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Factors that lead to the success of inner city Hispanic students in STEM dual enrollment: a mixed methods study

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FACTORS THAT LEAD TO THE SUCCESS OF INNER CITY HISPANIC STUDENTS IN STEM DUAL ENROLLMENT: A MIXED METHODS STUDY

by

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Dedications

To my mom and dad, who always pushed me for the highest and enabled me to dream big

To the love of my life – my daughter *Riddhi*

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Abstract

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The United States has been struggling to maintain its authority in technological world. Every year thousands of skilled STEM workers come to the United States to take jobs that are not filled by our college graduates. In order to uplift STEM education in the United States intermediation is required from the early years and also to encourage participation of Hispanic students in STEM majors and careers. Over the years the high school graduation rates for Hispanic youth has increased, and their enrollment in institutions of higher education have also increased, however, their participation in STEM majors has not yet seen the same increase. Besides advanced placement (AP) credits, dual enrollment credits have become very important part of high school curriculum. Federal government and various other organizations have been funding STEM dual enrollment programs throughout the country to promote participation of Hispanic and other minority high school students in STEM majors and careers. Although several grants are working on promoting and encouraging STEM Dual enrollment among Hispanic students, only a very small percentage of Hispanic students successfully take advantage of these opportunities. This dissertation focuses on studying factors that support the success of Hispanic high school students from inner city school districts in STEM Dual Enrollment.

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Chapter I

Introduction

"*Now is the time to build a firmer, stronger foundation for growth that will not only withstand future economic storms, but one that helps us thrive and compete in a global economy. It's time to reform our community colleges so that they provide Americans of all ages a chance to learn the skills and knowledge necessary to compete for the jobs of the future."* – President Barack Obama

The National Science Foundation defines STEM fields as computer science, mathematics, life science, physical science, behavioral and social science, and health related fields. In November of 2009, President Obama announced the 'Educate to Innovate' campaign, aimed to move "our country from the middle to the top of the pack in science and math education over the next decade" (Office of the Press Secretary, 2009). To better compete with other countries, the United States must improve STEM education. STEM education affects the U.S. economy in two ways. First, the professional STEM economy is closely linked to graduate school education, maintains links with research universities, but functions mostly in the corporate sector. It plays a vital function in keeping American businesses on the cutting edge of technological development and deployment. Second, the STEM economy draws from high schools, workshops, vocational schools, and community colleges. These workers are less likely to be involved in inventions, but they are critical to the implementation of new ideas. Their usage of the products provides feedback to researchers on feasibility of design options, cost estimates, and other practical aspects of technological development. Skilled technicians produce, install, and repair the products and production machines patented by professional researchers, allowing firms to reach their markets, reduce product defects, create process innovations, and enhance productivity (Rothwell, 2013).

Two of the biggest fears driving the STEM fervor are that the United States is losing its dominant position in global innovation and technological expertise, and that the future will see an insufficient number of U.S. citizens prepared to fill STEM-related jobs (Lowell & Salzman, 2007). Increasing the number of high school, college, and postgraduate students majoring in STEM subjects is critical for economic prosperity of the nation.

In the last two decades, a major shift in technology and other STEM jobs has occurred in the United States; many of these jobs and research initiatives have been outsourced to India, China, and Russia. Johnson and Kasarda (2008) note several reasons for these shifts, including dependency on international professionals who come to the U.S. on H-1B or L-1B visas to work in the highly-trained engineering, computer programming and other technology fields, and the quality of the workforce in the other countries. They further note that about 14 million U.S. occupations are vulnerable to offshore outsourcing. As a result, the United States has become the final assembler or utilizer of what might be called the "global supply chain of services" (Johnson & Kasarda, 2008). However, the most critical reason remains the same – the U.S. K-12 and higher education system is not producing enough students who wish to pursue STEM careers.

Over the last several decades, most manufacturing and technology jobs have been outsourced. Major technology companies have outsourced several STEM jobs because students are not interested in STEM careers, and the schools and colleges do not prepare them for the STEM degrees. Lemelson-MIT Invention Index (2012), which gauges innovation aptitude among young adults, found that 60% of young adults (ages 16-25)

indicated at least one factor that prevented them from pursuing further education or work in the STEM fields. Thirty-four percent said they don't know much about the fields, 34% said STEM fields were too challenging, and 28% said they were not well prepared at school to seek further education in STEM.

Several reports indicate that U.S. students have weak math and science skills when compared with students from other developed nations (Taningco, Mathew, & Pachnon, 2008). The President's Council of Advisors on Science and Technology (PCAST) (2010) cites less than one-third of U.S. eighth graders show proficiency in mathematics and science on the National Assessment of Educational Progress. Additionally, only about one-third of bachelor's degree earned in the United States are in a STEM field, compared with approximately 53% of first university degree earned by students in China, and 63% earned by students in Japan (PCAST, 2010). Furthermore, over half of the science and engineering graduate students in U.S. universities are international students (President's Council of Advisors on Science and Technology, 2010). These foreign-born students leave the country after earning their degrees, leaving the United States with fewer professionals in the field. According to Organization for Economic Cooperation and Development (OECD) (2010), the U.S. ranked 17th in science and 25th in mathematics out of the 65 countries who participated in the international evaluation program conducted by the organization. The following table projects the performance of U.S. 15-year-olds in science and math and the number of STEM graduates with bachelor's degree compared with other countries.

Table 1

STEM education in an international perspective

	Average PISA Math Scores (15-year-olds) (2009)	Average PISA Science Scores (15-year-olds) (2009)	STEM Graduates: Bachelor's Degree Equivalent (2008)	STEM Graduates as a share of All bachelor's Degree Equivalent Graduates (2008)	STEM Graduates per 100,000 employed 25-34 year-olds (2008)
United States	487	502	348,484	0.15	1,472
U. S. Rank in OECD	T- 25th	17th	1st	27th	23rd
OECD Average	496	501	53,612	0.21	1829
Remaining Top 15 OECD Countries (by nominal GDP)					
Australia	514	527	45,020	0.19	2,362
Canada	27	529	49,208	0.22	2,146
France	497	498	112,398	0.27	2,717
Germany	513	520	106,986	0.29	1796
Italy	483	489	50,877	0.22	N/A
Japan	529	539	160,993	0.24	1,643
Korea, South	546	538	130,468	0.33	3,555
Mexico	419	416	97,410	0.25	1,085
Netherlands	526	522	17,372	0.14	1,039
Spain	483	488	51,309	0.24	1,488
Sweden	494	495	12,736	0.24	1,596
Switzerland	534	517	10,285	0.23	2,010
Turkey	445	454	50,911	0.18	1,536
United Kingdom	492	514	121,269	0.23	2,380

Source. Chairman's staff of the Joint Economic Committee using data from the Programme on International Student Assessment (PISA), the organization for Economic Co-operation and Development (OECD), and the CIA World Fact book.

The latest report released by PCAST (2012) predicts that in order to meet the demands of the STEM industries, the United States must increase the number of students earning STEM degrees by about 300%. PCAST (2012) discusses increasing STEM graduates for the economic development of the nation.

Economic projections point to a need for approximately 1 million more STEM professionals than the U.S. will produce at the current rate over the next decade if the country is to retain its historical preeminence in science and technology. To meet this goal, the United States will need to increase the number of students who receive undergraduate STEM degrees by about 34% annually over current rates.

To compete in the global economy and continuously rank number one in the field of technology and innovation, the United States must increase the number of U.S- trained STEM professionals in the current employment pipeline. Minority students, who are currently underrepresented in all STEM careers, must be encouraged to pursue STEM majors. Several low-SES and minority students believe they need at least a bachelor's degree in the field to obtain an entry-level job in the STEM field. However, Bureau of Labor Statistics (2007) projects the availability of several STEM jobs, ranging from entry level to the professional level positions such as radiography technologists and engineer assistants, in the market that require an associate's degree or some college or post-secondary training.

Why the STEM Agenda is Important

On October 4, 1957, the Soviet Union shocked Americans by launching Sputnik, the first Earth orbit satellite. The United States' response was immediate and dramatic and this single event started the space race between the U. S.A. and the U.S.S.R. Before the end of 1957, President Eisenhower signed into law the National Defense Education Act, ushering the U.S towards a new era of political, military, technological, and scientific developments. Today, the U.S. faces yet another more serious but less visible challenge. The strongest pillar of American economy and prosperity—our scientific and technological superiority—is beginning to wither even as other nations are developing their own human capital (TAP, 2005).

