bias in STEM Fields

Bian et al. (2017) examined the developmental trajectory of associating intellect as being a masculine characteristic in 96 children aged 5, 6, and 7 (32 children per age group; half boys and half girls). The children came from middle class backgrounds and 75% were White. Race, ethnicity, and socioeconomic status did not significantly impact the results of interest. The authors observed that people generally associate intellect as being a masculine characteristic, which, in turn, discourages women from selecting careers of higher social prestige. As a result, women are underrepresented in prestigious professions. Bian et al. proposed that stereotypes have an impact on children, especially girls, who, at the age of six years old, believe that they are not as intellectually capable as their counterparts and therefore begin to avoid activities for those they perceive to be more intelligent. The authors added that although the stereotype of men having high-level of cognitive ability has been utilized to explain the gender gaps, very little is known about the development of this stereotype.

Bian et al. suggested that the dispersal of males and females across academic standings appeared to be affected by perception rather than actual possession of intellectual brilliance. The authors found that gendered notions of *smart* appear at a very early stage and produce an immediate impact on childrens' interest in STEM fields.

According to the authors, this stereotype has an effect on what interests children, which results in them narrowing their choice of careers. Bian et al. proposed that, at the age of five, there is no difference in expectations between the sexes. However, by age six, girls see themselves as not being intelligent and thus they begin to stay away from games perceived to be intended for people who are. The study showed that at the age of five, children linked intellectual ability with people of their own gender. However, the results suggest that children's ideas about brilliance rapidly change from age five to seven. Bian et al. also found that children's belief that brilliance is a male quality begins at a young age.

Ceci and Williams (2011) proposed that female underrepresentation in STEM fields is frequently due to sex discrimination, including providing females with limited resources that prevent exposure to STEM fields, unequal interview processes, and unequal policies related to studies and hiring processes. The authors did not support assertions of discrimination in these areas, but instead attributed the gender gap to sex differences in resources, abilities, and choices, whether voluntary or involuntary. Ceci and Williams pointed out that, based on a review of the past 20 years of data, some claims of discrimination are unsubstantiated. The authors proposed that discrimination is a factor in the low levels of women in STEM jobs, and its acceptance will prevent focus on the real factors that cause females' underrepresentation.

Researchers have maintained that addressing education, policy changes, and biological differences are potential interventions that would address gender fairness (Ceci & Williams, 2011; Wang & Degol, 2017). Since 1970, women have made dramatic gains in science such as receiving more than 50% of medical doctorates, social science

doctorates, life sciences doctorates, exceeded men in psychology doctorates and veterinarian doctorates, at 71% and 77% respectively. However, female presence has been limited in the field of mathematics and technology. This is indicative of a problem in those areas and the need to find its cause. It is therefore crucial to focus sources to solve gender fairness instead of employing energy in historical issues.

Recent scientific reports asserted that discrimination is the cause of woman underrepresentation (Ceci & Williams, 2011). Ceci and Williams indicated that resumes and journal articles were rated lower by male and female reviewers when they were told the author was a woman. Ceci and Williams also observed that female awardees needed substantially more publications to achieve the same competency rating as male awardees.

Moss-Racusin et al. (2012) suggested that providing women with equal treatment, advisors and a flexible work setting can be factors that contribute to motivating females to staying in science fields. Moss-Racusin et al. (2012) added that acknowledging this gender bias could translate into significant real-world advantages in the judgment and treatment of female science students. For example, women may become motivated to pursue academic science careers once the diminished competence judgments, lack of rewards, and lack of mentoring are addressed in the early years of their careers or school (Moss-Racusin et al., 2012).

Moss-Racusin et al. (2012) conducted a randomized double-blind study in the departments of science in research-intensive universities to investigate gender bias. Students' application materials were randomly assigned either a male or female name. The study showed that both male and female faculty rated male applicants as significantly more competent, more likely to be hired, and more apt to obtain a higher

starting salary than their identical female applicants. Moss-Racusin et al. also found that faculty offered more career mentoring to male applicants, and that female students were less likely to be hired due to the preexisting perceptions of incompetence in comparison to the male students.

In addition, although a careful system was established to select expert impartial participants, gender discrimination still existed among science faculty members who interacted with the students. These findings support the assessment that there is an increase in the chances that women may opt out of academic science careers due, in part, to diminished competence judgments, rewards, and mentoring received in the early years of the professions. Moss-Racusin et al. also found that gender discrimination existed among science faculty members who interact with students on a regular basis. However, the author specified that interventions addressing faculty gender bias might increase female participation in STEM fields. Moss-Racusin et al. identified three main factors that must be addressed to increase the number of female students in STEM fields: (a) faculty's perception of female students' competency, (b) preexisting subtle bias against women, and (c) supportive treatment and mentoring services provided to science female students.

Previous research illustrates just how early biases are formed, and the significant impact these biases have on women's decisions to enter the STEM field. These biases exist not only in employers and educational advisors, but even in institutions and within women themselves. The biases appear to be a product of societal gender norms that have been ingrained in people's minds from early childhood. They could result in large-scale disadvantages for women in relation to how they are judged and treated in the STEM

field during student evaluations and mentoring. Bandura (1977a) addressed in his model of reciprocal determinism (MRD) that an individual's behavior is influenced by personal factors and social environment. Therefore, it is imperative to address middle school girls' behavior and self-efficacy early in their education. Although researchers examined many biases against females in STEM fields, they could not totally rule out how other variables may contribute to widen the bias against females in STEM.

Factors That Motivate, Attract, Recruit, and Retain Females to Pursue and Persist in STEM Fields

Bandura (1977a) examined the framework of social learning theory (SLT). Bandura developed SLT in the 1960s, which involves self-efficacy and personal goals, and extends to learned behavior. The basic principle of SLT is that individuals learn not only from their own experiences, but also through the observation of others, a process called observational learning or modeling (Bandura, 2013). The fundamental aspects of SLT comprise observational learning, reinforcement, self-control, and self-efficacy (Bandura, 2013). Bandura proposed that practically all learning phenomena results are the product of lived experiences, or through observation of role models or other people's behavior.

Butler-Barnes, Estrada-Martinez, Colin, & Jones, (2015) conducted a study with a group of 12 African American middle school girls from the Brown school located in an underserved school district in north and central St. Louis. The purpose of this study was to help them gain confidence in themselves while enhancing their math and science skills. The author also sought to teach African American girls to appreciate their culture, with the ultimate goal of motivating the girls to pursue interests in STEM fields as a college

and career choice. Butler-Barnes et al. (2015) found that, despite efforts to increase girls' interest in STEM, African American girls had fewer support systems, less exposure to STEM fields, and lower academic achievement in STEM fields than their Caucasian counterparts. Utilizing evidence-based algebra intervention and self-efficacy programs, the author helped the young girls from underserved school districts participating in the study gain confidence in their math and science skills while gaining understanding and appreciation for their culture. The findings of this study revealed significant gains in racial pride, achievement motivational beliefs, and algebraic knowledge. However, the girls felt disconnected from real-world life experiences and applications.

According to Butler-Barnes et al. (2015), providing girls with a nurturing, caring, learning environment where females feel personally accepted, respected, included, and supported motivates girls to increase their academic efforts in STEM fields. This study addressed the disadvantage that African American girls had when compared to their Caucasian counterparts. Butler-Barnes et al.'s study also relates to Cooper and Heaverlo's (2013) study since both suggested that early exposure to the STEM field helps girls obtain the skills and knowledge necessary to select STEM fields. The authors of both studies also suggested the need to implement support systems that will ultimately increase academic achievement in STEM.

Cooper and Heaverlo (2013) conducted a study with the purpose of determining the extent to which middle and high school girls' interest and confidence in two fundamental aptitudes for STEM professions (problem-solving, and creativity and design) influenced their interest in STEM subjects. Cooper and Heaverlo employed a hierarchical regression analysis to show how middle and high school girls' age, interest,

and confidence in relation to STEM subjects are impacted when exposed to problem-solving, creativity, and design activities. The authors administered a survey to first-year students and identified the top factors to motivate girls to obtain degrees in STEM fields as follows: innovation, creativity, design, building things, math, science, practical real-world applications, knowing how things work, and problem-solving. Consequently, providing opportunities and curriculum with problem-solving can increase girls' interest in STEM subjects (Cooper & Heaverlo, 2013). In a follow up analysis, Cooper and Heaverlo identified the preferred after school activities that girls in the study selected. Researchers proposed after school programs with emphasis in problem-solving, creativity, and design, which take place with the objective of attracting female students to STEM subjects (Cooper & Heaverlo, 2013).

Cooper and Heaverlo (2013) suggest that as girls increase in age, they exponentially lose interest, confidence, and positive attitudes toward STEM subject areas. The researchers added that students start connecting to STEM when they need creativity and solutions to real world problems. According to Cooper and Heaverlo, by the year 2018, nine out of ten of the fastest growing jobs will demand mathematics or science expertise. As a result, through creativity and problem-solving, students can utilize STEM fields to innovate and change the culture and economic development in society. The authors added that STEM literacy in K-12 classrooms and commitment to STEM initiatives' improvements are a must for the United States to remain globally competitive. For girls to obtain the skills and knowledge necessary to select STEM fields in college, girls must be exposed to STEM subjects early in their education. One predictor that girls might select STEM fields in college is interest in STEM subjects at the beginning of high

school (Cooper & Heaverlo, 2013). However, Cooper and Heaverlo argued that, based on their data, more attention needs to be devoted to retaining girls' interest since the percentage of male interest in STEM careers at that time remained stable from 39.5% to 39.7%, while females' interest decreased from 15.7% to 12.7%.

Cooper and Heaverlo (2013) proposed that girls' perception of their inability in a STEM subject is a product of historical and invalid stereotypes, which negatively influenced their interest in STEM subjects. Two predominant stereotypes in this literature is that boys are better at math and science than girls are, and science and engineering careers are more suitable for males (Cooper & Heaverlo, 2013). The authors' findings indicated that girls interested in problem-solving were inclined to select all four STEM subjects, while girls attracted to creativity and design activities were interested in computers and engineering but lacked interest in science.

Moreover, to cultivate the girls' interest in STEM subjects, the authors supported the use of instructional strategies that involve problem-solving experience. This study is similar to Rosicka's (2016) study in that in both cases researchers supported instructional strategies that involve problem-solving experiences. Both studies emphasized that development through problem-solving and critical skills education increase student interest in STEM fields that involves a cross-disciplinary approach.

DuBow et al. (2017) suggested that there are many factors that contribute to motivating females to pursue STEM fields study or careers, including early exposure and access to computing classes and surrounding themselves with friends who also do computing. However, very limited information exists on the factors that motivate females to not only enter into but also to continue computing education regardless of the obstacles

they encounter, for example, subtle and more obvious biases from teachers, counselors and sometimes students, negative media influence and male dominated classes (DuBow et al., 2017). DuBow et al. interviewed 64 women (41% White, 30% Asian, 16% Latina, 8% Black, and 3% Native American) who had applied to the Aspiration in Computing Award in order to understand why women continue in the computing field regardless of the obstacles. The majority of the women (75%) were enrolled in college, while the remaining were in either high school, graduate school, or in the workforce. Over a 3-year period, the researchers collected data from 44 winners and 20 non-winners via phone conversations, video conference calls, in-person interviews, and focus groups. DuBow et al. found that employing a semi-emergent approach and social cognitive career theory (SCCT), in conjunction with social support from peer, family, and the community, provided females the respect and encouragement that motivate them to select and stay in STEM fields. In addition, a sense of belonging, developing a computing identity, and preparatory privilege are also key factors in recruiting and retaining females in computing fields, regardless of the obstacles they encounter (DuBow et al., 2017). The researcher emphasized that family community and peer support are some of the major factors that would help females to survive all the obstacles they may encounter. Although DuBow et al. discussed factors that keep girls in STEM, regardless of obstacles, the authors failed to provide advice regarding how to avoid those obstacles.

Ing (2014) conducted a study to examine how parental involvement can motivate children to improve mathematics performance and perseverance in STEM. Ing explored the development of student achievement in middle school in order to identify the external factors that induced children to excel in mathematics and to select STEM as a career

choice. The study included an attitudinal survey that collected students' responses, telephone interviews with parents, and survey responses from the student's principal and teachers. Students were organized in two cohorts, seventh and 10th grade respectively. Ing interviewed 52 middle school students from across the United States (70% White, 9% Hispanic, 11% African American, 4% Asian, and 2% Native American). The interviews involved an almost equal representation of gender (females 48% and males 52%). The researcher used a latent growth curve modeling approach to determine the relationship between parent's motivation and student performance in mathematics and STEM career choice. The author also employed longitudinal data from 130 predominantly White parents he interviewed over the phone. This data suggested differences between particular types of parental motivational strategies. With almost equal representation of (females, 48% and males 52%), the data showed differences between various types of motivational techniques parents used. Ing suggested that parental involvement is a contributing factor that motivates children to increase improvement in performance and sustain performance in STEM and career choice. The author also emphasized the importance of determining the techniques parents utilized to positively impact student performance. Ing proposed that parents have more influence on career choices than teachers, counselors, friends, and other family members. The author identified two types of factors that contribute to motivating children to pursue STEM fields: internal factors, such as self-concept; and external factors, such as the influence of parents, the media, and educators.

According to Ing, parents employed intrinsic motivation by instilling in their children self-concept, beliefs, and goals that reaffirmed the children in their intellectual abilities and the probability of their success in college. Parents also provided students

with extrinsic motivators such as reward and punishment based on performance. However, Ing suggested that behavior is not sustainable when obtained extrinsically. Findings in this study indicated that parents can positively influence their children's mathematics achievement and persistence in STEM careers. Ing also found that not all motivation practices positively influence student achievement and persistence in STEM. Extrinsic motivation was found to be less effective in promoting STEM achievement and participation.

Although several researchers have indicated that females may not be interested in engineering-related careers, those researchers agreed that STEM equity experts, teachers, and postsecondary faculty must continue to encourage and support females to enter STEM fields (Hill et al., 2010; Weber & Custer, 2005). The purpose of Hill et al.'s (2010) study was to measure operation, engagement, and capacity utilizing the Engagement, Capacity and Continuity Trilogy (ECC Trilogy) framework. Hill et al. employed the ECC Trilogy framework to determine factors that influence female decisions to enter technology and engineering courses. The authors employed a descriptive design. A survey administered to students showed measurable evidence that identified student's interest or disinterest in STEM. The population for this study included 303 middle school students (Grades 6 to 8) and 253 high school students (Grades 9 to 12) enrolled in technology and engineering courses at the state of Wisconsin. Out of the 556 students who responded, 120 were female middle school students, 48 were female high school students, while 183 were male middle school students, and 205 were male high school students. The findings in this study indicated that males and females had similar levels of interest in engaging in technology,

engineering-related activities and work. Female students had an interest in a subscale, while male students expressed more interest in emotionally and cognitive engaging activities. This latter finding contradicts past research in which females generally expressed more interest in emotionally engaging activities (Weber & Custer, 2005). Hill et al. also found that males had prior technical and mechanical experience while females did not, which might explain why males found these activities more interesting. As expected, males expressed more interest than females in vocational, technology, and engineering-related activities.

Pomerleau, Bolduc, Malcuit, and Cossette (1990) suggested that although children cannot explain their preferences for toys, the expectation of parents and other toys providers play a major role in discouraging females from selecting STEM fields. Pomerleau proposed that, from a very early stage, females are negatively impacted by the following factors: toy marketing in a stereotypical manner, the characteristics of toys, how those characteristics differentially affect boys' and girls' interests, and expectations of STEM fields. The authors found that when masculine toys, such as a hammer, are encouraged, there is greater motor activity observed in the children playing with it. Pomerleau et al. further asserted that not only are those toys made with biases, but also that these biases carry over into the computerized toys and games that are traditionally created with male interests, such as war or sports, in mind.

Shapiro et al. (2015) examined factors that may influence middle school girls' expectations, their perceptions of careers, and the impact that a single-sex environment may or may not have on those girls. The authors considered not only the limited factors such as career opportunity, expectations, and self-beliefs, but also the development

between the ages of 10 and 12 while girls were still in middle school. Shapiro et al. also sought to understand how current knowledge and curriculum tools available can address females' needs and limitations in middle school. The authors utilized the online platform Zoomerang drawing to survey 1,200 middle school boys and girls from two groups: Girl Scouts in Grades 6 to 8, and a Zoomerang database of preselected adolescents in the same grade. Shapiro et al. found that middle schoolers overall recognized the difficulty of working and parenting at the same time. Shapiro et al. indicated that girls expressed a stronger interest in choosing parenting over working. The authors also found that females had outperformed males in most graduate school health programs. Those outperformer females students constituted 55% of students who were in the top 10% of high school graduating classes. Those females students also earned an overall average GPA of 3.42, compared to 3.28 for men (College Board, 2012). In addition, the results also indicated that although women earn 55% of awarded college degrees, and outnumber men in most graduate and doctoral programs, the number of females in executive positions is very limited as compared with males. Two theories provided the insight of this study: social role theory and social cognitive career theory (SCCT).

Wang and Degol (2017) sought to identify the cognitive and motivational factors that induce women's decisions to opt out of STEM fields, describe the potential biological and sociocultural differences that impact in cognitive and motivational decisions, and to provide recommendations regarding how to attract, increase, and retain female interest in STEM. The authors suggested that the gender gap in STEM workforces and career choices continues expanding regardless of the effort to recruit and retain females in STEM fields. Wang and Degol (2017) observed that although women are

leading in medical and health science degrees, as well as increasing participation and performance in math courses, women continue to be underrepresented in STEM fields. The authors proposed that to reduce the gender gap in STEM, special attention must attend to cognitive, motivational, and sociocultural factors. After analyzing many studies over the past 30 years in the fields of psychology, sociology, economics, and education, Wang and Degol (2017) identified the following six factors, which they claimed are causing the low participation of U.S. woman in STEM fields: occupational interests or preferences, lifestyle values or work-family balance preferences, field-specific ability beliefs, gender-related stereotypes and biases, relative cognitive strengths, and cognitive ability. The authors added that possible biological and social-cultural factors may also influence gender cognition and motivational behavior. Wang and Degol (2017) suggested that cognitive and motivational factors affect women's decisions to opt out of STEM fields. In addition, Wang and Degol (2017) proposed that it is difficult to determine gender differences because math skills are not developed in early childhood.

Wang and Degol (2017) also asserted that fellow students can be a factor that contributes to motivating other students to pursue STEM courses. The authors proposed that children who interact with peers who encourage and endorse STEM subjects are more likely to select STEM subjects. According to Wang and Degol (2017), bias and discriminatory behavior most frequently occur at younger ages when boys and girls are developing their career interest. The authors also suggested that, in the United States, a woman's decision to select caring for her family over her career might reflect personal choices, which may, in turn, be influenced by cultural norms and stereotypes that still dictate that female's main responsibility is childcare and housework. Wang and Degol

(2017) proposed that to increase and retain a female's interest in STEM fields and career choices, the following factors must be present: incorporating flexible, family-oriented programs and policies in the workplace; utilizing early STEM interventions; emphasizing importance of a STEM degree and its application to the real world; and finally, providing and celebrating female role models in STEM fields. The authors also recommended further investigation to address gender differences within STEM choices, female diversity, and the impact of biological, psychological, and environmental factors on the gender gap in STEM fields.

In an earlier study, Wang and Degol (2013) sought to explain how previous research could contextualize factors related to gender differences in STEM education and career choices with the goal to provide suggestions for future interventions and a well-defined theoretical framework that addresses the gender differences. The authors suggested that expectancy-value theory could explain how individual choices, intellectual aptitudes, and motivational beliefs affect individuals' STEM decisions. Wang and Degol (2017) addressed how intellectual aptitudes, intellectual ability, self-concept, interest value, occupational values and lifestyle values influence women perception.

In addition, the authors considered school values, classroom structures, differentiated curriculum, teacher's low expectations, stereotypes, and familial mindsets as factors that negatively affect females' beliefs, values, and attitudes toward STEM fields. Although Wang and Degol (2017) identified many factors that positively and negatively influenced women's perception and interest in STEM fields, they asserted that the US lacks the technology workforces needed. The researchers added that regardless of the attention and investment in STEM education as well as female progression in the

STEM fields, the number of females pursuing degrees and careers in STEM continues to be limited (Wang & Degol, 2013).

Targeting STEM Specifically to Girls

This section discusses how increasing math and science skills in females also increases girls' self-confidence and appreciation for their culture (Butler-Barnes et al., 2015). Cooper and Heaverlo (2013) discussed how, as girls increase in age, they lose interest, confidence, and positive attitudes toward STEM subjects and careers. Butler-Barnes et al. (2015) suggested that providing girls with a nurturing, caring, learning environment in which they feel personally accepted, respected, included, and supported motivates girls to increase their academic efforts in STEM. In addition, Cooper and Heaverlo (2013) found that females' interest decreased from 15.7% to 12.7% and thus, STEM literacy in K-12 and commitment to STEM initiatives' improvements are necessary for the United States to maintain global competitiveness.

The literature also revealed two predominant stereotypes: that boys are better at math and science than girls, and that science and engineering careers are for males. Moreover, this literature review revealed that creativity, math, science and real world, hands-on applications increase girls' interest in STEM subjects (Cooper & Heaverlo, 2013). In addition, Gilligan et al. (1990) found that females suppressed their voices during their teenage years, and continue to do so in adulthood, sacrificing their ambitions to fulfil the role of mother and wife. Another key issue is that internal factors, such as self-concept, and external factors, such as the influence of parents, the media, and educators, impact female innate interest and career options (Ing, 2013). Research has also shown that hands-on practice, exposure to role models, providing computing courses,

offering immersion programs, creating female mentorship, and providing role model programs could inspire young women to pursue a career in STEM computing (Gilligan, 1982). In addition, Wang and Degol (2017) suggested that although women are leading in the medical and health fields, girls continue to be underrepresented in STEM fields.

Researchers have failed to examine the factors leading to such limited number of Latinas in STEM field education and career major, such as their culture, socioeconomic status, and possible language barrier. With previous studies indicating the significance of STEM exposure at early ages (Cooper & Heaverlo, 2013), there is a clear need to examine the factors motivating middle school Latinas to enter the STEM field, a demographic that could significantly contribute to fulfilling the demands of the future American STEM workforce.

Instructional Curriculum in STEM

Papazian, Noam, Shah, & Rufo-McCormick (2013) reported that a program in education provided after school and focusing on resiliency (PEAR) created a dimension of success (DoS) assessment tool specific to STEM fields to help out-of-school Time (OST) and researchers to monitor and measure quality. out-of-school time (OST) are transitional programs that connect content across contexts. Papazian et al. sought to align DoS with the National Science Foundation (NSF) (2017a) framework and the National Research Council (2010) strands to assess curricula, materials, and space offered by after school programs. The findings suggest that students' positive attitudes and interests in STEM are influenced by the caliber of science instruction. The authors also suggested that well-structured and high-quality OST programs connect students with opportunities across a range of contexts, motivate youth, keep them engaged, and build student interest

in pursuing future STEM careers. However, high quality programs must have clear definitions and indicators to measure quality. The DoS tool enables researchers to collect systematic data including 12 quality indicators in order to determine the strengths and weaknesses of the afterschool program and to personalize instruction (Papazian et al., 2013).

The Bill and Melinda Gates Foundation (2012) and other researchers, such as Gitomer (2012), have developed reliable observation tools for assessing STEM instruction in school settings, including the Reformed Teaching Observation Protocol (RTOP), the Classroom Observation Protocol, and the DoS (Weiss, Pasley, Banilower, & Heck, 2013). More specifically, the DoS assessment follows the current national frameworks of STEM assessment. This assessment helps OST programs to measure the quality, strengths, and weaknesses of a STEM program using systematic data collection along 12 quality indicators in four domains: features of the learning environment, activity engagement, STEM knowledge and practices, and youth development. This data serves as the foundation to develop technical assistance, professional development, and curriculum mapping to meet the needs of each student (Noam & Shah, 2013; Yohalem, Granger, & Pitman, 2009).

Since the development of the DoS assessment tool, the Mott Foundation, in collaboration with the Noyce Foundation, has created a technical assistance team to support nine state afterschool STEM networks. Each state trains and certifies teams to use the DoS assessment tool across the country. Funders, researchers, and practitioners continue to invest millions of dollars to motivate, recruit, and retain student interest in STEM field (Noam & Shah, 2013; Yohalem et al., 2009).

The proposed study will be significant based on the fact that there was lack of prior study done on Hispanic/Latinas. It will not only fill an important gap in the research literature but will also have critical implications for informing social and educational issues associated with the gender disparity in science.

This section reviewed rigorous curriculum, afterschool programs, resiliency, and the transition to connect content across contexts. Papazian et al. (2013) suggested that well-structured and high-quality OST programs connect students with opportunities across a range of contexts, motivate youth, keep them engaged, and build student interest in pursuing future STEM careers. The authors also examined the NSF's framework strands, curricula, and space to provide rigorous after school programs that optimally contribute to motivating girls to pursue STEM fields. Moreover, Papazian et al. discussed the limited research on Hispanic women.

Additionally, research has shown that hands on practice, exposure to role models, participation in computing courses, immersion in computer programs, implementation of female mentorship, and implementation of role model programs are all factors that contribute to motivating young girls to pursue a career in STEM computing (Wang & Degol, 2017). Problem-solving, design, building things, AP classes, practical-real world application, and STEM curriculum in general are crucial elements that must be part of the instructional curriculum in order to motivate girls to pursue a career in STEM (Cooper & Heaverlo, 2013). However, a great number of middle school Hispanic/Latinas attend schools in which these factors are either not stressed or not part of the instructional curriculum at all. It is thus imperative not only to establish girls' afterschool programs

that address those factors in all middle schools, but also to embed those instructional units in the regular instructional school day.

A cross-cultural approach. Countries around the world, including the United States, face the need of recruiting more individuals into STEM fields (Hill et al., 2010; Regisford, 2012). A significant number of countries are struggling with the limited number of individuals trained in using and creating the technology needed to improve domestic production (Schwab & Sala-i-Martin, 2012). Additionally, as countries compete to attract and retain the best talent, they are also experiencing an increased mobility of high-skilled workers, including those educated or employed in science and engineering (S&E) fields (OECD, 2012, p. 54). Like many countries across the world, the United States is also struggling to produce the necessary number of STEM-educated individuals needed for the growing STEM workforce. As the need for a larger STEM workforce continues to expand, it ultimately impacts the global economy negatively (Mayo, 2010).