An increased number of STEM graduates are crucial for economic prosperity in the United States. The American workforce grew 130% from 1950 to 2000, while the STEM professions grew 669% in the same period (Lowell & Regets, 2006). Even with an abundance of STEM jobs, a high rate of unemployment exists in several states because the field lacks trained workers to fill the workforce pipeline. STEM jobs were created in fields and industries that had not existed before 1950s, so post-secondary institutions were not prepared to train the required skills for these professions. Telecommunication, semiconductors, computers, and information technology boomed during this era (Hegedron & Purnamasari, 2012). Low levels of high school and college graduation are a major obstacle to filling some technical jobs.

According to Bureau of Labor Statistics (BLS) (2007) and the White House (2010a), STEM related occupations will attribute to the majority of job growth from 2008

to 2018 and will require at least an associate's degree. BLS (2007) further projects an additional 2.7 million jobs in the STEM field by 2018. About 30% of these jobs will require either an associate's degree or some college certification (BLS, 2007). According to another estimate, 8 in every 10 jobs will require higher education and workforce training in STEM fields. STEM jobs and occupations that are projected to grow in the next five years and require only an associate's degree include registered nurses, physical therapy assistants, dental hygienists, forensic science assistants, veterinary technologists, diagnostic medical sonographers, occupational therapist assistants, computer technicians, data entry positions, and engineer assistants (Bureau of Labor Statistics, 2007).

According to the U.S. Bureau of Labor Statistics (2007) by the year 2018, of the eight occupational subgroups within the professional and related occupations, three: health care practitioner and technical occupations; education, training, and library occupations; and computer and mathematical science occupations are expected to account for nearly 75 percent of the new jobs, as shown in following table.

Table 2

Bureau of Labor Statistics, STEM job projections for year 2018

Occupational group	**Change (in thousands)**	**Change (in percentage)**
Professional and related	6,046	21.2
Health care practitioners and technical	1,756	25.8
Education, training, and, library	1,740	20.0
Computer and mathematical science	976	30.7
Community and social services	483	20.8
Arts, design, entertainment, sports, and media	375	14.9
Architecture and engineering	315	12.5
Life and physical science	216	16.4
Legal	194	15.9

Additionally, the STEM field expects a major shift in STEM jobs and careers with retirement of 50% of the "baby-boom" generation engineers. Furthermore, most jobs in the 21st century will require some technical expertise. The ten-year employment report given by the U.S. Labor Department (2007) identifies 15 of the 20 fastest growing

occupations projected for 2014 required significant mathematic or science preparation to successfully compete for a job.

Purpose Statement

Until a few decades ago, the United States workforce placed little emphasis on developing STEM professions. Employers could hire the required technicians from China, Germany, and India (Cooper, 2013). However, this practice can no longer continue as new immigration laws prohibit employers from hiring technicians and other professionals from other countries in bulk (Cooper, 2013). Currently the world is changing; technology is becoming more important not only for jobs but for everyday lives.

The Bureau of Labor Statistics (2008) projects about three million new jobs requiring some post-secondary STEM degree will be available in the next 10 years. To remain competitive in STEM fields, the United States must train approximately one million more STEM professionals over the next decade (Cooper, 2013; Gates & Mirkin, 2012). TAP (2005) reports that to remain the technological leader in the 21st century, the United States must double its STEM graduates with bachelor's degrees by 2015.

An important question is "How will we increase the number of workers in the STEM- workforce?" Several studies indicate lack of interest and participation by Latinos and other minorities in STEM fields. Taningco, Mathew, and Pachon (2008) write that the Latino population is the fastest growing ethnic group in the U.S. The U.S. Census Bureau (2008) projects Latinos to comprise nearly 30% of the U.S. population by 2040. Although high school completion rates for Latino students have risen, Latino men have

the highest rate of non-completion, and as a group, Latinos still lag in educational attainment at age 25 or older (NCES, 2011b; Ryan & Siebens, 2012). To make the situation more complex, only a small percentage of Latinos who graduate with a college degree graduate with a STEM degree. In addition, Latinos suffer from a worse gender gap in the STEM careers than Asian and African Americans. Currently, Hispanics and other minority groups represent only 11% of the total STEM careers in the U.S (Ryan & Siebens, 2012). Since Hispanics are the fastest growing entrants of the school-age population, they become a great potential pool of future STEM professionals. In a press release, Dr. Freeman Hrabowski, President of the University of Maryland-Baltimore County (2012) mentioned, "The minds and talents of underrepresented minorities are a great, untapped resource that the nation can no longer afford to squander. Improving STEM education of our diverse citizenry will strengthen the science and engineering workforce and boost the U.S. economy."

In a report, Fry (2010) points out that 40% of Hispanic adults in the U.S. over the age of 20 lack a high school diploma. Nearly 20% of Hispanic students dropped out of high school in 2008, citing language barriers and a need to help support their families via full-time jobs. Even when Hispanic high school students express strong interest in completing high school and going to college, their likelihood of considering STEM majors are low because of their academic weakness in core STEM subjects (Fry, 2011). If the U.S. wants a homegrown STEM workforce, Latino students must be encouraged to take interest in higher education and pushed in STEM majors and careers by being provided with a strong foundation in science and math courses at the high school level.

The Integrated Postsecondary Education Data Systems (IPEDS) Completion Survey (2000) for the 1999-2000 academic years indicated that Hispanic students were less likely to earn undergraduate degrees in STEM professions than white or Asian students of the same age and socio-economic status. An effort to increase the percentage of Hispanic students in all STEM initiatives, including STEM dual enrollment programs, is ethically correct and vital for the progress of the country.

The nation's current economic problems demonstrate an urgency to increase the participation of women and other minority groups in technical fields in order to maintain leadership in the scientific community that has driven economic prosperity for decades (Leary, 2012). Women are underrepresented in STEM jobs. Despite the high enrollment of women in college, their participation in STEM fields is limited to allied health professions such as nursing and other medical fields. The gender gap exists in many STEM fields such as engineering, manufacturing, technology, aviation technology, and automotive technology (Hyde, Lindberg, Linn, Ellis, & William, 2008). Colleges and universities have several support programs for promoting STEM among female students, but they have failed to attract women in the field. According to National Board (2010), women make up only 26% of the Science & Engineering workforce. The 'Educate to Innovate' initiative designed by the Obama administration to promote STEM education aims to "expanding STEM education and career opportunities for underrepresented groups, including women and girls" (White House, 2010a).

The STEM issue in the United States became my topic of interest when I accepted my current position at Passaic County Community College (PCCC) in 2012. PCCC is an urban community college, and my primary responsibility is to promote STEM courses

and careers among Hispanic high school students. To achieve this task, the STEM Department at PCCC offers students various hands-on opportunities to explore STEM fields through field trips to different STEM industries, afterschool workshops in several STEM areas, and college experience through dual enrollment courses. Dual enrollment is a partnership between local college/university and local high schools whereby qualified high school juniors and seniors enroll in a credit bearing college course as part of their high school schedule. This does not sound complicated; however, this is not an easy goal to achieve. Through grant money, PCCC can offer all of these opportunities to the qualifying students at no cost, but very few Hispanic students take advantage of these opportunities and actually become successful in earning college credits for STEM courses.

Although several programs like the STEM initiative at PCCC strive to improve the performance of Hispanic and other minorities in STEM education via dual enrollment, they are unable to serve the target audience. Most of the target students do not qualify for the dual enrollment programs because of their low GPAs and SAT scores, and those who qualify lack interest to participate in STEM careers. Teachers and guidance counselors who encourage these underachieving and underrepresented students for dual enrollment credits see mixed results. Over the course of two years, I have struggled to encourage Hispanic students from two inner city school districts to participate in STEM afterschool workshops and dual enrollment program without significant results.

However, a small percentage of Hispanic students achieve substantially more than their peers attending the same schools. For example, a STEM dual enrollment student

was determined to finish pre-calculus dual enrollment asked us to convince his father to allow him to take advantage of this opportunity. Another student earned 24 STEM college credits before graduating from high school and is attending an Ivy League school to pursue his engineering degree. The purpose of this study to understand the factors that lead to the successful participation of inner city Hispanic students in dual enrollment despite the similar academic, social and cultural challenges of their peers.

Research Questions

The following research questions will guide the study:

1. What factors support the success of Hispanic high school students from inner city school districts in STEM dual enrollment activities at a local community college?

2. How do these factors support the success of Hispanic high students from inner city school districts in STEM dual enrollment activities at a local community college?

Sub questions:

I. What academic factors support the success of Hispanic high school students from inner city school districts in STEM dual enrollment activities at a local community college? How do they support the success of these students?

II. What social factors support the success of Hispanic high school students from inner city school districts in STEM dual enrollment activities at a

local community college? How do they support the success of these students?