In the international arena, the Program for International Student Assessment (PISA) showed that the average mathematics and science literacy scores in the United States were below the average scores of all developed countries, and the United States had substantially fewer high scores and more low scores than other developed countries (National Science Board, 2016). Governments in many countries have made increased access to science and engineering-related postsecondary education a high priority (National Science Board, 2016). According to the most recent estimates, the number of first university degrees in science and engineering globally reached about 6.4 million; almost three-fourths of these degrees were conferred in China (23%), India (23%), and

the European Union (21%) while the United States produced 9% (National Science Board, 2016).

U.S. policy initiatives. To maintain global competitiveness and enhance capacity for innovation, U.S. policymakers have called for increases in the number and diversity of students pursuing degrees and careers in STEM fields (NAS COSEPUP, 2005; NGA 2007). Nationally, federal, state policymakers, legislators, businesses, and universities have called for efforts to develop strong STEM pathways from high school to college with the hope of eventually expanding STEM-capable workforces in the United States (National Science Board, 2016).

The United States has significantly under-produced students in the highest levels of mathematical achievement relative to other developed countries (National Science Board, 2016). The United States also moderately under-produced students in the highest levels of scientific achievement and, to an extent, overproduced students in the lowest levels of mathematics and science achievement (National Science Board, 2016).

According to the National Science Board (2012), the United States has one of the lowest ratios of STEM to non-STEM bachelor's degrees in the world. In 2012, the United States was ranked 18th among industrialized nations and was experiencing falling graduation rates in STEM areas (Roberts, 2012). Mayo (2010) found that only 15% of U.S. college students—in comparison to 50% in China, and 67% in Singapore—graduated with a degree in a STEM field. Moreover, top U.S. students with great potential to become future STEM innovators have avoided careers in STEM fields (Bettinger, 2010). English and King (2015) and Rosicka (2016) suggested that due to the dearth of STEM success in the United States right now, a focus on STEM education should involve a cross-

disciplinary approach to teaching that increases student interest in STEM-related fields through the development of problem-solving and critical thinking skills.

The need to sustain a globally competitive position considering the fast and ever-increasing demand for a highly skilled labor force in STEM has captured the attention of the U.S. government to address employment shortages and college success in STEM fields (Carnevale, Smith, & Melton, 2011). As an attempt to address these concerns, previous administrations have sought to garner more interest in STEM (PCAST, 2012). In 1958, to ensure that the United States could continue to compete globally and fearing competition from scientists in the Soviet Union, the National Defense Education Act (NDEA) allocated \$1 billion to support STEM education reform over the span of 4 years (Jolly, 2009). Recent political leaders have also acted; for example, former President Barack Obama made STEM reform a central priority in his educational policy. These policies have endured during the Trump administration.

In 2009, the Obama administration signed into law the American Recovery and Reinvestment Act (ARRA, 2009) and The School Improvement Plan Grant, often referred to as the “stimulus” package, which allocated more than \$650 million to technology education. A 2012 policy report by the President’s Council of Advisors on Science and Technology recommended that colleges and universities at all levels produce more STEM graduates (PCAST, 2012). To improve teaching and learning with technology in order to close the achievement gap that exists between Latinas, minority students in general, and their White, nonminority, and more affluent counterparts, President Obama signed the Every Student Succeeds Act (ESSA) on December 10, 2015 (Every Student Succeeds Act of 2015). ESSA reauthorized the Elementary Education Act

of 1965 and replaced the widely criticized No Child Left Behind Act. President Obama funded ESSA through more than \$4 billion over a period of 3 years (2017, 2018, and 2019; ESSA ACT, 2015). In 2016, President Obama proposed a new initiative, Computer Science for All, which the Senate and House of Representative enacted on May 2017 and funded with \$4 billion to support the initiative (Computer Science for All Act, 2017). President Obama also funded the Enhancing Education through Technology (EETT) program that had ended in 2011.

At the state level, in an effort to not only serve students and educators better but also to close the persistent achievement gap between minority groups and their White counterparts, the New York State Board of Regents developed a state ESSA plan, which took full effect in the 2017–2018 school year (NYSED, 2018).

Although the United States has established a variety of policies, recent studies have demonstrated that efforts to address these shortages in STEM areas have fallen short. The National Department of Commerce (NDC) (2014) projected that by 2018, the United States would have more than 1.2 million unfilled STEM jobs due to a lack of qualified workers in the fields. The department also estimated that STEM careers would grow 17% by 2018, which is nearly double the growth for non-STEM fields (National Department of Commerce, 2014). Yet the Computer Science for All Act of 2017, section 2, reported that by the year 2020, 70% of all technology jobs will be unfulfilled due to the rate at which American universities have produced qualified graduates. Crisp and Nora (2012) asserted that although federal STEM programs provided crucial support for minority students in the form of internships, summer programs, and career counseling, they did not address the intrinsic structural and institutional problems that produced the

underrepresentation of Hispanic and African American students in STEM fields and careers. Crisp and Nora (2012) also recorded the limited number of research studies dedicated to uncovering the issues, barriers, and successes that affect Latinas students entering STEM programs.

Latina learning gaps. The World Economic Forum (2016) reported that, for the past 20 years, STEM workforces have been composed of 76% men compared to only 24% women, and of the latter group, only 3% were Latinas. The National Science Foundation (NSF; 2017b) reported that out of the science and engineering workforce in 2015, Latinas comprised 2%, the lowest representation, followed by Black women at 4%, Asian women at 14%, and White women at 18%. The data from this report revealed the low numbers of women in the scientific and engineering fields especially among Hispanic women who entered the STEM workforce at a rate of one in 10 persons employed in science and engineering (S&E) positions (NSF, 2017b).

Yet, according to Ong, Wright, Espinosa, and Orfield (2011), Latinas have comprised the second largest ethnic group in the United States and 7% of the total female population between the ages 15 and 24. The U.S. Census Bureau's (2017) latest estimates revealed that the Latino population in the United States has continued to expand, reaching a record 58.6 million in 2017, and has been responsible for more than half of the country's demographic growth (51%) since 2000. According to the U.S. Census Bureau's (2012) report, the United States was home to nearly 55 million Latinos, making them the largest ethnic minority in the country and accounting for over 17% of the nation's total population of 315 million. The report also revealed that Latinas represented the second largest ethnic group in the United States at 7% of the total females in the U.S. population

ages 15–24 (U.S. Census Bureau, 2012). However, according to Ong et al. (2011), Latinas only receive 4.33% of STEM bachelor's and 2.53% of doctoral degrees awarded in the United States.

As of 2012, the New York City (NYC) metro area was home to 4.8 million Latinas, the second largest metropolitan concentration of Latinas in the country (U.S. Census Bureau, 2012). As of 2017, Latinas comprised 40.4% of the public school student population in New York City (NYC DOE, 2017). Before the year 2030, Latinas are expected to represent 25% of the total school-aged population, consisting of 16 million students (Pew Research Center, 2018). The growing number of Latinas is significant. Yet Ginorio and Huston (2001) indicated that graduation rates for Latinas were lower than that of girls in any other racial/ethnic group, and Latinas who leave schools are less likely to return (Ginorio and Huston, 2001).

According to Yoder (2016), of all awarded doctoral degrees in 2015, only 5.7% went to Latinas, which included both males and females. Of all awarded undergraduate degrees, only 10.7% went to Latinas, which included both males and females (Yoder, 2016, p. 15). Yoder's (2016) report also revealed that less than 8% and 7% of master's and doctoral degrees in engineering were earned by Hispanic/Latinas/os as compared to 60.2% and 62.9% earned by Whites, respectively. Therefore, aggressive actions should be taken to ensure the proportionate inclusion of such a large part of the U.S. population in science and engineering, throughout all levels of education (Nelson & Brammer, 2010).

After all, students exposed to early STEM education become engaged in STEM subjects and have the tendency to graduate with STEM diplomas at a postsecondary level

(Marginson et al., 2013 and Morgan, et al. , 2016). By the time students graduate from high school, women are more likely than men to have a specific idea about their goals and occupational paths (Morgan, Gelbgiser, & Weeden, 2013), leading to the conclusion that STEM initiatives at the college level will not be as effective as those in elementary and middle schools. The rate at which the minority population is growing is outpacing the rate at which the educational system is becoming more effective at educating these students (Zverina, 2012, p. 1).

Yet it appears that graduation rates for Latinas will not keep pace with their population growth (Solórzano, Villalpando, & Oseguera, 2005). The National Center for Educational Statistics (2016) reported that Latina dropout rates were 8.4% as compared with their White (4.1%) and Black counterparts (6.5%). According to the New York City Department of Education's (2017) most recent K–8 mathematical assessment report, 75% of Latinos did not meet proficiency levels as compared to 41% of Whites and 32% of Asians or Native Hawaiian/other Pacific Islanders. In addition, in the 2017 school year, only three out of 20 Latino students in New York City graduated from high school prepared for college (NYC DOE, 2017).

The American College Testing (ACT, 2016) organization reported that students interested in STEM continued to show higher college readiness than students who were not involved in STEM. Only 8% of the Hispanic population that took the ACT met the STEM benchmarks, and Hispanics female students scored even lower than their Hispanic male counterparts (ACT, 2016). Nationally, a record of 64% of the 2016 graduating class took the ACT in 2016 (ACT, 2016). Hispanic students were underrepresented among AP exam takers, particularly among more advanced mathematics and science courses

(College Board, 2012). Hispanic students comprised 19% of the 2013 high school graduating class from which less than 10% took the calculus College Board (CB) and successfully passed it (College Board, 2012). The limited number of Latinas interested in selecting or continuing to study STEM fields negatively impacts the country's ability to compete or meet the technological demands of the future since Latinas are the second largest ethnic group in the United States (Mayo, 2010; Roberts, 2012).

The National Science Board (2012b) found that the rates at which U.S. undergraduates choose STEM majors trail those of several key competitors. Roberts (2012) asserted that minority students and society are at a disadvantage when avoiding STEM fields because STEM jobs can be enormously rewarding, well paying, and highly needed. The National Science Board's (2016) report revealed that half of the workers in science and engineering (S&E) occupations earned \$81,000 or more in 2014, which represents more than double the median salary (\$36,000) of the total workforce. The report also revealed that employed college graduates with the highest degrees in S&E earned more than those with non-S&E degrees; median salaries in 2013 were \$65,000 and \$52,000, respectively (NSB, 2016). Noonan's (2017) report revealed that STEM workers obtained higher wages, earning 29% more than their non-STEM counterparts. Roberts (2012) also claimed that the scarcity of females in STEM fields negatively impacts society due to the current need for and the lack of skilled workers.

Chapter Summary

This literature review examined the gender gap in the STEM workforce and educational system, focused on the increasing factors that caused the gender bias in STEM, as well as creative and intentional approaches to closing the gender gap amongst

girls, especially of Hispanic/Latina origin. Chapter 3 outlines the research methodology for the study. Chapter 4 provides data analysis, and Chapter 5 covers the implications of the research and recommendations for the future.

Chapter 3: Research Design Methodology

General Perspective

There is a significant gender gap in the STEM workforce, which will continue to expand and ultimately impact the U.S. economy as wages widen (Mayo, 2010). In American society, factors such as a family's belief system, mass media, school curricula, and even toy manufactures create stereotypes that deter girls from participating in STEM fields (Ing, 2014; Pomerleau et al., 1990). Mayo (2010) found that by the time girls reach middle school, many of them believe science subjects are too difficult for them to master. The pressure from external institutions influences young girls to avoid activities that require advanced scientific and complex critical thinking skills. Roberts (2012) asserted that these students are at a disadvantage because STEM jobs can be enormously rewarding and well paying. Roberts also proposed that this gap has a negative impact on society due to a lack of skilled workers in the STEM fields. In addition, Roberts (2012) suggested that the educational system has not produced the literate STEM workforce needed for the United States to regain a global industrial leadership position. According to Moss-Racusin et al. (2012), female students' preferences, participation, and performance in STEM has resulted from many factors that were present from their early years of education.

A growing amount of research has revealed that, despite demonstrating an interest in pursuing a career in the STEM fields, African American and Hispanic/Latina girls have fewer support systems, less exposure, and lower academic achievement in STEM

fields than their Caucasian counterparts (Butler-Barnes et al., 2015). As such, interventions are needed to stimulate young girls' interest in STEM beginning in middle school and, in some cases, as early as elementary school (Butler-Barnes et al., 2015).

Ensuring that young girls—especially young girls of color—have the proper environment and support to lead them into promising STEM fields is essential to guaranteeing the success of not only American girls but also of the country as a whole (NAPE, 2016). In response to this growing crisis, the purpose of this qualitative study was to explore the factors led middle school, Hispanic/Latina students to select a STEM-focused high school education in New York City.