III. What cultural factors support the success of Hispanic high school students from inner city school districts in STEM dual enrollment activities at a local community college? How do they support the success of these students?

IV. What role do economic factors play in supporting the success of Hispanic high school students from inner city school districts in STEM dual enrollment activities at a local community college?

V. What environmental factors support the success of Hispanic high school students from inner city school districts in STEM dual enrollment activities at a local community college? How do they support the success of these students?

Role of the Researcher

My experience with the four-school districts that I work with has shaped most of my beliefs and assumptions. Factors that influence students to pursue STEM degrees include socio economic status (SES), parental involvement, a strong science and math foundation in high school, positive early childhood experiences, influences of role models and peers and self-efficacy about pursuing the STEM careers. I wish to learn about other, social, and cultural factors that support and encourage Hispanic students from inner city school districts to participate in STEM dual enrollment. I hope that the study and the new knowledge will provide me and other educators with solutions that can

help increase the participation of Hispanic students in dual enrollment programs, especially in STEM areas. The study may also discover how we can encourage other underrepresented minorities in the STEM fields at and beyond the high school level.

Through my current position, I am at an advantage, being directly involved in the effort of increasing Hispanic students' participation in STEM majors. My fundamental duties, which include motivating high school students to consider STEM careers and majors after graduating from high school, offer first-hand experience of the situation. Since I already have a relationship with the students, I can easily approach them to get a deeper understanding of their lives. This will help me in my qualitative analysis of the situation. My experience has some obvious disadvantages. For example, my administrative role can cause some difficulties with IRB at the school district. Another concern is my South East Asian heritage. Indians are well represented in the STEM field and students have often accused me of not understanding their struggle with subjects such as math and science.

Significance of the Study

Over the past several decades, the number of students receiving degrees from various colleges and universities has increased, since several federal and state grants are available for low-income students; however, the share of students graduating with STEM degrees has declined. The U.S. Congress Joint Economic Committee (2012) reports the share of bachelor's degrees awarded in STEM fields peaked at 24% in 1985; by 2009, the share had fallen to 18%. The share of master's degrees in STEM fields dropped from 18% to 14% over the same period.

Academics and researchers accept the importance of dual enrollment programs in increasing STEM degrees for underrepresented minority groups, including Hispanics. Students who are motivated, high achieving, and who aspire to attend college are most likely to benefit from STEM dual enrollment programs. Many Hispanic students in the inner-city schools are not enthusiastic about enrolling in STEM dual enrollment college credits. Students who are not college ready are unable to enroll in STEM dual enrollment programs. Many Hispanic students are underprepared in high schools, hence are unable to benefit from these programs. This study will help discover several social and cultural factors that promote STEM dual enrollment among the Hispanic students from inner city school districts despite the fact that they have challenges.

Notable Definitions

Dual enrollment. An agreement between a high school and a two or four-year college, which allows the high school students to earn college credits towards a degree while they are still in high school. These credits can be earned in two ways. The college can offer a yearlong course at the high school, which enables students to earn credits both for their high school graduation and towards a college degree. The other option is to take college credits at the college campus towards a college degree at a reduced or no cost.

STEM. The acronym STEM stands for science, technology, engineering, and math. Various agencies disagree about which degrees and occupations will fall into this category. For this dissertation and the Grant program, STEM includes life science (except medical sciences), physical sciences, mathematics and statistics, computing, and engineering.

STEM dual enrollment. An agreement between a high school and a two or four-year college, which allows high school students to earn college credits in science, technology, engineering, and math subject areas and these credits counts towards earning a degree in a STEM field.

Overview of Chapters

This study will be carried out as a mixed method study, involving a qualitative and quantitative strand. The proposal consists of three chapters. The first chapter is the introduction. The second chapter is the 'literature review' and will review some of the existing literature about how the historical, cultural, and social background of Hispanics discourages their pursuit of college degrees in STEM areas, how STEM dual enrollment can increase participation of students in STEM fields and why Hispanics are not taking advantage of such opportunities, and what factors encourage Hispanic students to pursue STEM majors. I will relate why it is important for the nation to increase participation of Hispanic students in STEM related fields, discuss some of the challenges that they face in pursuing STEM dual enrollment programs, and how some of these students have overcome these challenges. In the third chapter, I will discuss the methodology chosen to conduct this study. This section will include sampling strategies, qualitative data collection procedures and qualitative data analysis techniques, interview questions, and details of other data collection methods. The timeline for completing the study is also included in this chapter.

Chapter II

Literature Review

There is growing concern that the United States is not preparing a sufficient number of students, teachers, and professionals in the STEM area. American political and education leaders continuously discussed this issue for the past 60 years. The STEM issue became a concern of public policy after the launch of Sputnik in the 1950s (Gonzalez, 2012). Although several bills proposing improvement of STEM education in the United States were introduced in Congress and signed into law, U.S. students continue to underperform in science and math compared to the students in other developed countries. The Congress recognized this issue in Goals of 2000 Educate America Act (Goals 2000, 1994, section 102, 5Biii) and put forward acts such as 'No Child Left Behind' to promote science and math for all students. Since then, the federal government has invested billions of dollars in K-12 and post-secondary STEM programs including STEM dual enrollment programs supported by the Department of Education (U.S. Government Accountability Office, 2005). Such programs focus on encouraging high school students to enroll in colleges offering STEM undergraduate degrees.

Policymakers recognized long ago that the goal of increasing STEM professionals in the workforce cannot be achieved without increasing the number of undergraduate Hispanic students completing STEM degrees. According to U.S. Census Bureau (2011), Hispanic or Latinos have heritage, nationality group, lineage, or country of birth of the person or the person's parents or ancestors before their arrival in the United States from Central or South American Spanish-speaking countries. Based on this definition,

according to 2010 Census, 308.7 million people resided in the United States on April 1, 2010, of which 50.5 million (16%) were of Hispanic origin. There was an increase of 15.2 million in the Hispanic population in 10 years when compared to the census of 2000. However, their participation in STEM fields has not increased in the same proportions. If we have to increase the number of homegrown STEM professionals, we have to close the enrollment and achievement gaps for Hispanics in the nation's degree attainment goals (Santiago, 2011b).

In 2012, The National Center for Education Statistics conducted a study using the data from the National Education Longitudinal Study of 1988 to examine the factors that affect the student's persistence in STEM. Early interest in a STEM career was found to be sufficient to sustain students in the STEM pipeline (Snyder & Dillow, 2013). Tai, Liu, Maltese, and Fan (2006) found that even after controlling for students' backgrounds and academic achievement in mathematics, those who planned on pursuing a STEM career were two to three times more likely to graduate with a college degree in the sciences than the students who did not have such plans.

The purpose of this literature review is to provide a profile of what is currently known about the factors that influence the STEM degree attainment for Hispanic students and how dual enrollment helps in increasing degree attainment of minority students. There is very little literature available on factors that support Hispanic students from inner city school districts to become successful in STEM dual enrollment courses; however, I will construct this review to provide an understanding of factors that affect STEM dual enrollment in inner city high schools.

Factors Affecting Participation of Hispanic Students in STEM Majors

A lot of research has been conducted to predict factors affecting participation of Hispanic students in the STEM areas. In a white paper prepared for the Hispanic Association of Colleges and Universities, Nora and Crisp (2012) point to several academic, cognitive, and socio-cultural factors affecting the representation and retention of Hispanics in STEM areas.

One of the key factors in increasing representation of Hispanic students in STEM areas is the availability of opportunities in STEM areas during their elementary and high school years. The training students receive in mathematics and science coursework in high school is directly related to their interest in pursuing a STEM degree in college (United States Government Accountability Office, 2005). This fact, while positive for non-minority students, creates a barrier for many minority students due to lack of resources needed to foster their interest in STEM areas (Peng, Wright, & Hill, 1995). Inequalities in teacher quality, school funding, and monies spent on instructional resources negatively impact the academic preparation of Hispanic students (Young, 2005). Hispanic families are more likely to live in school districts with poor funding sources; hence, the students are less likely to have access to challenging high-quality math instruction, which directly affect their participation in STEM (Berry, 2005; Chacon, 2000).

Early interest has been identified as a good predictor of who will earn a STEM degree (Tai et al., 2006). Students who have taken a greater number of and more rigorous math and science course work are more likely to pursue STEM degrees (Maltese & Tai,

2011). Fewer African American and Hispanic students complete advanced coursework compared to their Asian and White peers. Nonetheless, those Hispanic students who do are equally as likely to complete STEM degrees (Tyson, Lee, Borman, & Hanson, 2007).