This chapter outlines the research question, design, research context, research participants, the instrument used for data collection, and the process for data analysis and validity. In this study, Bandura's social learning theory and Gillian's moral development theory were used as methodological and analytical frameworks for collecting and interpreting participants' responses. Social learning theory is a theoretical framework that enables the examination of critical factors affecting the processes of learning (observation) and self-efficacy. Moral development theory concerns external factors that specifically impact women's self-esteem and self-concept. A phenomenological qualitative approach, coupled with social learning theory and moral development, addressed the following research question: What factors led middle school Hispanic/Latina students to select a STEM-focused high school education?

In order to answer the research question, a phenomenological qualitative methodology provided an opportunity to capture the intersectionality and complexity of academics, cognition, gender, race, and socioeconomic status of these students and their

involvement in STEM. Phenomenology centers on the lived experiences of a particular phenomenon and is used as a guide for researchers to examine participants' experiences and understand an essential concept or idea (Creswell, 2014). Using an online questionnaire facilitated access and added knowledge to the content analysis.

Research Context

The researcher utilized a qualitative research design to thoroughly examine and understand the STEM of experiences of 25 high school Hispanic/Latinas as they navigated their early instructional years. To recruit the participants, the researcher sent an email to 20 principals in both public and private STEM high schools throughout the five boroughs during the fall of 2018; the researcher received two letters of interest. As a result, two private high schools were selected for this study. To maintain confidentiality, the names of the two schools were changed. SRA and AFG are located in the Bronx and have STEM-based programs for entering ninth grade students. Overall, these schools have a high percentage of Hispanic/Latina students.

Research Participants

The study explored the STEM-related academic, cognitive, and social-emotional experiences of ninth-grade Hispanic/Latina students purposively drawn from two designated STEM high schools in the Bronx. Despite the prevalent demonstrated tendency for female students to avoid STEM-focused high schools, these students were expected to have successfully completed STEM courses in middle school and continue STEM education in high school. A qualitative approach enabled the researcher to ask the participants to reflect on their experiences and to identify constructive, beneficial factors that contributed to motivating their sustained engagement in STEM-focused schools.

Patton (2002) proposed that there are no rules for sample size in a qualitative study. Patton (2002) added that the purpose of the study guides the sample size by determining what will be useful, have credibility, and what can be done with available time and resources. As a result, 25 participants completed the online questionnaire within the time allotted for this study.

Participants were carefully selected to participate in this study because they were able to provide greater insight into the persistence and fortitude needed to pursue a career in STEM. Each participant received a link to access the study and create a private password. Qualtrics distributed and returned the results within 48 hours. Once the participants completed the online questionnaire, the data were analyzed and coded. This allowed the researcher to discover themes or patterns in the data that would assist in explaining the support and guidance needed to increase and retain Hispanics/Latinas during K12. After the online Middle to High School STEM Experience questionnaire was completed, the researcher coded the data using open-ended coding systems (Creswell, 2014). The data were analyzed based on emergent themes. Codes included *performance accomplishments*, *indirect experiences*, *school experiences*, *family experiences*, *verbal encouragement*, *self-concept*, and *self-esteem*. In the final phase, the researcher produced precise codes, in order to identify specific types of factors affecting students' decision to pursue STEM and their experiences in high school. There were no direct benefits to students for participating in the study. Participants did not receive compensation, and the study posed minimal risks.

Recruitment Procedures

The standing principals from the two identified high schools selected participants using a qualitative sampling technique known as purposeful sampling. According to Creswell (2014), purposeful sampling is a procedure in qualitative research for selecting individuals to study and understand the central phenomenon. Participants were selected based on the following criteria: (a) of Hispanic/Latino descent, (b) engaged during middle school in a STEM cocurricular program, and (c) entering ninth grade with an interest in pursuing STEM beyond high school. The online Middle to High School STEM Experience questionnaire was conducted during school hours in a media/computer lab by the students' homeroom teachers. It took the participants 30–40 minutes to complete the online questionnaire.

Prior to visiting the two high schools, the Institutional Review Board (IRB) at St. John Fisher College granted permission to conduct this study (see Appendix C). For this study, the central phenomenon examined the participants' academic, cognitive, and social-emotional experiences in order to ultimately improve the low percentage of Hispanic/Latinas in STEM high school programs. The principals were provided with letters of introduction, invitation, informed consent, copies of the online questionnaire, and an outline of the scope and purpose of the study (see Appendix C and Appendix D) written in both English and Spanish, to be distributed to the participants' parents or guardians. All consent forms were signed and returned to the principals. Since the questionnaire was taken online via Qualtrics, participants' identities were protected; only the standing principals knew their identities. Twelve participants from SRA and 13 participants from AFG completed the survey. The surveys from both schools were

combined into one data set, resulting in a sample size of 25 participants. To ensure anonymity, participants were referred to as P1–P25. The researcher downloaded all surveys to a password protected file. Comments attributed to any participant were quoted verbatim.

Instrument of Data Collection

The implementation of validity strategies during the data analysis process minimizes the injection of research bias into findings and conclusions. The researcher employed the following strategies to ensure data trustworthiness: (a) confirming the accuracy of a few descriptors or themes the researcher identified, (b) peer briefings that a graduate STEM professor performed by reviewing and eliciting questions about the qualitative study, and (c) tasking an independent reader with reviewing and validating the themes and descriptors outlined in the coded report.

Demographic questionnaire. Hispanic/Latina participants completed The Middle to High School STEM Experience questionnaire, which consisted of five multiple-choice demographic questions. Participants were asked to describe themselves in relation to (a) their age, (b) gender, (c) primary language, and (d) secondary language.

Middle school/high school experiences. This section of the questionnaire consisted of nine open-ended questions about the participants' middle school experiences and nine open-ended questions about their first-semester high school experiences. The online questionnaire investigated the participants' broader experiences at home, in cocurricular activities, and with the support of their school to persist in a STEM high school program.

Procedures for Data Collection and Analysis

Once the participants' online questionnaires were compiled, the data were analyzed and hand-coded using an open-code method. The researcher organized transcriptions from the Qualtrics survey and then analyzed them based on emerging themes. The researcher transcribed the data to interpret and classify them into codes and themes. The researcher organized the themes to establish an overall understanding of the phenomenon regarding the emotional, cognitive, and social-emotional support of Hispanic/Latina females interested in STEM (Creswell, 2014).

Through an examination of the codes, the researcher was able to determine if new codes continued to emerge or not as the surveys and coding progressed. The codebook was developed into a chart to report the major emergent themes from the study. Tables and direct quotations were also created to illustrate and articulate meaning.

The researcher used the following validity strategies: (a) member checking, (b) rich think descriptions, (c) clarity of research bias, and (d) peer briefing. To ensure qualitative validity and data integrity, the researcher shared a copy of the final report with educational mentors to confirm that the findings represented an accurate description of the participants' articulated experiences.

Chapter Summary

Although theorists and researchers have provided evidence for the existence of the gender gap in STEM field at the college and career levels and have identified responsible factors for the gap, limited research exists on the even wider gap in STEM for Latinas (Beede et al., 2011; DuBow et al., 2017; NAPE, 2016). The unique contribution of this study resides in giving voice to ninth-grade Hispanic/Latinas regarding the factors

that led Hispanic/Latina middle school students to select a STEM high school education in New York City. Chapter 4 presents the data analysis and findings, followed by Chapter 5, which includes a discussion of the research findings, as well as a discussion of future research.

Chapter 4: Results

Introduction

This study used a qualitative, descriptive approach to explore the STEM-related academic, cognitive, and social-emotional experiences of ninth-graders. The online open-ended questionnaire allowed the researcher to collect data that included experiences, attitudes, and thoughts of ninth grade Hispanic/Latina students about their STEM high school experience. Chapter 4 is organized according to the research question and the findings that emerged from the online questionnaire. The first section covers the profile of the participants. The second section outlines the findings and participant responses to the study by addressing the research question.

Research Question

What factors led middle school, Hispanic/Latina students to select a STEM-focused high school education in New York City?

Research Participants

The research participants for this study were ninth graders enrolled in a STEM program in New York City. The majority of the participants attended a STEM middle school program either after school or as part of their school curriculum. The data were collected in the fall of 2018. For this phase of the qualitative process, a purposeful sampling of 25 students was drawn from two schools in the Bronx. The first four preliminary questions were provided in order to gather background demographic information, which related to the research question. The online survey questions evolved

from the participants’ middle school STEM experiences to their perceptions and lived experiences in high school. Lastly, the questions covered retention and recruitment of other Hispanic/Latina girls into STEM programs.

Table 4.1 presents the demographic profile of the participating Hispanic/Latina students attending a STEM NYC high school. Twelve participants came from SRG high school while 13 participants came from AGS. The majority of the participants identified themselves as female and spoke English as their primary language. Twenty-three participants identified Spanish as their secondary language, while one said English was her secondary language, and another said Spanish and Japanese were her secondary languages.

Table 4.1

Demographic Profile of the Participants

Participants <i>N</i> = 25	Count	%
Age of participants		
Under 14	1	4%
14–15	24	96%
15 and older	0	0%
Gender		
Female	25	100%
Transgender	0	0
Other	0	0
Primary language		
English	24	96%
Spanish	1	4%
Other	0	0%
Secondary language		
English	1	2%
Spanish	23	96%
Other	1	2%

Data Analysis and Findings

Survey question 5. The first nine questions were designed to obtain information about the participants' middle school experiences. These questions provided insight into the participants' earlier exposure to STEM and the type of support or direction they received. Survey question 5 described the participants' elementary/middle school support systems and how those affected their decision to select a STEM-focused high school.

Throughout the online questionnaire, one prominent theme emerged from the categories and codes: the participants perceived family as the supportive factor that had the most significant influence on their journey to STEM. Table 4.2 displays a qualitative summary of the codes, categories, and themes that emerged from Question 5.

Table 4.2

A Qualitative Summary of the Codes/Categories/Themes from Question 5

Codes	Category	Theme
My family wasn't interested in a plain public-school education that lacked extra-curriculum STEM opportunities. They wanted me to go to the best school that will provide me with a future.	Family	
My teachers and guidance counselor supported me and my work. They wanted me to focus and if I stayed focused, I can get into a good high school and a good college.	Relationship/interactions with teachers	Social support
A close family friend told me about the school I needed to get into and the programs I need and how they will challenge me.	Mentoring	

Note. All 25 Hispanic/Latina participants were asked the following question: "Describe your elementary/middle school support system. How did it affect your decision to select a STEM-focused high school?"

As participant P1 stated:

My middle school/elementary school started offering STEM programs when I was in 7th or 8th grades, but they only offered it for student in the lower levels thus I chose a STEM focused high school to change all of that.

Participant P3 reflected: “My elementary/middle school support system was helpful. Yes, it did affect my decision to select a STEM-focused high school because it would help me reach and realize my full potential.”

Participant P14 shared these views:

My elementary/middle school support system affected my decision to select a STEM-focused high school because during my middle school and elementary school years, I was constantly being challenged. I wanted to make sure I would keep being challenged even after I left, so I knew I had to choose a school that would keep challenging me and I knew a STEM focused high school would give me that challenge.

Participant P15 commented:

I heard that this STEM high school focused on challenging girls in Science, Technology and Math. As I heard this I really wanted to come to this school and I did because I am one who likes to be challenged in a STEM focused high school.

Participant P16 claimed: “My school allowed me to take advanced classes and take regents for High School.”

Survey question 6. Survey question 6 asked participants what STEM classes/programs they enrolled in during their middle school years. Table 4.3 displays a

quantitative (frequency) summary of the categories that emerged from the data collected from the online questionnaire.

Table 4.3

A Quantitative (Frequency) Summary of the Categories from Question 6

Categories	Participants																									Total	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25		
Mathmania	x					x						x				x					x					5	
Honors math		x		x	x	x								x											x	x	7
Honors science			x					x		x	x	x		x				x	x	x	x						10
Regents		x		x												x											3
Computer / coding			x									x	x						x						x		5
Afterschool science						x		x	x	x	x			x	x	x	x			x	x				x		12

Note. The table illustrates six categories that emerged during the online questionnaire of all the participants for question 6. The question was: “What STEM classes, STEM programs, or honors programs were you enrolled in during middle school?”

As participant P4 said: “During elementary school, I took Advanced Math in 7th grade, Algebra 1 in the 8th grade and Biology.”

Participant P21 stated: “I was enrolled in a Saturday program for Algebra regents help as well as an afterschool program for living environment. I took 9th grade courses in middle school and it helped a lot for this year. “

Survey question 7. Table 4.4 displays a quantitative (percentile) summary of the categories that emerged from the data. The researcher wanted to explore if any middle school classes or programs helped guide the 25 Hispanic/Latina participants into the academic area of STEM. The majority of the participants (60%) felt their school experiences helped guide them onto a career in STEM.

Table 4.4

A Quantitative (Percentile) Summary of the Classes/Programs that Influence Participants in STEM from Survey Question 7

MSE3	Count	%
Yes	10	40%
No	15	60%
No response	0	0%

Note. The figure illustrates three categories that emerged during the online questionnaire of all 25 Hispanic/Latina participants for interview question 7. The question asked, “Did any middle school classes or programs help guide you in your academic journey? How?”