Bandura (1986) introduces self-efficacy as a major non-cognitive force affecting academic decision making. He defines self-efficacy as people's judgment of their own capabilities to perform a task. Self- efficacy is concerned with judgment of what one can or cannot do with one's skills. Hispanic students' attitude and perceptions of themselves and the academic environment have been shown to influence student's decisions to remain in a STEM career (Crisp & Nora, 2010). Self-efficacy is a key factor that has been recognized by the researchers as a strong predictor of consideration of mathematics as a career choice (Post-Krammer & Smith, 1986). Stevens, Olivarez, Lan, and Talent-Runnels (2004) agreed that self-efficacy is an important factor in predicting the performance of Hispanic students in mathematics. Most researchers indicated that Hispanic students have very low self-efficacy in the situation of taking a course in science and math and a very few of these students perceive themselves as becoming engineers or scientists in the future.

Other non-cognitive factors that predict the persistence of students in STEM majors include 'locus of control' and 'degree utility' (Urias, Johnson, & Wood, 2013). 'Locus of control' is a term used to describe students who lack a personal sense of control of their behaviors and lives; rather, they attribute the control of their lives to forces outside of their personal power (Faison, 1993). In an educational environment, the control refers to the academic trajectories, experiences, and outcomes for the student. In general, students with an internal locus of control (these students believe they have

control over their situation and fate) are more likely to persist and succeed than those with an external locus of control (these are the students who think that they have no control over their circumstances) (Bean, 2005). Another important non-cognitive factor that literature refers to is 'degree utility'. Students are likely to take majors that they think have utility. The students evaluate their path to degree achievement with other potential pathways and opportunities before pursuing a degree (Bean & Metzner, 1985; Mason, 1998).

Role of Two- and Four-Year Degree Colleges in STEM Degree Completion for Hispanic Students

Another debate that the researchers are involved in focuses on the relationship between the type of higher educational institution that students attend and their achievement of a STEM degree. College and university environment is another factor that mediates the academic performance of the minority students in various majors (Cole & Esponoza, 2008).

The majority of researchers posit that the students who attend four-year colleges have increased chances of achieving a STEM degree as they get exposed to various research opportunities and have better access to student support services (Astin, 1993). However, the majority of Hispanic students who plan to pursue an undergraduate degree start at a community college (Pew-Hispanic Center, 2005). In 2004, 66.2% of Hispanic students enrolled at an open-door institution or community college compared to 45% of White students (Pew- Hispanic Center, 2005). One of the deciding factors that push the Hispanic students towards community college is their academic inability to attend a four-year college. According to the President's Advisory Commission (2002), less than half of

the Hispanic students who graduate from high school qualify to enroll in a four-year institution due to low SAT scores.

Data collected by California Postsecondary Education Commission (CPEC) (2009) are reflective of Hispanic students around the country. According to CPEC (2009), of every 100 Hispanic students who graduate from California high schools, only 40 enroll at a post-secondary institution. Of these 40 students, 30 begin at one of the state's community colleges; three are admitted and enrolled at the University of California and seven at California State University system campuses (Solórzano, Villalpando, & Oseguera, 2005). Most Hispanic students choose community colleges for their higher education because the majority of His panic Serving Institutions (HSI's) in the country are community colleges (Hurtado, Milem, Clayton-Pedersen, & Allen, 1998) . Several researchers argue the decision to attend community colleges negatively influences the completion rate of Hispanic students and vastly decreases the chance of Hispanic students majoring in STEM for (PEW Hispanic Center, 2005).

In the recent years, the White House has recognized the importance of community colleges in increasing the pipeline for STEM workforce. Congress has signed several proposals into bills to allocate billions of dollars to community college to increase representation and retention of Hispanic students in STEM degrees. The Louis Stokes Alliance for Minority participation (LSAMP) grant by NSF is one such resource that provides research opportunities to community college students registered in STEM degrees at various four-year institutions.

Various Social and Cultural Factors Affecting Participation and Retention of Hispanic Students in STEM

The available literature on factors affecting the participation and retention of Hispanic students in STEM majors also touches upon socio-cultural factors. Astin and Astin (1992) found that the most consistent environmental influence on a student's choice of major is peer influence. Hispanic students tend to major in the same areas as their friends and other peers. Another social factor that affects the participation of Hispanic students in the STEM fields is family support. Researchers argue that family support assists in developing interest in science and mathematics careers for minority students (Catsambis, 1994). Parents in the engineering or science-related fields become instrumental influences on the choices their children make to major in STEM (Reyes, Kobus, & Gillock, 1999). On the other hand, family responsibilities, financial concerns, and full-time work commitments negatively impact the participation of Hispanic students in STEM majors and career (Barton, 2003; Fenske, Porter, & DuBrock, 2000).

Jencks and Phillips (1988) and Spencer (2000) note that even when socioeconomic factors are controlled for African American, Latino and Native American students, these students still typically lag behind White and Asian students in science and math, since the culture at home is different from the academic and overall culture at school. Ramirez, Laurel and Rodriguez- Aguilar (1999) recognized the importance of family and culture as necessary attributes for the successful entry and outcome of Hispanic students into STEM work force.

Understanding Culture, Cultural Capital and Cultural- Incongruence and its Role in Educational Attainment of Hispanic Students

What is Culture? Culture, as defined by Webster's Dictionary, is the totality of socially transmitted behavior patterns, arts, beliefs, institutions, and all other products of human work and thought. Soriano (1995) defines cultural competence as "a set of congruent behaviors, attitudes, beliefs, and values that enable people to work effectively in a cross-cultural situation" (p. 67). Culture has a significant effect on how and what children of various ethnic groups learn.

Cultural capital usually refers to the socialization into cultural activities such as reading literature, listening to classical music, and attending museums and theaters (Kalmijin & Kraaykamp, 1996). Similarly, cultural capital alludes to the familiarity and ease with which one navigates the dominant culture of society (Bills, 2003). Bourdieu (1977), a leading scholar of cultural capital, argued "the educational system produces a culture that is closer to the dominant culture of society and uses a pedagogy that requires initial familiarity with the dominant culture." He further argues success in the educational system often requires a predisposed cultural competence gained through family upbringing (Bourdieu, 1977). Cole and Espinoza (2008) theorized a number of Latino students have parents who only have a high school education; the cultural capital of these students is different from students with college educated parents. Alternately, college-educated parents would have better access to cultural capital, which translates into better understanding of the academic culture in college.

This theory leads Cole and Espinoza (2008) to the concept of cultural-incongruence. They define cultural-incongruence as the difference in the behavior and

values of students from low socioeconomic status and the behavior and values reflected by white male students in the middle-class universities (Cole & Espinoza, 2008). Minority students are further challenged to balance their participation in "home" culture and "university" culture. Other issues that explain the lower levels of cultural-incongruence as well as the negative perception of the university environment include unwelcoming/hostile learning environment and encounters with discrimination (Gloria, Hird, & Navarro, 2001). Cole and Espinoza (2008) concluded that higher levels of cultural capital lead to higher levels of cultural congruity. Hispanic students from low socioeconomic backgrounds may be more likely to experience cultural incongruity because of their lack of cultural capital (within the dominant system).

How do Parents Affect the Educational Pursuits of Their Children?

Parental involvement and their level of education is another predictor of success for minority students in higher education institutions. The level of parental education provides an idea of how well a student understands the academic culture and how well a student is able to make social and academic decisions once in college (Cole & Espinoza, 2008). Although going to college is considered an achievement in most Hispanic families, the parents lack financial and academic ability to support their children (Boden, 2011; Borrero, 2011).

Many times Hispanic parents, who don't have college degrees, and are first generation immigrants, fail to guide their children to make the best choices in high school, affecting their choices for higher education. Choy (2001) notes that in comparison to prospective continuing-generation students, prospective first-generation students tend

to pursue a less rigorous high school curriculum, particularly in science and math, resulting in lower aspirations for a STEM major at the college level. Financial cost of achieving higher education is yet another concern of Hispanic parents. Since they have not gone through the process, they may not know the various options available for their children.

Other factors that affect the participation of Hispanic parents include language barriers and demanding work schedules. Most parents fail to participate in the school activities of their children, thinking that they don't understand the language spoken at school, and they will fail to communicate effectively with the school personnel. A majority of Hispanic parents work as blue-collar laborers, forcing them to work at odd hours, limiting their attendance at parent-teacher conferences and other important school events. Culturally, the majority of Hispanic parents consider involvement at the school as interference with the work of teachers and other school administrators.

Gibbon and Borders (2010) note that the first-generation Hispanic college students encounter additional barriers compared to the second or third-generation Hispanic college students. Prospective Hispanic first-generation college students perceived less support from school personnel than did their Hispanic peers whose parents had some postsecondary education. The first-generation students have less self-efficacy expectations, more family obligations, less parental education support, and lower positive outcome expectations related to college than their continuing-generation Hispanic peers.

Role of Colleges in Improving Retention of Hispanic Students in STEM

Support services at colleges improve the retention and graduation rates of Hispanic students. A lot of literature is available on the positive outcomes of mentoring, and tutoring services in the retention of Hispanic and other minority students in STEM courses.

Early introduction to college atmosphere and curricula also increases the likelihood of pursuing a college degree for Hispanic first-generation students. Participating in dual enrollment programs during the junior and senior year is considered a factor in increasing the likelihood of attending college and pursuing a degree after high school.

Dual Enrollment Programs and How they Help Hispanic Students to Consider College

Dual enrollment programs have existed for several decades in various states throughout the country (Johnson & Brophy, 2006). Dual enrollment became popular in the 80s and today these programs have become a ladder to increase the participation of high school graduates in STEM related degrees at various 4-year and 2-year colleges (Andrews, 2004; Girardi & Stein, 2001). As stated in Chapter I, dual enrollment programs are a partnership between a high school and a local community college, whereby allowing the high school students to earn college credits while still in high school (Karp, Calcagno, Hughes, Jeong, & Bailey, 2008).

Though the term dual enrollment can generally be applied to any program where students receive credit from both secondary and postsecondary institutions, simple "dual enrollment" programs typically refers to the option for secondary students to take one or

more college level classes with their high school curriculum for postsecondary credit. These classes may be offered at the secondary institution or at the postsecondary institution granting the credit. Instructors may be full-time college instructors or employed by a secondary institution and meet college teaching requirements (Karp et al., 2008).

There is evidence that the number of science, mathematics, and English courses taken by high school students serve as a major predictor of choosing a STEM college major (Astin & Astin, 1992; Simpson, 2001). Based on the same rationale, STEM dual enrollment programs enable high school students to take more science and mathematics courses and earns college credits in various introductory science courses. In addition, according to research, taking introductory courses in STEM dual enrollment provides several benefits for high school students including hands on experience in various STEM areas and becoming familiar with the curriculum and degree expectations. STEM dual enrollment encourages students to consider college as a choice after high school, helps them explore various majors in STEM field without wasting time, saves money, helps them get ready for the college, prepares them to get in the workforce, and helps the nation to compete in the global economy (Swanson, 2010; An, 2012; Karp et al., 2008).

STEM dual enrollment programs are becoming increasingly popular in urban school districts. In several school districts, these programs are an attempt to promote career and technical education programs (CTE) among Hispanic students who are underrepresented in these fields. Some of the school districts have revised their curriculum and began offering trade and profession-oriented curriculum to the inner city school students, starting freshman year. Collaborating with local colleges for dual

enrollment opportunities provides a strong foundation for higher education to the students in various STEM high school academies (Karp et al., 2008).

Various Models of Dual Enrollment Offerings

It is important to discuss various models of STEM dual enrollment sections. The first models of dual enrollment are yearlong sections, during the school day, "at school sites." A qualified teacher from the school in the subject area is hired as an adjunct by the community college to deliver the course material and maintain academic integrity. The students enroll in a dual enrollment program, attend college classes during their daily school schedule and are awarded credits for a high school 'honors' course and a 'college' course simultaneously. The most popular dual enrollment courses are general chemistry, pre-calculus, and college algebra.

Another "at school site" model takes place at the end of the school day. These semester-long sections are often taught after school by college adjuncts or full-time professors; this model ensures college-like experience for students and is aimed to maximize participation and to minimize issues of transportation. The schools that often opt for this model of STEM dual enrollment are either not connected by a direct public transportation mode to the college or usually lack a qualified teacher to deliver the course material. Based on the articulation agreement, the students earn dual credits for college and for their high school graduation requirement. Graphic design, engineering, and AutoCAD are popular courses for this model.

In the third model, high school students attend classes after school at the college campus with other college students. They attend the regular evening section and are treated as

college students. They are not awarded high school credit in this model. Most students who attend these courses are motivated and willing to work diligently to earn college credits.

Factors that Influence Dual Enrollment Participation

There are several pre-college experiences that have been shown to influence Hispanic students' participation in STEM fields, including test scores and academic experiences in mathematics and science in high school which depends on the quality of teachers and availability of resources at the high school level (Barton, 2003; US Government Accountability Office, 2005). Hispanic students who attend inner city school districts with poor resources have fewer resources compared to the students from suburban school districts. Several science teachers in K-12 are not certified nor have they majored in the subject areas in which they teach. In 2007-2008, 36.9% of total math teachers in the US were not certified or former math majors (Thomasian, 2011). These numbers become larger among physical science and chemistry teachers. In 2007-2008, only 36.8% chemistry and 27.4% earth science teachers both majored and were certified in the subject area (Thomasian, 2011). These percentages disproportionally affect schools in poor communities.

Student support services play a critical role in retaining minority students in dual enrollment courses. STEM dual enrollment programs provide several support services to encourage and retain these students in the registered courses, including tutoring, counseling and advisement, summer-bridge programs, after school hands-on workshops, field trips to various STEM industries, and mentoring.

The majority of these students are first-generation college students; they are the first in their families to attend college. As a result, as I have mentioned before, these parents may not be aware of available academic and financial resources for higher education. Parental involvement is also a deciding factor for the successful participation of Hispanic students in STEM dual enrollment programs. An (2012) writes, "mid- and high-SES parents, with perhaps more extensive knowledge of the importance of courses on their children's education, tend to be more involved with their children's academic progress than low-SES parents."

Studies have found that participation in dual enrollment differs across social and ethnic groups. Advocates of dual enrollment consider that it largely benefits low socioeconomic status (SES) Hispanic students. An (2012) further asserts that the low-SES students benefit equally from dual enrollment programs as high-SES students; however, low-SES students fail to take advantage of available opportunities because of several social, historical, and cultural factors that have not been studied by researchers.

The rate at which low-SES Hispanic students participate in the STEM dual enrollment program is much lower than that of their high-SES peers (Karp et Al., 2008). Grimardi and Madduss (2004) reported that financial and social implications relate to low-income students transitioning from high school to college and participating in dual-enrollment program, but the choice to attend college may be better explained through econometrics. Econometrics is the application of statistical methods to economics. An econometric model explains that a choice to attend college is made in monetary terms as a rate of return on educational investment (Hossler, Braxton, & Coppersmith, 1989).

Most Hispanic parents and students fail to understand this and they prefer supporting the family throughout employment, not education.

It is argued by several researchers that dual enrollment programs promote college readiness among underrepresented and underprepared high school students. However, the colleges accept these students based on their SAT scores or their performance on college placement tests such as Accuplacer. Farrell and Seifert (2007) conclude that students who are performing well in school take advantage of these programs, and those who are underprepared continue to perform poorly in these programs (p. 74). Student motivation is one of the most important factors that affect the participation of Hispanic students in STEM dual enrollment programs. Several issues that affect a student's motivation to participate in dual enrollment opportunities include the availability of transportation after school, their socioeconomic status, after-school job schedules, their first language, absence or presence of role models in life, if they have other siblings attending college, peer pressure, and encouragement provided by their teachers and guidance counselors.

History of Hispanics in the United States and How It Relates to their Achievement in Education

To understand Hispanic culture and how it affects their interest in STEM fields, it is important to understand the historical background of educational opportunities for various Hispanic groups in the United States. The term Hispanic is often interchangeably used with Latinos for different political purposes. The term was originally used for the ethnic group that largely consists of immigrants from Mexico, Cuba, and Puerto Rico. Due to the changing immigration trends from other South and Central American countries, the term Hispanics is now used for all people who have ethnic ancestry based

in Dominican Republic, Nicaragua, El Salvador, Guatemala, Chile, Colombia, and Argentina. Tatum (1997) notes that over 60% of Hispanics are of Mexican ancestry, which includes US-born Mexican Americans (also known as Chicanos) and recent immigrants. Approximately 13% of Hispanics are Puerto Ricans, 5% are Cuban, and approximately 20% are considered "other Hispanics," as stated by Landivar (2013) for the Census Bureau report. Each group is a distinct population with a particular historical relationship to the Unites States.

Since the Annexation of Mexican territory in 1848, people of Mexican ancestry have become subject to white domination. In the initial years of annexation, Mexicans were not willing to become part of the mainstream American society. The white settlers looked down upon the Mexicans and always treated them as an inferior race, resulting in segregated schools, segregated housing, and employment discrimination. Use of Spanish was banned in schools in Texas and California (Tatum, 1997). After the conquest of Mexico, there was an initial decline of the Mexican population in the Southwest; it increased again in the 20th century when US farmers actively encouraged the immigration of Mexicans as cheap agricultural labor. Since then, Mexicans have immigrated to the United States for employment as laborers. Although most Mexicans in the United States are legal residents, they are often stereotyped as illegal aliens (Tatum, 1997).