As participant P4 stated:

When I was in the seventh grade, I had taken 2 math classes. I took regular math and I took Advanced Math. Then when I was in 8th grade, I took regular math and I took Algebra 1. I think that taking these classes really helped my academic journey because now I a one of the few freshmen taking Geometry (a 10-grade math class). I feel confident in my math skills. It will also look good on my record. I am very grateful that I had the opportunity to take these classes in advance.

Participant P8 claimed: “I always had a big interest in biology, math, and some critical reading. I know those are very important things to know. Those classes always guided me to thinking outside the box.”

Participant P14 commented:

Yes, in my middle school I had technology classes that interested me, because one year I had done robotics in my Technology class and I really enjoyed the class. I had also done coding another year, which was another technology class I really enjoyed. These things are what made me interested in Technology and confident,

and what the STEM program had to offer in Technology. I am grateful for the exposure at a younger age.

Participant P15 reflected:

There are three programs that helped me guide in my academic journey. One program that helped me guide in my academic journey was Technology.

Technology has helped because during these three years...my teachers have taught me how to access the websites. How to be able to use technological materials. I love science and taking science early in my journey helped me understand what earth science means.

Participant P22 said: “Yes, many of the classes I took helped me improve in my academics and improve on my skills. The more I learned in that class the more skills and knowledge I gained.”

Participant P25 commented: “My school had an after-school STEM program which helped me find a good STEM focused high school. The exposure I received from that program was rewarding.”

Survey question 8. In the responses to question 8, two themes emerged: The participants perceived those factors that hindered their journey to STEM as relating to their gender. Table 4.5 displays a quantitative summary of the data based on interview question 8. Fifteen participants (60%) felt excluded in their STEM classes whereas 10 participants (40%) claimed they felt included.

Table 4.5

A Quantitative Summary (Percentile) of the Categories from Survey Question 8

MSE8	Count	%
Included	10	40%
Excluded	15	60%
No response	0	0%

Note. The figure illustrates two categories that emerged during the online questionnaire of all Hispanic/Latina participants for interview question 8.

Participant P6 stated:

Yes, I was always included in the work. I loved to participate by answering questions or giving them a try, reading, or helping out others with the work. My teachers always said that it was good to be an active student, even if you are not sure, because it really opens your mind. Being involved is being an aware student.

Participant P9 claimed: “Yes, I did they were very nice and liked to make sure everyone got a chance to solve a problem and they provided extra help if needed.”

Participant P10 said: “I felt socially and academically included in the science and math classes although sometimes, science was a little bit difficult to me. When I participate in class I learn more and more as the days go by.”

Participant P14 said:

I always felt socially and academically included during my middle school honor programs because I knew everybody that was in my program and we had known each other for years from the program so we always involved each other in whatever honor activities we were doing.

Participant P18 stated: “I felt very anti-social since there wasn’t anyone in school around my age who were interested in Science and Technology.”

Participant P21 claimed: “I felt socially and academically included in my middle school STEM classes because after school we had robotics and computer courses which gave me a sense of direction.”

Participant P23 said: “I felt very included in all my STEM classes and always felt a part of the activity that took place in my program.”

Survey question 9. For question 9, participants were asked: Did anyone inspire/motivate/mentor you to perform well in middle school? Table 4.6 shows the two major catalysts: teachers and family. The table displays a quantitative summary of all the categories that emerged from the data as well as the participants that contributed to these categories.

Table 4.6

A Quantitative Summary (Percentile) of the Categories from Survey Question 9

MSE9	Count	%
Teachers	9	36%
Family members	15	60%
Other	1	4%

Note. The figure illustrates three categories that emerged during the online questionnaire of all 25 Hispanic/Latina participants for interview question 9: Did anyone inspire/motivate/mentor you to perform well in middle school?”

Survey question 10. Throughout the online questionnaire, the notion of whether or not your gender presented a challenge in your academic progress during your middle school year, the majority of the participants, 96% felt their gender was a challenge to their success in STEM, whereas 4% said it did not. Two participants did not answer the question.

According to Table 4.7, the majority of Hispanic/Latina students said they felt their gender when they attended a STEM class with their male counterparts. However,

seven participants said they did not feel different and that the teamwork was respectful and collaborative. Two participants decided not to respond to this question.

Table 4.7

A Quantitative Summary of the Categories from Survey Question 10

MSE10	Count	%
Yes	16	64%
No	7	28%
No response	2	8%

Note. The table illustrates three categories that emerged during the online questionnaire of all Hispanic/Latina participants for interview question 10: “Do you remember feeling that your gender presented a challenge to you in your academic progress during middle school?”

Participant 5 said:

Yes, I very much felt that my gender presented a challenge for me in my academic progress during the time I was in middle school. In my 8th grade class, the girls were very much distracted since there was a greater ratio between the boys and the girls. The boys were much more favored in the school and they were much smarter than the rest of us.

Participant 11 said: “Yes, I felt included the teachers made sure everyone worked together and made sure they understood the lesson.”

Participant 14 commented:

Yes, I do remember feeling that my gender presented a challenge to me in my academic progress during middle school because unfortunately a lot of people tend to think that girls are weaker than boys and I met a lot of people who thought I had the intellect for stem but not the strength.

Participant 18 responded:

My gender did, in fact play a challenge. I am not going to sugar coat this; the boys were just dirty and only interested in looks and not the goals a girl had. Since I was known for not begin a “pretty girl” or any source of attraction towards males. They told me to stop trying to be successful, because girls could not do anything and just to go back where I came from, this put me at a rather big stop in my academic progress. I went from a B straight down to a D! This occurred in 7th grade. I let their words get to me, and it worked. I stopped caring and decided not to focus on my studies but try to fit in with crowd... little did i know it took away who I was.

Participant 24 said: “Maybe because girls are not all into STEM so that pushes you to know that you can be different and so good for yourself.”

The majority of the students claimed that their gender helped them succeed in their STEM classes because it made them work harder and not to accept the stereotypes that girls cannot understand or master STEM.

Survey question 11. Throughout the online questionnaire, perceptions were explored of whether gender helped or hindered the participants’ pursuit into STEM. The majority of the Hispanic/Latina participants said that their gender helped them. Table 4.8 displays a quantitative (percentile) summary of the categories that emerged from the data as well as the participants that contributed to these responses. The majority (76%) of the students claimed that their gender helped them succeed in their STEM classes because it made them work harder and not to accept the stereotypes that girls cannot understand or master STEM.

Table 4.8

A Quantitative Summary of the Categories from Survey Question 11

MSE11	Count	%
Helped	19	76%
Hindered	3	12%
No response	3	12%

Note. The figure illustrates three categories that emerged during the online questionnaire of all Hispanic/Latina participants for interview question 11.

Participant P4 stated:

I think my gender was the main reason why I chose to participate in any STEM programs. One thing that motivated me was knowing the history of the women in our past and knowing how they had to work hard for everything they wanted because they weren't handed anything. So, it just reminds me that if I want something, I must work for it and if I want a good education I need to take as much of an advantage as I possibly can.

Participant P5 commented: “My gender hindered me in pursuing my interest in STEM; it made me feel like I wouldn't be smart enough or capable enough to get the jobs or opportunities to become something bigger during middle school.”

Participant P6 said: “Yes, to show that girls can do the same thing a boy can do.”

Participant P11 said:

My gender has helped me in pushing my interest in STEM because I feel as a female, women don't have the same accomplishment as men, so we have to prove ourselves more, this helps make me determined in doing what I love which is science.

Participant P14 claimed:

My gender has helped me academically in pursuing my interest in STEM because I met a lot of people that didn't believe in me or that I would be able to make it to the STEM program because I was a girl because I wouldn't be too strong. But part of what motivated me to keep going and to ignore the ones who didn't believe was the chance to be able to prove them wrong and to show them how wrong they were to judge me.

Participant P16 stated:

I believe that the level of education my school offered, no one felt as if they were any less or any better than one another. Everyone worked together and helped each other without bringing each other down due to our gender.

Survey question 12. For the 12th online question, the researcher investigated whether the participants' families supported their academic interest. Overwhelmingly, all participants agreed that their family was their support system. Table 4.9 displays a quantitative (percentile) summary of the categories that emerged from the data as well as the participants that contributed to these categories.

Table 4.9

A Quantitative Summary of the Categories from Survey Question 12

MSE12	Count	%
Yes	25	100%
No	0	0%
No response	0	0%

Note. The figure illustrates the three categories that emerged during the online questionnaire of all 25 Hispanic/Latina participants for online question 12: “Did your family support your academic endeavors in STEM?”

Participant P9 claimed: “Yes, they did they always helped and made sure I had the help I needed and made sure that I was treated fairly and that I had assistance when I needed.”

Participant P14 wrote: “Yes, my family were my biggest supporters for my academic endeavors for STEM because every time I was discouraged or could not do it my family was there for emotional, physical, and intellectual support.”

Participant P15 said: “Yes, my family always supported me and always wished the best for me. My mother was always active in my school life and always did her best to give me the best.”

Participant P22 claimed: “They supported it but did not know much about the subject of STEM due to having a lack of opportunity during their education.”

Participant P24 said: “Yes, my family thinks it is something different and they thought it was something good to do and that it is a good idea to do.”

Survey question 13. Online question 13 asked Hispanic/Latina participants to identify when they first became aware/interested in STEM. Table 4.10 displays a quantitative (percentile) summary of the ages and grades that emerged from the data as

well as participants that contributed to these categories. The data revealed a split between the first category, ages 11–12 years of age and the second category, 13 years old.

However, 40% of the participants became aware of STEM in the seventh grade.

Table 4.10

A Quantitative Summary of the Categories from Survey Question 13

MSE13	Count	%
Age		
Under 10	4	16%
11–12	10	40%
13 and older	10	40%
No response	1	4%
Grade		
1–5	4	16%
6th grade	6	24%
7th grade	10	40%
8th grade	4	16%
No response	1	4%

Note. The 25 Hispanic/Latina participants were asked the following question: “When did you first become aware/interested in STEM?”

Participant P1 stated: “Yes, I did become interested in STEM when I was 13 and the grade, I was in was 7.”

Participant P14 claimed: “I became interested when it was in the 5th grade when i had computer classes for the first time. I was about 10 or 11 years old.”

Participant P15 said:

I was 12 years old when I first became motivated in STEM. My cousins who were in college told me to take STEM because it will help me a lot for the future. More opportunities for me, and decisions. I was in sixth grade when they have told me this. And this was the truth

Participant P16 commented:

I was interested in STEM when I was in 6th grade because my middle school really introduced me to a well-established program that helped kids become more involved with our courses and take after school programs for extra help.

Participant P25 said: “I was about 6 years old and I believe I was in first grade. “

Survey question 14. For question 14, participants were asked to reflect upon their ninth-grade high school experiences in STEM. Table 4.11 displays a quantitative summary of the categories that emerged from the data as well as the participants that contributed to these categories.

Table 4.11

A Quantitative Summary of the Categories from Survey Question 14

HSE14	Count	%
Easy	13	52%
Difficult	8	32%
No Response	4	16%

Note. The 25 Hispanic/Latina participants were given the following prompt: “Describe your high school enrollment or selection process.”

Participant P3 stated: “My high school enrollment was exciting, stressful and mixed emotions. “

Survey question 15. In responding to question 15, the majority of the participants (88%) claimed that they indeed received help with their high school selection process. Two stated they did not receive external assistance and one participant did not answer the question.

Table 4.12

A Quantitative Summary of the Categories from Survey Question 15

HSE15	Count	%
Yes	22	88%
No	2	8%
No response	1	4%

Note. The 25 Hispanic/Latina participants were given the following prompt: “Describe your high school enrollment or selection process.”

Participant P4 said:

My guidance counselor helped me through the process, she gave me all the information I needed to apply, she let me know the days to open houses, and also reminded me the day before to make sure I did not forget. She was very helpful during this process and I knew I could always come to her with any questions I had.

Participant P5 stated:

My mom was the only one who helped me the most including my cousin. I found them very useful, my mom being able to raise children herself and not knowing anything about any private high schools and my cousin being one of the top students in his high school.

Participant P13 wrote: “Yes, my mother. I did since she chose the high school, she believed I will feel comfortable in.”

Participant P17 claimed: “The assistant principal and tutors help with the high school selection process.”

Survey question 16. Two dominant themes emerged from the responses to question 16 (see Table 4.13). Ten participants claimed it was their high school’s

reputation that caused them to select their high school, whereas nine participants said it was the programs and opportunities. Four participants said it was the family’s decision and two indicated that there were other factors involved.

Table 4.13

A Quantitative Summary of the Categories from Survey Question 16

HSE16	Count	%
High school reputation	10	40%
Programs and opportunities	9	36%
Family	4	16%
Others	2	8%

Note. The 25 Hispanic/Latina participants were asked the following question: “What experiences influenced you to enroll in a STEM-focused high school?”

As participant P5 stated:

One experience I could say that influenced me to enroll in a STEM-focused high school is the time where high schools were coming to visit the schools, I payed [sic] close attention to each and every one high school, since I wanted to better myself for the future

Participant P6 said: “The experience in 6th grade showed me that it is fun and a good learning experience to learn from.”

Participant P8 claimed: “STEM-focused high schools are really great academic preparation schools for colleges and your own future. My grades and my interest in those subjects really got me into finding the right STEM-school.”