According to the most recent census data, Hispanics of Mexican origin are the youngest subgroup although the median age of Mexicans has increased from 24.1 years in 1990 to 38 years (Tatum, 1997; PEW Report, 2012). Fifty-nine percent of Mexicans in the United States are under poverty (Tatum, 1997; PEW Report, 2012).

Puerto Ricans are the second largest Hispanic group on the U.S. mainland (Tatum, 1998; PEW report, 2012). After conquering Spain in 1898, the United States added Puerto Rico as an unincorporated territory in its union. After the treaty of Paris in December 1899, the United States established itself as the world imperial power. Under the terms of this treaty, the US acquired the naval base of Guantanamo Bay, Cuba. The former Spanish subjects of Puerto Rico and Cuba thus found themselves transferred from one imperial power to another (Tatum, 1998; Macdonald, 2004).

The colonial legacy of Puerto Rico under Spain and then under the United States have shaped their history and has affected their view of public education in the United States. In the early 1900s, public education was used as a vehicle of Americanization; attempts were made to replace Spanish with English language as the language of instruction. The attempts to displace Spanish were vigorously resisted by Puerto Rican teachers and students alike (Tatum, 1998; Macdonald, 2004). In 1915, a resistance to the imposition of English resulted in a student strike at Central High School in San Juan. This incident was fuel to the fire of independence from the United States. Instead of asking the Puerto Ricans to vote on whether they wanted U.S. citizenship, the U.S. Congress passed the Jones Act of 1917, imposing citizenship and the obligation to serve in the US military but denying the right to vote in national election (Tatum, 1998). In 1951, the island was established as a commonwealth territory with its own constitution. This allowed Puerto Ricans to have greater control of their school systems, and Spanish was restored in the schools (Tatum, 1998; Macdonald, 2004).

The island of Puerto Rico was acquired in an era of the U.S history when scientific racism was gaining credence and conquered people were viewed as genetically

inferior (MacDonald, 2004). A multi-racial population descended from the European colonizers, enslaved Africans and the indigenous Taino Indians. Several Puerto Ricans were dark skinned and were subjected to more discrimination and segregation in jobs and schools than the lighter skinned Hispanics (Tatum, 1998). In addition, the American officers treated the natives of the island as inferior beings; instead of understanding their culture, they tried to "enlighten" them by forcing American culture and language on them. The American education leaders in Puerto Rico tried to implement American education without any realistic understanding of the culture of Puerto Rico (MacDonald, 2004).

Economic conditions of Puerto Rico have driven many people from the Island to New York and other Northeastern U.S. cities. Most Puerto Ricans immigrated in the 1940s and 1950s to works in the factories. However, with the globalization of trade and outsourcing of manufacturing units, several Puerto Ricans were displaced and returned to the Island. The U.S. citizenship given to the islanders has contributed to the circular immigration patterns for this group of Hispanics. In general, the Puerto Ricans have the poorest economic conditions of all Hispanic groups; the poverty rate is over 60% (Tatum, 1998).

Cubans are the third largest Hispanic group in the Unites States. Cuban Americans are older and more affluent than other Hispanic groups in the United States (Tatum, 1998; MacDonald, 2004). The story of Cubans in America goes beyond the first mass immigration in 1959 after the revolution led by Fidel Castro.

MacDonald (2004) writes English language and American education was valued among Cubans, particularly among the elites, who saw its utility in future advancement and trade with the United States. Cubans were involved in education exchange programs with America in the 1900s. Harvard University conducted summer sessions for the Cuban teachers in 1900 and 1901 in which teachers spent several weeks learning English and studying pedagogical methods. Cubans wanted to train their teachers in US ideals, and other ways to become Americanized. They went to the extent of translating English books in Spanish to introduced American ideals among their youth (MacDonald, 2004).

The first major mass immigration from Cuba happened in 1959. Tatum (1997) notes the upper class, light-skinned Cubans who had always appreciated the American life style were among the first batch of immigrants. They brought their personal fortune with them and established businesses on their arrival in the United States. The second batch of Cubans arrived in the United States after a few months of Castro's rule and consisted mainly of middle-class professionals and skilled workers. The United States government and charitable organizations provided help to these immigrants to make United States their home. The last major group of Cuban immigrants, known as Marielitos, arrived in 1980. They were dark-skinned, poor, less educated, and had lived most of their lives under the socialist rule of Castro.

Overall, Cubans were the only groups among the three main Hispanic groups who have acculturated themselves to the United States mainstream schools and education; they had different type of political relation with the United States and it was considered elite to become Americanized.

However, all Hispanic groups share basic cultural characteristics. Tatum (1997) notes 'familism' is one such cultural value that all Hispanic share independent of their national background, birth place dominant language, or any other sociodemographic characteristics. Tatum (1997) further mentions that all Hispanics are connected with each other through the Spanish language. Spanish is the main household language for all Hispanic families and use of English is discouraged by parents.

My Experience with Hispanic Students and their Participation in STEM Dual Enrollment

In spite of the generous federal support for promoting Hispanic students in STEM careers, there is very little participation by Hispanic students in STEM dual enrollment programs. Many deserving students who initially sign up for these programs as a result of encouragement by their teachers, guidance counselors and other social workers often withdraw from these courses within the first two weeks. In spring 2013, due to the efforts of an administration at a local high school in Paterson, NJ, 40 students signed up for dual enrollment credits with STEM program at PCCC. However, only 10 students continued to attend classes and successfully complete the course.

My assumption is that there are numerous social and cultural factors that affect the participation of Hispanic males and females from inner city schools in STEM dual enrollment opportunities that have not yet been studied. For some students, it is important to work after school so that they can bring food to the table for their family, and many others baby-sit their younger siblings while their parents are at work. Some live with parents who are either abusive or are never home to provide love to these children when required.

I am further assuming that many of these students are struggling to meet their basic needs of food, shelter, and safety; therefore, acquiring STEM college credits is a lofty dream for several students. In a conversation with a school administrator, I was informed that one of our dual enrollment students was killed in gang wars over the summer. He further explained that many students from his school are afraid to come to the college campus because of these gangs in the neighborhood. Another student mentioned that he eats only once a day, not because he is fasting but because he can't afford to buy food more frequently. These are very important social issues in inner city neighborhoods that need to be addressed. However, the first task is to identify such issues using scientific research methods.

Most inner-city students go through the same social and educational experience and are not encouraged to pursue any STEM careers. According a newspaper article published on NorthJersey.com, only 3.2% (19 out of 594) students who took SAT test in 2014 from the Paterson public school district placed at a college level (Malinconico, 2014). One of these 19 students is a STEM dual enrollment student in my program who has accumulated up to 24 credits and is accepted in an Engineering Program at an Ivy League school. In this study, I am focusing on these 3.2% students who despite the same social, cultural, economic, historic and academic environment achieve their dreams.

Framework for the Study

Most studies of the past have generalized success of students in STEM based on their race, socioeconomic status, and culture. According to these studies, Hispanic students are considered at risk for STEM majors (Maltese & Tai, 2011; Mau, 2003).

Deficits in the math and science preparatory course work are also considered a major hindrance for Hispanic students in pursuing STEM dual enrollment.

The theoretical framework that I am using in this study to understand the motivation of the successful Hispanic students in STEM dual enrollment program is based on the expectancy value model of achievement-related choices (Eccles, Adler, Futterman, Goff, Kaczala, Meece, & Migley, 1983). Students choose paths with which they feel comfortable; they have some association with the topic. Above all, they focus on subject with which they can personally identify. According to the expectancy–value model defined by Eccles (2009), identity can be conceptualized in terms of two basic sets of self-perceptions: a) perceptions related to skills, characteristics, and competencies, and b) perceptions related to personal values and goals. Students develop a set of beliefs about whom they are and who they would like to become during their school years based on their social, academic, and cultural beliefs.

Based on this model, students' decisions to continue in STEM dual enrollment program and later declare STEM as their major is affected by their expectations for success and the relative importance that they give to each available option. The success in STEM for most students depend on their self-beliefs about ability, such as science and mathematics self-efficacy. Relative importance is described by 'subjective task value' (STV) that describes the importance of taking mathematics and science courses in terms of four elements: a) the utility value as related to the student's future goals, b) the intrinsic value, c) the attainment value (the consistency of mathematics and science with the student's identity), and d) the cost, such as time taken away from other activities or the negative response of the student's peers (Eccles, 2009). It is important to note that the

STV is individually constructed based on the processing of inputs from culture, socializers, and experiences.