Participant P14 wrote: “Being challenged by my middle school and my family always motivating me and making sure I had the best education.”

Participant P19 said: “I decided to enroll in a STEM focused high school because like I said before I am very interested in medicine and this involves math and science.”

Survey question 17. There was a wide range of responses to question 17 (see Table 4.14). Eleven participants said they were prepared for academic challenges in high school, whereas five participants said there were not academically prepared. Two participants did not respond to the question.

Table 4.14

A Quantitative Summary of the Categories from Survey Question 17

HSE4	Count	%
Prepared	11	44%
Somewhat prepared	7	28%
Not prepared	5	20%
No response	2	8%

Note. The 25 Hispanic/Latina participants were asked the following question: “Prior to entering high school, did you attend a STEM program during the normal school day?”

Participant P6 said: “Yes, because I did learn a little bit of what I did in 8th grade in math and science. So, this showed that what I learned can only get bigger and harder.”

Participant P11 wrote: “Yes, because I took 9th grade classes in the 8th grade and took the regents exam too.”

Participant P16 claimed: “Yes, indeed I was more than prepared because I took high school classes in middle school.”

Participant P21 stated: “Yes, very much because I took AP courses which I find are very useful now.”

Participant P25 said: “Yes, because I was extremely smart due to the STEM Program provided by my afterschool.”

Participant P16 stated: “Yes, practice program for specialized school”

Participant P22 wrote: “I took extra math and science classes.”

Survey question 18. The responses to question 18 revealed that the majority of the participants claimed they did attend a STEM program during the normal school day, whereas four participants claimed they did not participate in a STEM program, and two did not answer the question (see Table 4.15).

Table 4.15

A Quantitative Summary of the Categories from Survey Question 18

HSE18	Count	%
Yes	20	80%
No	3	12%
No response	2	8%

Note. The 25 participants were asked the following question: “Prior to entering high school, did you attend an after-school or summer camp STEM program?”

Survey question 19. Data retrieved from question 19 revealed that the majority of the participants (64%) said they attended a STEM program after school, whereas six participants attended summer camp. Three participants did not respond to the question (see Table 4.16).

Table 4.16

A Quantitative Summary of the Categories from Survey Question 19

HSE19	Count	%
After school	16	64%
Summer camp	6	24%
No response	3	12%

Note. The 25 Hispanic/Latina participants were asked the following question: “Did you attend a STEM program after school or at a summer camp?”

Participant P6 stated: “Educators can make things more entertaining and more eye appealing and maybe add a little bit of Spanish in it so they can retain more Hispanic and Latina students.”

Participant P8 commented: “Advertise in those areas and populations. We see a lot of upper west side schools being offered programs but not necessarily schools here in the Bronx. Probably more outreach from programs to Bronx principals.”

Participant P15 said: “Educators do to recruit and retain more Hispanics/Latina students in STEM programs is to have more opportunities for us.”

Participant P23 claimed:

I don't think there is really anything educators can do because it's really based on the student and whether they are interested or have the academic requirements to do so. But if I had to say something it'd have to be to motivate the students to want to be a part of a program like STEM.

Survey question 20. This online question asked Hispanic/Latina participants to identify the tools needed for success in STEM. This question was designed to obtain information on the factors they view as significant to their advancement. The majority said hard work followed by determination were significant.

Table 4.17

A Quantitative Summary of the Categories from Survey Question 20

REC20	<i>N</i> = 25	Frequency
Motivation		13
Hard work		20
Focus		6
Determination		14
Asking for help		8
Self-confidence		10

Note. The table illustrates six categories that emerged from question 20, which stated: “What do you think are some tools for success in STEM-focused education?”

Participant P9 said: “You need determination and to be the right state of mind and also like tutoring sessions with teachers and students that would help.”

Participant P11 claimed: “Good teachers and computers.”

Participant P14 stated: “I think self-confidence, support, faith, dedication, and intellect are some great tools for STEM-focused education.”

Participant 19 suggested: “Wanting to succeed and participation.”

Survey question 21. Data retrieved from question 21 revealed the activities that the 25 Hispanic/Latina participants believed educators could conduct to recruit and retain more Hispanic/Latina students in STEM programs. The majority believed that having more after-school STEM programs would help, followed by 11 students who believed that more advanced STEM programs would lead to improvements, and 9 of the participants believed that administrators should implement more recruitment efforts (see Table 4.18).

Table 4.18

A Quantitative Summary of the Categories from Survey Question 21

REC21	<i>N</i> = 25	Frequency
Bilingual STEM instructors		8
More STEM programs		11
Advanced STEM program		6
Better recruitment efforts		9
More afterschool programs		14

Note. The 25 Hispanic/Latina participants answered the following question: “What can educators do to recruit and retain more Hispanic/Latina students in STEM programs?”

Participant P2 wrote: “Advertising in those areas and populations. We see a lot of upper west side schools being offered programs but not necessarily school here in the Bronx. Probably more outreach from programs to Bronx principals.”

Participant P4 said: “Motivate the students to want to be a part of a program like STEM.”

Participant P5 claimed: “Give more equality to young Hispanic and Latin students, especially the females.”

Participant P11 stated: “Provide STEM programs that are more than just in English.”

Participant P12 said: “Look at their education not their gender or race.”

Participant P18 suggested: “Try to show us that we do matter, and maybe put in Hispanic speaking classes so people who don’t really speak English can do really well.”

Participant P21 claimed: “Educators can really try to inform us and allow everyone, not just honor roll students, to take STEM programs.”

Participant P24 suggested: “They can do more advertisement and just give them a good look about how STEM works.”

Survey question 22. Data retrieved from question 22 revealed the advice that 25 Hispanic/Latina participants gave to young Hispanic/Latina girls wanting to pursue a STEM-focused education (see Table 4.19).

Table 4.19

A Quantitative Summary of the Categories from Survey Question 22

REC22	Count	%
Courage and effort	8	32%
Confidence	12	48%
Determination	11	44%
Unlock your potential	4	16%
Keep grades up	10	40%
Look for resources	7	28%
Ask for advice	9	36%
Join STEM programs	13	52%
Step out of comfort zone	7	28%

Note. The 25 Hispanic/Latina participants were asked the following question: “What advice would you give to young Hispanic/Latina girls wanting to pursue a STEM-focused education?”

Participant P5 stated:

Do not think you are any different from the others, everyone is the same does not matter what ethnicity or gender you are, we are all the same. And to prove who you are especially show off your intelligence to each and every one who thinks differently about you.

Participant P6 claimed: “To do it and don’t let anyone or anything hold you back at all in any type of way.”

Participant P12 said: “Keep your grades up, talk to your teachers or parents or someone who knows a lot about school you are interested in.”

Participant P14 wrote: “No matter how discouraged you may or how many obstacles you have to face to reach your goal for STEM never give up because in the end it will all be worth it.”

Participant P18 suggested: “You can do anything! You can be anything! Don’t EVER let someone tell you just because you are a Latina female that you can’t do it, because I believe you can! Always try to reach for the stars.”

Participant P21 said: “I would tell them to not let their background nor their gender get in the way of anything. Instead to pursue their goals and empower others.”

Participant P22 stated: “To never give up and focus on your education. Being a Latina is a great thing and always embrace your heritage because it is part of you. Always try your best and be your best.”

Summary of Results

“At the end of the conclusion of this study, four major themes emerged from the data. The findings offered insight on the support Hispanic/Latina students require in order to forge and excel in STEM. “

Support services needed for success. The participants considered the type of support the school provided to better assist Hispanic/Latina students (see Table 4.22). The first suggestion was a mentoring program to assist students with the transition from middle school to high school and even to college. The participants also suggested better communication during the recruitment and selection process and other support services available at their schools. They explained that better communication during these

processes and services would have helped many of their middle school peers that lacked family and school support. The final suggestion was the purposeful engagement of Hispanic/Latina students in high school. They believed that if their high schools engaged them earlier, it would have created more access and opportunities for understanding the challenges and demands of high school.

Mentoring programs. The participants conveyed the importance and value of providing incoming ninth-grade Hispanic/Latina students with a mentoring program. They discussed the significance of ninth-grade Hispanic/Latina student receiving an introduction to the many opportunities at school and the reasons why they should take advantage of them. The participants believed that a mentoring program would provide students with the support and guidance they need to succeed. In addition, they realized how important and necessary it is to establish peer-to-peer support systems to handle the competition and pressures of a STEM program.

Support systems needed for success in a STEM high school. The participants of the study commented that the support they received from their family members, teachers, and peers motivated them to succeed while in school. Families provided motivation and the early desire to be successful. Many of the participants discussed how their family members motivated them to enter a STEM field. For their parents, STEM was not a career choice, and many did not attend college. Yet the participants credited them with being effective motivators and supporters. Equally so, the participants claimed they worked hard in middle school to get into a quality STEM program in order to make their parents proud.

Self-discipline. All the participants unanimously agreed that self-discipline drove them to excel in STEM throughout middle school. They believed that self-discipline helped them to stay focused and achieve their goals. The participants also commented that self-discipline that was a significant enabler of their motivation to succeed. They realized in middle school that self-discipline gave them the confidence to enroll in STEM programs and to be successful. They shared the importance of being an individual instead of a follower. Family members encouraged academic excellence from a very young age, and they did not want to disappoint them.

The literature reviewed on this topic contained an array of qualitative and quantitative approaches that relied on secondary data due to the limited articles on this topic. This study may help to advance exploratory approaches by creating a research model that specifically examines the student's relationship to middle school guidance counselors, high school guidance counselors, the community, and family support in order to increase enrollment in STEM.

Chapter 5: Discussion

Introduction

This study sought to identify the perceptions of Hispanic/Latina ninth graders and the type of support they needed in their endeavors in science to increase their potential to enter a career in STEM. The findings allowed the researcher to generate a list of recommendations based on the research question: What factors led middle school, Hispanic/Latina students to select a STEM-focused high school education in New York City?

The research participants for this study were entering ninth graders attending two private STEM schools in New York City. The study employed a purposeful sampling of 25 participants. All responding participants met the criteria of the study and fully participated in the research. Their responses drove the results of the study.

The qualitative research method, including an online, open-ended questionnaire, allowed the researcher to collect data about perceptions that included situations, detailed descriptions, and experiences from Hispanic/Latina students who described their values, beliefs, thoughts, and attitudes. Participants received prompts to share their ideas, thoughts, or reflections regarding their perceptions of their middle and high school STEM experience. Each participant received the opportunity to answer three questions specific to recruitment and supporting future Hispanic/Latina girls in STEM.

The researcher collected and analyzed responses to each of the online questions. Upon reviewing the transcripts of the online questionnaire, the researcher began

interpreting the data using percentiles, frequencies, categories, and themes that emerged from the coded data. After that, the most prominent ideas became the themes for discussion.

Implications of Findings

Characteristics that drive success. Two noteworthy discoveries arose from the study. The first finding suggests that intrapersonal skills (self-esteem, resiliency, and self-awareness) played an important role in participants' continued success in STEM. The categories that emerged related to this theme were a willingness to learn, open-mindedness, and self-determination (see Tables 4.15 and 4.20). These characteristics and qualities explained the participants' sense of self-efficacy (Bandura, 2013). As Gilligan (1982) outlined, girls and boys have a need to be proficient in their skills in order to gain a sense of control over their lives.

Also, before entering high school, the participants were highly driven individuals. As Table 4.3 illustrates, over 80% of the participants were enrolled in advanced math and science classes, entered AP or Honors programs, and attended after-school robotics camps or STEM-based programs. As one participant indicated, "I am in the 7th grade but I am taking high math classes so I feel confident that I will major in Math when I go to college." Another participant stated, "During the summer I go to several STEM camps so I can compete against my classmates so I feel confident that I will do well in STEM." Having girls engaged in these classes and STEM programs counters the stereotype that boys are better at math and science. As Wang and Degol (2017) stated, a healthy competitive environment with hands-on practices and competition can boost one's self-confidence and self-esteem.

External barriers. The second major finding from the research question concerns external barriers. All 25 Hispanic/Latina participants identified three specific external barriers to success: (a) gender bias, (b) lack of bilingual educators in STEM, and (c) perceived lack of ability. The second finding suggests that external factors, such as family, school, community, and mass media play a role in how Hispanic/Latina girls view their career choices. Media literacy or other forms of interventions must address consumers' self-image and the negative impact of the media on self-esteem, particularly for Latinas because of their underrepresentation in magazines and the limited number of female role models (Butler-Barnes et al., 2015).

Recommendations

Awareness to STEM majors, careers, technical training, and extracurricular activities provided to Hispanic/Latina students should begin at an early age, when students' natural curiosity is greatest; this should begin in elementary school and continue all throughout middle, and high school.

Exposure to STEM was one of the major requests by the participants. Embedding STEM courses into the instructional curriculum (using electronic mapping for better effectiveness in distribution) and aligning the STEM curriculum to all courses offered allow Hispanic/Latina students to connect STEM skills to possible career paths and expand their vision of what is possible in life by enabling them to identify the use and application of different careers in STEM.

Allocation of STEM funding to Hispanic/Latina students from academic institutions, private organizations, community centers, and support-based organizations should be aimed at supporting Hispanic/Latinas pursuing STEM educations and careers.

These financial supports should be distributed in the form of merit scholarships, need-based scholarships/grants, and socioeconomic disadvantage grants.

Experiential learning provides infinite opportunities to Hispanic/Latina students to advance self-development, which can also serve as a great factor that motivates Hispanic/Latina students to select STEM professions and careers. Providing these students with internship (paid and unpaid), volunteer, collaboration, and intervisitation opportunities would allow Hispanic/Latina students to explore different venues involving STEM. These opportunities can enhance their understandings of the application of STEM in the workplace. Internships can also provide limitless and untapped potentials, which are key to socioeconomic growth; Hispanic/Latina students can take part in special projects, conferences, and seminars that will prepare them for the technological work place, open them up to business opportunities, and sharpen their entrepreneurship skills. It has already been demonstrated that learning through social interaction leads to cognitive growth and knowledge acquisition. For example, Hispanic/Latina students exposed to STEM instructions were found to use prior knowledge of science, technology, engineering, and mathematics to construct new experiences within their STEM educations (Bandura, 1977b). Bandura's (1977b) theory applies to Hispanic/Latina students engaged in problem-solving, hands-on, group, and individual STEM activities as they learn not only from role models within the STEM fields but also those who teach STEM courses.

Social Support through mentorships for Hispanic/Latina students can provide Hispanic/Latina students with the opportunity to not only obtain group support but also one-to-one support. Mentors can guide them process of selecting and working towards

their careers of choice. Social learning theory (SLT) emphasizes the notion that individuals learn from one another through collaboration, personal interactions in society, and instruction. From an early age, Hispanic/Latina students should be introduced to ambassadorship concepts. Thus, Hispanic/Latina students will not only be motivated to select STEM careers and professions but will also aspire to support a national and global outreach that helps and supports the legacy of Hispanic/Latinas in STEM. DuBow et al.'s (2017) study also related to Bandura's model of reciprocal determinism (MRD) since the researchers suggested that females who surrounded themselves with friends who were also involved in computing had higher chances of selecting and remaining in STEM fields.

Latina role models selection should be a requirement for all organizations.

Selecting Latina role models from within the administrators, educators, advisors, mentors, older peers etc. to be available to mentor Hispanic/Latina students can motivate these students to select STEM professions and careers. The fundamental principle of SLT is that individuals learn not only from their own experiences but also through the observation of others, a process called observational learning or modeling (Bandura, 2013).

Allocation of STEM funds to instruction and tools would fund professional development of staff, updating technology (hardware-software, equipment, tools, systems, and infrastructure), and providing teachers, administrators, and organizations with the repertoire necessary to deliver rigorous personalized quality instructions that meet the demands of an ever-changing STEM world. Professional development in STEM provides teachers with the skills to effectively deliver a personalized STEM instruction to

Hispanic/Latina students as well as the skills necessary to implement and utilize technology tools, systems, and digital curriculum that increase teachers' productivity, knowledge, and innovation in the effective use of resources, digital curriculum, and digital literacy.

The utilization of one-to-one laptops, iPads, and cellphones is an important component of personalized instruction. Moreover, operating learning management systems and personal learning pathway systems offers Hispanic/Latina students the opportunity to refine their learning experiences by enabling them to connect their learning experiences with their lives while still remaining competent in core subjects. Latina/Hispanic students can benefit from software that educates them to be proficient in digital literacy, robotics, coding, artificial intelligence and automation, technology and computer skills, critical thinking, and keyboarding, as it would allow them to create tools and activities important to them and their economic situations. Social learning theory emphasizes the notion that individuals learn from one another through collaboration, personal interactions in society, and instruction (Bandura (1977b). Upgrading infrastructure to a next generation wireless network system or fifth generation (5G) network infrastructure would allow Hispanic/Latina students to use a wider range of technology and still have access to fast network speed and internet connectivity not only at the organizations they are attending but also at home and in public areas. Enhancing the infrastructure and network to support media, digitized video, and video broadcasting services allow Hispanic/Latina students to have a school-home connection that is seamless.

Federal/state incentive STEM funds and accountability – There should be federal and state incentives as well as merit STEM funding allocated to public, private, and religious organizations, academic institutions, community centers, and support-based organizations committed to improving Hispanic/Latina student participation in STEM professions/careers. Incentives should depend on the level of commitment demonstrated by organizations according to the number of Hispanic/Latinas that graduate. The funding should be used as follows:

For academic institutions that specialize in STEM – to be used towards improving *digital literacy* amongst Latinas, adding time and rigorous STEM curriculum to regular schedule, providing extracurricular opportunities, career days/fairs, providing rigorous STEM *professional development in STEM to staff, as well as* educating all constituencies *on issues affecting Latinas*. Gilligan et al. (1990) have proposed that some of the main factors that impact the lack of females at all levels of education and career pipelines in STEM fields are internal factors—such as self-concept theory and self-esteem. *Ultimately, academic institutions that provide personalized learning classrooms and services that not only enhance the unique strengths but also meet the instructional, social, and emotional needs of Hispanic/Latina students.*

For organizations that can demonstrate adequate commitment to supporting Latinas in STEM based on numbers of STEM diplomas/certificates obtained by Latinas.

For technical schools in any STEM area that cater to Latina students in developing the hard and soft skills necessary to improve productivity, innovate, and provide services.

Campaigns – These should be held at the city, state, national and global levels and aimed at recruiting and retaining Hispanic/Latinas in STEM by addressing the social and

emotional stereotypes (Gilligan et al., 1990) that can discourage Latinas from embracing STEM. Gilligan et al. (1990) have proposed that some of the main factors that impact the lack of females at all levels of education and career pipelines in STEM fields are internal factors, such as self-concept theory and self-esteem, as well as external factors, such as the influence that parents, schools, media, institutions, and educators have on them.

Public relations campaigns requirements across all forms of media geared towards positively reinforcing Latinas in STEM can motivate Hispanic/Latina students to select STEM educations and careers. Forms of media include but are not limited to books, magazines, newspapers, movies, television, video games, music, toy advertisements, social media, and the internet. The application of the theoretical frameworks created by both, Bandura and Gilligan, guided this researcher's development of the survey utilized in this study. Both approaches established an initial set of factors of interest for this study, which are Bandura's concepts of *performance accomplishments, indirect experiences, verbal encouragement, and psychological states*, and Gilligan's factors of *self-concept* and *self-esteem*. Considering these dimensions through a critical feminist lens reveals how the broader social discourse regarding young women of color interacts with their STEM interests.

Professional development requirements across all industries intended to recruit, retain, and promote Hispanic/Latina females in STEM areas can motivate them to select STEM education and careers.

Limitations

Due to qualitative nature of the study, it only indicates what factors motivate Hispanic/Latina students to select STEM education but does not show why.

A second limitation is the study's time frame. It did not allow this researcher to conduct semi-structured personal and peer-to-peer interaction (focus groups) with students, parents/guardians, teachers, administrators, and technical support team. This study only included an electronic survey via Qualtrics, which could influence the amount of elaboration given for responses.

A third limitation is the varied experiences of participants. Study participants had varied experiences regarding STEM within their private schools. This study however did not include input from public school students.

Potential confounding factors represent a four limitations in this study. Girls attending private school may be socioeconomically better off than their public school counterparts. As such, motivating factors vary both in type and in effectiveness for different groups of Latina students.

And a fifth limitation in this study is the normative societal values – there is an incomplete consideration for how normative societal values may shape also girls' perception of STEM. These values are often exhibited through forms of mass media for example, social media, entertainment media, and role models.

Recommendations for Future Research

There are numerous recommendations for future research investigating the factors that led Hispanic/Latina middle school students to select a STEM high school education.

They are as follows:

1. A mixed study could be undertaken that quantifies and ranks the effectiveness of recommendations in motivating Latinas to pursue STEM. For example, did role models or early exposure to STEM have more of an influence on a girl's choice?

Hypothetically both recommendations could be equally effective or demonstrate no significant effect on a girl's choice to pursue STEM

2. A study could be undertaken measuring how does early exposure to personalized STEM curriculum affect Hispanic/Latina girls' motivation to select STEM majors and careers.

3. An additional study should be conducted on a larger scale with a bigger sample size that also involves public school students from the New York City Department of Education in order for the findings to be more generalizable.

4. An additional study should be conducted involving personal interviews with other influential individuals and groups in a Latina student's life, such as focus groups, parents, teachers, administrators, guidance, and technology technical support personnel. It should also include observations of practices such as conferences between Hispanic/Latina students and teachers, ongoing professional developments in STEM provided to faculty and administrators, ongoing formative assessments that authentically involve Hispanic/Latina students, and a collection of student learning portfolios that gather evidence of learning.

Conclusion

There is a significant gender gap in science, technology, engineering, and mathematics (STEM) careers as well as in the STEM workforce that continues to expand, ultimately impacting the global economy (Mayo, 2010). As new technologies like artificial intelligence and machine learning rapidly emerge and penetrate nearly all existing industries, the need for a quickly growing STEM-educated workforce is more urgent than ever before. In our society, factors such as the beliefs of parents, institutions,

the media, schools, and toy makers create a bias that deters girls from participating in STEM fields (Pomerleau et al., 1990). According to Moss-Racusin et al. (2012), female students' preferences, participation, and performance in STEM resulted from many factors that are present from their early years of education. Interventions focused on increasing girls' interest in science need to begin in middle school and, in some cases, as early as elementary school (Butler-Barnes et al., 2015).

Although theorists and researchers provided substantial evidence for the existence of the gender gap in the STEM fields at the college and career levels, no researcher has examined the even wider gap existing in STEM for Latinas (Beede et al., 2011; DuBow et al., 2017; NAPE, 2016). Researchers have also not identified factors that are responsible for that gap (Beede et al., 2011; DuBow et al., 2017; NAPE, 2016). The lack of research in this area is surprising for several reasons. First, previous researchers have generally highlighted an urgent need for more women and minorities in the STEM workforce (Shapiro et al., 2015). Second, of the 15% of U.S. college students that graduated with degrees in STEM fields, only 6.7% of them were women, with Latinas being disproportionately underrepresented when compared to the general population (Mayo, 2010). This researcher sought to fill the gender gap in STEM careers and education. The purpose of this qualitative study was to explore the STEM-related academic, cognitive, and social-emotional experiences of ninth-grade Hispanic/Latina students eager to pursue and persist in high-school STEM education in New York City as well as to discover the factors led middle school, Hispanic/Latina students to select a STEM-focused high school education in New York City.

The literature review on STEM and Hispanic/Latina students first examined the gender gap in the STEM workforce and educational system. Second, the literature review focused on the factors that have caused the gender bias in STEM. Third, the literature review covered creative and intentional approaches to closing the gender gap amongst girls, especially of Hispanic/Latina origin.

Bandura's (1977a) and Gilligan's (1982) theoretical frameworks guided the development of the survey in this study. Both approaches established an initial set of factors of interest for this study, which were Bandura's concepts of performance accomplishments, indirect experiences, verbal encouragement, and psychological states, and Gilligan's factors of self-concept and self-esteem. Bandura's social learning theory posited the need for support and motivation to strengthen self-determination and self-esteem and Gilligan's theory asserted the need to address the girls' internal factors, such as self-esteem, and external factors, such as the influence that parents, media, institutions, and educators have on girls. The phenomenological qualitative methodology in this study provided an opportunity to capture the intersectionality and complexity of academics, cognition, gender, race, and the socioeconomic status of these students and their involvement in STEM. The methodology also examined the reality of Hispanic/Latina students' family involvement and community support in order (a) to investigate the current practices and policies that support or impede Hispanic/Latina success and (b) to examine the high school to college pipeline to successfully encourage, motivate, support, and connect future Hispanic/Latina students.

The researcher designed this study to gain insight about the perceptions of Hispanic/Latina ninth graders and the type of support they needed in their STEM

endeavors to increase the possibility that they would pursue a career in STEM. The data collection process began with a purposeful sampling of 25 Hispanic/Latina students drawn from two designated STEM high schools (SRA and AFG) in the Bronx. This study used an online questionnaire to collect information from Hispanic/Latina students on the school premises. Each participant received a link to access the study and create a private password. Twelve participants from SRA and 13 participants from AFG completed the survey. Participants completed the online questionnaire within the time allotted for this study. To ensure anonymity, participants received the designations P1–P25.

Once the participants completed the online questionnaire, the data analysis and coding began. Qualtrics distributed and returned the results within 48 hours. The researcher combined the surveys from both schools into one data set. This allowed the researcher to discover themes or patterns in the data that would assist in explaining the support and guidance that Hispanic/Latinas needed to increase and retain their participation from K–12.

After the online questionnaire, the researcher coded the data using open-ended coding systems (Creswell, 2014). The data analysis was based on emergent themes. Codes included *performance accomplishments*, *indirect experiences*, *school experiences*, *family experiences*, *verbal encouragement*, *self-concept*, and *self-esteem*. In the final phase, the researcher produced precise codes in order to identify specific types of factors affecting the students' decision to pursue STEM and their experiences in high school.

The first four preliminary questions solicited background demographic information, which related to the research question. The online survey questions ranged from their middle school STEM experiences to their perceptions and lived experiences in

high school. Lastly, the questions covered retention and recruitment of other Hispanic/Latina girls to STEM programs.