Further, all four components of STV are affected by the racial, ethnic, and cultural backgrounds of the individual and the interactions of the individual with STEM culture (Anderson & Ward, 2013).

My hypothesis for this study is that although social, cultural, economic, environmental and historical factors play a definitive role in the participation of Hispanic students from inner city school districts in STEM dual enrollment, their self-efficacy, after-school activities, peers, and several other non-cognitive factors contribute to the successful participation and continued enrollment in STEM dual enrollment programs.

Chapter III

Methods

Introduction to Research Design and Strategies of Inquiry

Mixed method research study design. This research was focused on understanding how some of the inner city Hispanic high school students succeed in STEM dual enrollment programs in spite of the existence of various social, cultural, historical, and academic factors that negatively affect the participation of most of their peers in similar programs. The study magnified the successes of inner city high school students who enrolled in STEM dual enrollment program through their local community college and moved beyond the deficit perspective. The effects of support services such as mentoring on student success and focus was also highlighted. Additionally, the study considered the numerous hurdles that negatively impact their participation in STEM dual enrollment participation.

A lot of research has documented solutions to narrow representation inequities and racial achievement gaps in STEM fields (Harper, 2010). However, Black and Latino undergraduates continue to lag behind their white and Asian American counterparts (American Council on Education, 2006; National Science Foundation, 2006). In this research, I explored the factors that support the participation and success of Hispanic students from inner city school districts to participate in STEM dual enrollment programs, which eventually may lead them to STEM majors and careers in future.

Research Questions

The following research questions will guide the study:

1. What factors support the success of Hispanic high school students from inner city school districts in STEM dual enrollment activities at a local community college?

2. How do these factors support the success of Hispanic high students from inner city school districts in STEM dual enrollment activities at a local community college?

Sub questions:

I. What academic factors support the success of Hispanic high school students from inner city school districts in STEM dual enrollment activities at a local community college? How do they support the success of these students?

II. What social factors support the success of Hispanic high school students from inner city school districts in STEM dual enrollment activities at a local community college? How do they support the success of these students?

III. What cultural factors support the success of Hispanic high school students from inner city school districts in STEM dual enrollment activities at a local community college? How do they support the success of these students?

IV. What role do economic factors play in supporting the success of Hispanic high school students from inner city school districts in STEM dual enrollment activities at a local community college?

V. What environmental factors support the success of Hispanic high school students from inner city school districts in STEM dual enrollment activities at a local community college? How do they support the success of these students?

Rationale for Using Mixed Method Research Design

In this study, an emergent mixed method research design was used to collect data and answer the research questions. The results of the first strand, which was a qualitative strand, opened possibilities of further investigations and generalization (Creswell & Clark, 2011). As defined by Caracelli and Greene (1993), this study used qualitative and quantitative research methods for development purposes. More specifically, "In development mixed method designs the different method types are used sequentially. The intent is to use the results of one method to help develop or inform the other method. Development is broadly construed to include sampling and implementation, as well as measurement decisions" (Caracelli & Greene, 1993, p. 196).

Like any other mixed method research design, qualitative and quantitative techniques were employed to comprehensively understand and seek solutions to the research problem. Data was collected, analyzed, and interpreted using more than one data collection strategy, topology, and paradigm for the different strands of the study. Results of one data collection methods was used to enhance, illustrate, and clarify the results of

the other data collection method. Mixing different data collection methods in this study helped me overcome the weaknesses of the single data collection technique (Teddlie & Tashakkori, 2009).

The rationale for mixing both types of data was that neither quantitative nor qualitative methods alone are sufficient to figure out the details of the situation. Moreover, the use of different methods in this single study provided me means of gaining a broader understanding of the issues by transcending inadequacies in each method (Monti & Tingen, 1999). The objective of this mixed method design was to use different data collection methods to understand various factors affecting the participation of Hispanic inner city students in STEM dual enrollment programs at community colleges (Teddlie & Tashakkori, 2009; Johnson, Onwuegbuzie & Turner, 2007). Further, mixed methods research allowed me to expand the scope of this study by adding breadth and range to the different inquiry components (Caracelli & Greene, 1993). Additionally, mixed methods research also helped me in gaining different perspectives of the collected data which in turn enhanced the rigor of the research (Ross & Webb, 1997). Finally, a mixed method design provided completeness to the study and a basis for triangulation of the data (Bryman, 2006; Williamson, 2005).

Furthermore, this study was designed as a sequential exploratory design. In this sequential mixed design, the phases of the study occurred in a chronological order; the findings of the qualitative strand lead to the survey questions of the quantitative strand (Teddlie & Tashakkori, 2009). Creswell and Clark (2011) write, "The primary purpose of using sequential exploratory design is to generalize qualitative findings based on a few individuals from the first phase to larger sample gathered during the second phase."

Not many studies have been conducted to understand the social, cultural, economic, environmental, historic, and academic experiences of Hispanic students' inner city school districts that lead them to successful participation in STEM dual enrollment courses. To understand the success journey of some inner city Hispanic students, who have overcome their challenges and are successful in pursuing STEM dual enrollment program, the qualitative method was the most appropriate strand in the first phase of this study; it will give me a chance to collect narrative data of these successful students. For the qualitative strand of the study, the most suitable technique of data collection was individual interviews. One-on-one interviews were very effective in developing an understanding of STEM dual enrollment students' social, cultural, high school, college experiences, and the influence of other factors that have resulted in their persistence and ultimate success in dual enrollment courses from their individual perspectives.

Creswell and Clark (2011) suggest using an exploratory design when the researcher identifies new emergent research questions based on qualitative results, which cannot be answered with qualitative data. I approached the qualitative strand without any prior biases, and I was hoping to develop a new understanding of the factors that lead to the success of inner city Hispanic students in the STEM dual enrollment courses. The quantitative strand was planned for this study to answer some of the questions and themes that have emerged in the qualitative data analysis. Another rationale for using this design was the sample size for the initial phase of the study. The sample size that has been chosen was very small; to validate findings to the population at large, quantitative methods were employed using a survey instrument, which was developed using the findings of the qualitative results.

Further, Onwuegbuzie and Collins (2007) suggested four main reasons to use a sequential mixed method design: complementarity, development, initiation, and expansion. Conducting this study as a sequential exploratory mixed method design helped me in developing a new theory and in expanding the results of data analysis.

Qualitative Data Collection Method

In the qualitative data collection strand of the study, the data was collected in the form of one-on-one interviews.

The method of collecting data in this qualitative strand of the study was one-on-one interviews. Interviews are one of the most reliable sources for data collection in qualitative research methods. Based on the guidelines, and applying extreme case sampling techniques four students from four different sites who have successfully participated in STEM dual enrollment for more than two semesters were chosen to form an understanding of the research problem by giving a diverse variation of individuals and sites (Teddlie & Tashakkori, 2009; Creswell, 2013). The participants were selected based on the model of dual enrollment in which they were participating. This sampling process helped me achieve representativeness and comparability among different groups of students from different sites (Teddlie & Tashakkori, 2009).

These interviews with successful students helped me in developing an understanding of the factors that have supported the success of some Hispanic students from inner city schools as compared to several others.

Seidman (2006) and Rubin and Rubin (2012) have provided several practical suggestions to conduct interviews. To understand how some of these inner-city students

have been successful in accomplishing dual enrollment college credits after school or during the school, the interviews were conducted based on Seidman (2006) model, where he suggests to conduct interviews in three phases, allowing the interviewee to reflect on the information he/she has provided in the previous interviews. Setting three different interview sessions with each participant also helped me validate the information provided by them in their previous interviews. In the first interview open-ended personal questions were asked, allowing the participant to develop a narrative of their experiences and life (Seidman, 2006). The question in the second and third interview were focused on the information directly related to the research questions (Rubin & Rubin, 2012). I reflected on the collected information and followed up with the interviewee in case of discrepancies and inconsistencies. Follow-up interviews were arranged in case the information provided by the participant was not clear to me or of there were any missing links or details in the original interview (Rubin & Rubin, 2012). The questions in all three interviews were open-ended, which left enough room for the interviewee to develop a story and provide information from their experience (Seidman, 2006; Rubin & Rubin, 2012). An interview protocol was developed in advance to conduct these semi-formal interviews(Appendix A).

All these interviews were tape-recorded, and each interview lasted for 35-45 minutes. The interviews were taped for two major reasons; first so that I can pay attention to be engaged in the conversation during the interview, and second so that I can later transcribe the data collected to reflect on what was said. Seidman (2006) suggests the interviewer tape-record the interviews for similar reasons when he writes that tape recording interviews facilitate active listening.