The data allowed the researcher to identify factors that led Hispanic/Latina middle school students to select STEM high school education. The findings of the study suggest that intrapersonal skills such as willingness to learn, drive, open-mindedness, and self-determination played a key role in the success of the participants. All 25 Hispanic/Latina participants identified three external barriers to their success: (a) gender bias, (b) lack of bilingual educators in STEM, and (c) perceived lack of ability. The findings also suggest that external factors such as family, school, community, and mass media play a role in how Hispanic/Latina girls view their career choices. Media literacy or other forms of interventions must address girls' self-image and the negative impact of the media on self-esteem, particularly for Latinas because of their underrepresentation in magazines and the limited number of female role models (Butler-Barnes et al., 2015). Having teachers dedicated and committed to the goals and needs of Hispanic/Latina girls could help their future counterparts succeed.

The results indicated that family support was the most significant source of motivation. Many of the participants explained how their family members motivated them to begin or continue in STEM. Support for Hispanic/Latina girls goes beyond peers to include teachers, guidance counselors, and school support. With an increased number of Hispanic/Latino students entering K–12 who are connecting cultural experiences to the learning process, more Hispanic/Latino may receive an opportunity to enhance and increase academic achievement in STEM.

This study adds to the existing body of literature on the factors that led Hispanic/Latina middle school students to select a STEM high school education. Much of the literature reviewed on this topic contained an array of qualitative and quantitative approaches that relied on secondary data due to the limited articles on this topic. In contrast, this study captured Hispanic/Latina girls' perceptions that included situations, detailed descriptions, and experiences from Hispanic/Latina students and that describe values, beliefs, thoughts, and attitudes. The study identified the factors that can positively motivate Hispanic/Latina student to select STEM education and careers.

This study is significant for several reasons. First, the country is facing a significant gender gap in STEM careers and education that could negatively impact the profitability of every industry in the nation. The underrepresentation of women is not only a pressing moral and social issue but also a critical economic challenge (McKinsey Global Institute [MGI], 2015). MGI suggested that if women, who account for half of the world's working-age population, do not achieve their full economic potential, the global economy will suffer (MGI, 2015).

The problem of underrepresentation is critical because Latinas have comprised the largest female minority group in the United States, reaching a total of 8% of the entire U.S. population in 2001 (Ginorio & Huston, 2001). The underrepresentation of Latinas in STEM fields is even more acute because Latinas are the fastest growing group in the country. Therefore, Latinas' underrepresentation could put the country at risk of expanding the significant gender gap that exists in STEM careers and education, exacerbating the pressing moral and social issues surrounding Hispanic/Latina students in STEM, and enhancing the risk of women not achieving their full potential. These risks

can not only negatively impact the profitability of every industry in the nation but also affect the global economy.

The results of this study could benefit (a) educators at all levels by teaching them to provide girls with the social, educational, and emotional support needed to increase Latina participation in STEM, (b) policymakers by highlighting the national concern over the dearth of females enrolling and persisting in STEM fields and careers, and (c) scholarly literature in STEM. The findings may also be of highest interest to STEM educators and policymakers because the results could provide them with a deeper understanding of the factors that motivate Hispanic/Latina students to select and remain in STEM-focused fields and careers. Additionally, this study may help to advance exploratory approaches by attempting to create a specific research model that examines the whole student's relationship to middle school guidance counselors, high school guidance counselors, the community, and family in order to increase the enrollment numbers in STEM.

Recommendations for further research include conducting a broader research project with a larger sample size that also involves public school students from the New York City Department of Education in order to make the findings more generalizable.

Despite the limitations of the study, this qualitative research captured an understanding of the lived experience of these Hispanic/Latina students. To address the longstanding and persistent problem of the gender gap in STEM fields and education, it is imperative that educators, public organizations, private organizations, religious organizations, and policy makers not only develop a large qualified STEM workforce but also that they shape a STEM education system that is more family friendly and

acknowledging of the potential value and contributions that Hispanic/Latina students have to offer. This research is only the investigative beginning of the long overdue need to explore factors motivating young Hispanic/Latinas into the STEM fields careers and education and achieving growing STEM workforce demands.

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Appendix A:

Student Demographic and Open-Ended Questions

Questionnaire to be filled out using Qualtrics only

Demographic Questions

1. What is your age?
 - a. Under 14 years
 - b. 14 to 15 years
 - c. 16 to 17 years
 - d. Older than 17 years

2. What is your gender?
 - a. Female
 - b. Transgender
 - c. Choose not to answer
 - d. Other_____

3. What is your **primary** language?

4. What is your **secondary** language?

Open-Ended Questions

Part One: Middle School Experience

5. Describe your elementary/middle school support system. How did it affect your decision to select a STEM-focused high school?
6. What STEM classes and/or STEM programs or honors programs were you enrolled in during middle school?
7. Did any middle school classes or programs help guide you in your academic journey?
How?
8. Did you feel socially and academically included or excluded in your middle school STEM classes? How?
9. Did anyone inspire/motivate/mentor you to perform well in middle school?
- a. None
 - b. Teacher
 - b. Family member
 - c. Other (relationship): _____
10. Do you remember feeling that your gender presented a challenge to you in your academic progress during middle school? If so, how?

11. Has your gender helped or hindered you academically in pursuing your interest in STEM? How?

12. Did your family support your academic endeavors in STEM? How?

13. When did you first become aware/interested in STEM?

a. How old were you?

b. What grade were you in?

Part Two: High School Experiences

14. Describe your high school enrollment or selection process.

15. Did anyone help you with your high school selection process? Did you find them useful/valuable in that process?

16. What experiences influenced you to enroll in a STEM-focused high school?

17. Do you feel that you were academically prepared for high school? Why or why not?

18. Prior to entering high school, did you attend a STEM program during the normal school day?

19. Prior to entering high school, did you attend an after-school or summer camp STEM program?

20. What do you think are some tools for success in STEM-focused education?

21. What can educators do to recruit and retain more Hispanic/Latina students in STEM programs?

22. What advice would you give to young Hispanic/Latinas wanting to pursue a STEM-focused education?

Apéndice B:

Cuestionario para el Estudiantes de Preguntas Demográficas y de Final Abierto

Cuestionario para ser Completado por los Estudiantes Solamente por la Vía de Correo Electrónico Qualtrics

Preguntas Demográficas

1. ¿Cuál es tu edad?

- a. Menores de 14 años
- b. 14 a 15 años
- c. 16 a 17 años
- d. Mayores de 17 años

2 ¿Cuál es tu género?

- a. Hembra
- b. Transgénero
- c. Elijo no responder
- d. Otro: _____

3. ¿Cuál es tu idioma principal?

4. ¿Cuál es tu idioma secundario?

PREGUNTAS ABIERTAS DEL ESTUDIANTE:

Primera Parte: Experiencia en la Escuela Intermedia

5. Describa su sistema de apoyo de escuela primaria / secundaria y su decisión de seleccionar una escuela secundaria enfocada en STEM.

6. ¿Cuáles fueron las clases de STEM y / o los programas de STEM / Programas de Honor en los que estuvo inscrito en la escuela intermedia?

7. ¿Alguno de los programas / clases de la escuela intermedia lo guio en su viaje académico? ¿Cómo?

8. ¿Te sentiste social y académicamente incluida / excluida de las clases de STEM de tu escuela intermedia? ¿Si es así, cómo?

9. ¿Alguien te inspiró / motivó / fue tu mentor para que te desempeñe bien en la escuela secundaria?

a. Nadie

b. Profesor

c. Miembro de la familia

d. Otro (relación) _____

10. ¿Recuerdas haber sido desafiado académicamente por tu género (femenino) en la escuela secundaria? ¿Si es así, cómo?

11. ¿Tu género (femenino) te ayudó o te dificultó académicamente en tu interés por STEM? ¿Si es así, cómo?

12. ¿Tu familia apoyó tus esfuerzos académicos en STEM? ¿Cómo?

13. ¿Cuándo comenzaste a descubrir tu interés por STEM?

a. ¿Cuántos años tenías? _____

b. ¿En qué grado estabas? _____

Segunda Parte: Experiencias de la Escuela Superior

14. ¿Describa su inscripción o el proceso de selección para entrar a la escuela superior?

15. ¿Alguien te ayudó con este proceso de selección de escuela superior? ¿Los has encontrado útiles / invaluable?
16. ¿Qué experiencias previas al STEM le influyeron para inscribirse en una escuela superior enfocada en STEM? Por favor explique.
17. ¿Usted cree que estaba preparada académicamente para la escuela superior? ¿Porque o porque no?
18. ¿Asistió a un programa de STEM durante el horario regular de clase
19. ¿Antes de ingresar a la escuela superior asistió a programa de STEM después de la escuela o en el programa de campamento de verano?
20. ¿Cuáles crees que son algunas herramientas para el éxito en la educación centrada en STEM?
21. ¿Qué pueden hacer los educadores para reclutar y retener a más estudiantes Hispanas / Latinas en los programas STEM? Por favor explique
22. ¿Qué consejo le darías a las jóvenes Latinas que desean seguir una educación enfocada en STEM?

Appendix C:

IRB Approval

October 16, 2018

File No: 3889-062118-03

Maria Lopez
St. John Fisher College

Dear Ms. Lopez:

Thank you for submitting your research proposal to the Institutional Review Board.

I am pleased to inform you that the Board has approved your Full Review project, "An Exploratory Study: The Factors that Led Middle School Hispanic/Latina Students to Select a Northeastern STEM High School Education". The Board considers your project adequate to protect the rights and welfare of human subjects as well as meeting the standards for informed consent.

As principal investigator, you are responsible for promptly reporting (in writing), through your department head, the following:

- The location where the signed consent forms will be kept on file for a period of three years.
- Progress reports of the research will be sent to the Board annually. If the research is not concluded within a year's time, you will need to petition the Board for a one-year renewal.
- Any injuries to human subjects.
- Any unanticipated problems that involve risks to the human research subjects or others.
- Changes in a research activity.
- Changes in research during the period for which the Board approval has already been given shall not be initiated by research investigators without the Board review and approval, except where necessary to eliminate apparent immediate hazards to the subject. In such occurrences, the Board is to be notified as soon as possible.

Following federal guidelines, research related records should be maintained in a secure area for three years following the completion of the project at which time they may be destroyed.

On behalf of the Board, I wish you success with your research project.

Should you have any questions about this process or your responsibilities, please contact me at irb@sjfc.edu.

Sincerely,



Eileen Lynd-Balta, Ph.D.
Chair, Institutional Review Board
ELB: jdr

CC: Dr. Josephine Moffett
Dr. Janice Kelly

Appendix D:

Principal Permission Form

Dear High School Principal,

I am a doctoral candidate enrolled in the Executive Leadership program at St. John Fisher College. I am writing to request your permission to conduct a qualitative study at your school. The name of the study is “A Qualitative Exploration of the Factors that Led Middle School Hispanic/Latina Students to Select a Northeastern STEM High School Education.

The study is being conducted as part of my doctoral research involving northeastern STEM high schools. The Institutional Review Board at St. John Fisher College has approved this study. You were selected because your school is a STEM-based Northeastern high school with Hispanic/Latina 9th grade students.

I am writing to request your permission to administer an electronic questionnaire to students at your school who meet the study criteria. I am asking that the principal/designee randomly select 10 Latina STEM-focused students from the 9th grade to participate. I am also asking that the principal/designee administer the electronic questionnaire to the selected students utilizing a link that will be provided by the investigator. The investigator will not have any direct contact with the students. These data will aid the investigator in better understanding the factors that motivate Hispanic/Latina students to select a STEM-focused high school in the Northeastern region of the United States.

You and your school must meet the following criteria for inclusion in this study:

- 1) At the time of the questionnaire, you must work in the New York City Department of Education or parochial High School as a principal.
- 2) You must be leading a school where a STEM program is provided to students including 9th-grade female students identified as Hispanic/Latina. Schools that do not provide STEM programs to 9th grade Hispanic/Latina students are not eligible to participate.
- 3) Your school must be located in an area with a large Hispanic/Latino population.
- 4) You must have at least ten female 9th-grade Hispanic/Latina students in STEM.

This letter does not mandate you to permit your students to participate in this study. Participation is completely voluntary. There will be no adverse effects should you decide not to allow your students to participate in this study. Furthermore, you do not have to respond to this letter if you are not interested in allowing your students to participate in this study. If you decide to allow your students to participate in this study, please sign this

consent at the bottom of the page and return it via email to mal07119@sjfc.edu. You will then be sent a letter confirming your consent for your students to participate.

Because the participants in this study are minors, parental consent and student assent forms will be needed for the students to participate. I will need to obtain approval from the St. John Fisher College Institutional Review Board to complete this research.

I am requesting your signature at the bottom of this page as well as a signed statement on official school letterhead that indicates your approval of the participation of your school and students in my research study. Please respond by email to mal07119@sjfc.edu

Thank you for your time and consideration. I look forward to hearing from you.

Sincerely,

Maria Lopez
Doctoral Candidate
St. John Fisher College
Executive Leadership in Social Justice Program

I, _____, Principal of _____ approve the participation of students from my school in your research study.

Principal's Name (Print)

Principal's Signature

Date