After finalizing the list of participants, formal consent letters were sent to the participants, seeking their permission to participate in the study. The consent letters included some basic information about the study such as the reason why I was conducting the study, any possible risks and benefits that were involved, a statement about the confidentiality of the records, and my contact information (Seidman, 2006). After receiving consent from the participants, email correspondence was used to arrange one-on-one interviews. In order to maintain confidentiality and to allow participants to get some space and become comfortable, I invited the participants to meet me in a nearby café or public library.

Quantitative Data Collection and Survey Design

For the quantitative strand of the study, a survey instrument was used to collect data. Fink (2013) describes a survey as an "information collection method used to describe, compare, or explain individual and societal knowledge, feelings, values, preferences, and behaviors" (p. 2). Since this is sequential exploratory design, the survey instrument was developed after analyzing the data of the qualitative strand. Based on the qualitative analysis, a series of quantitative hypothesis were developed and tested using the survey. Each item on the survey instrument reflected the analyzed themes of the qualitative strand. A survey was the best-suited tool for data collection in this strand of the study, as it assisted in expanding the findings of the qualitative study to a larger group.

An online survey was administered to about 80 students, 20-30 students from each model of dual enrollment who have successfully accumulated six or more college credits in the last two semesters of dual enrollment.

Mixed Method Sampling Approach

Sampling is the process of selecting "a portion, a piece, or segment that is representative of a whole" (The American Heritage College Dictionary, 1993, p. 1206). Sampling is an important step in the research process because it helps to inform the quality of inferences made by the researcher that stem from the underlying findings (Onwuegbuzie & Collins 2007). Two important considerations that I have to make during the sampling for this study were 1) the number of participants; i.e. sample size and 2) How to select these sample members; i.e. sample scheme (Onwuegbuzie & Collins, 2007).

For the two different strands of the study, two different sampling approaches were used. The sampling scheme for the qualitative strand has been already explained in the previous section of this chapter. For the quantitative strand, I employed purposeful non-random sampling scheme (Fink, 2013; Creswell & Clark, 2011). Forty students from each model who have successfully completed at least 6 credits in the last two semesters. This means a total of eighty students were asked to take the survey.

In a mixed method study, a rigorous and reliable sampling design was very important for the representation, legitimation, integration, and politics of the study (Onwuegbuzie & Collins, 2007). Further, my sampling design helped me to determine the extent to which my findings can be generalized and can be used to make "meta-

inferences." Tashakkori and Teddlie (2003c) use the term "meta-inferences" to describe the integration of generalizable inferences that are derived on the basis of findings stemming from the qualitative and quantitative components of a mixed methods study (p. 687).

Onwuegbuzie and Collins (2007) discuss eight different sampling designs for a mixed method study based on the time orientation (i.e. sequential or concurrent) of the study and the relationship of the quantitative and qualitative samples. Based on this combination, I have used design #6 in my study to understand the factors that lead to the successful participation of inner city Hispanic students in the STEM dual enrollment courses. In this design, a parallel relationship exists between the sampling techniques of the two strands, and the study is conducted as a sequential mixed method analysis. A parallel relationship specifies that the samples for both strands are different but are drawn from the same population of interest; in my study, this population will be STEM dual enrollment students who have successfully completed 6 or more dual enrollment credits in the past two semesters. Further, the students who have participated in the qualitative strand of the study will not participate in the quantitative strand of the study.

Analyzing the Data

Mixed method analysis is a highly iterative process that is best undertaken with a spirit of adventure. It involves a process in which qualitative and quantitative data analysis strategies are combined or connected (Teddlie & Tashakkori, 2009). The data collected from the first strand was analyzed first and the results were then used to develop the survey instrument for the quantitative strand of the study. After analyzing the

data from both strands, some integration of the results were conducted at the interpretation stage (Greene, Caracelli, & Graham, 1989).

The five steps were taken to analyze data in both strands to develop an understanding of the factors that support the success of inner city Hispanic students in the STEM dual enrollment program: Data cleaning, data reduction, data arrangement of quantitative data and qualitative data, data correlation and comparison (i.e. cross tabulation of quantitative data), and analysis of inquiry conclusions and final inferences (Greene, 2011).

The collected data from one-on-one interviews was analyzed based on conventional and directed content analysis techniques as described by Hsieh and Shannon (2005). In conventional content analysis, coding categories are derived directly from the text data; that is, the themes were develop as I continued to analyze the data. Whereas in the directed content analysis, the researcher starts with a theory or relevant research findings for initial codes (Hsieh & Shannon, 2005). An initial codebook that consisted of themes that have appeared in the literature review were maintained.

The first step in analyzing the qualitative data was to transcribe the interviews. The collected data was coded using structural and attribute coding techniques. The next and most important task was applying the codes to the collected data and searching for new codes. The final task was searching and making sense of similar themes and categorizing codes.

Quantitative data will be analyzed using descriptive statistics, which "…provides simple summaries about the sample and the responses to some or all questions" (Fink,

2013). Descriptive statistical methods include interpretable tables, graphs, or single representation of a group of scores (Teddlie & Tashakkori, 2009). First, the frequency of each response was calculated then followed by finding percentage for different variables.

The next most important task was to mix the data to form a final interpretation of the collected data to answer the research questions.

Timing, Priority and Mixing

In this exploratory sequential mixed method study, timing, priority, and mixing strategies of the data were very important. The course and the results of the study primarily depended on these three design factors of the study.

Timing refers to the temporal relationship between the quantitative and qualitative strands within the study (Creswell & Plano Clark, 2011). Timing is not only discussed in relation to the time the data sets are collected, but most importantly, it describes the order in which the results from the two sets of the study are analyzed and used to reach the overall understanding of the problem (Creswell & Plano Clark, 2011). This can occur either concurrently or sequentially (Morse, 1991). When data are collected, analyzed, and interpreted roughly at the same time for both strands of the study, the mixed method design is called one-phase or concurrent (Creswell, 2009; Creswell & Plano Clark, 2011; Morse, 1991). On the other hand, when one strand of the study is conducted before the other stand of the study, the timing is considered sequential (Creswell, 2009; Creswell & Plano Clark, 2011; Morse, 1991). This study was conducted as a sequential study; the results of the qualitative strand of the study led to the construction of the survey instrument that then was used for the quantitative strand of the study.

Priority refers to the relative importance or weighting of the quantitative and qualitative methods for answering the study's questions (Creswell & Clark, 2011). Priority can be given to one form of data over the other, or both forms of data can be weighted so that they play an equally important role in the study. According to Creswell and Plano Clark (2007), "The weighting is thus influenced by the goals, the research questions, and the use of procedures from research traditions such as quantitative experimental designs or qualitative case study designs" (p. 82). Other factors that influence weighting decision include (a) the researcher's familiarity with one method over the other, (b) resources, and (c) the intended audience (Creswell, 2009).

Based on these factors and Creswell and Plano Clark's (2011) and Creswell's (2009) definitions, the data in this study could be considered to be weighted equally for various reasons. First, each strand of the study was designed to achieve its specific goals. The qualitative strand was designed to understand the underlying factors that supported the success of some of the most successful students from inner city high schools in STEM dual enrollment. The quantitative strand was then developed to support the findings with a larger audience. Another reason for equally weighting the strands was that I was equally familiar with the qualitative and quantitative research strategies. Lastly, both methods were equally mixed throughout the discussion to reach the final understanding.

Creswell and Plano Clark (2011) conceptualize mixing of data at four possible points in a mixed methods study: interpretation, data analysis, data collection, and design. In this study, mixing occurred during data collection stages and during interpretation of the data. The mixing was important to connect the two strands of the study. The results of

the first strand of the study were used to shape the collection of data in the second strand of the study by developing a data collection survey instrument (Creswell & Plano Clark, 2011, p. 67). Further, in this study, the two strands of the study were mixed for interpreting the results of the two strands. Once all of the qualitative data were analyzed, the most prevalent themes were used to develop questions for the survey instrument. During mixing of data through discussion and interpretation, I have addressed each variable/code/theme by discussing both the qualitative and quantitative data and how data from both sets compare and contrast with one another.

Credibility, Validity Threats and Test

Validity is the extent to which scores generated by an instrument measure the characteristics or variable they are intended to measure for a specific population (Onwuegbuzie et al., 2007). Several validity threats exist in a mixed method study. These threats are often conceptualized as alternative explanation or interpretation, or sometimes can become "rival hypotheses" (Huck & Sandler, 1979). These alternative interpretations can occur if interviewees are not expressing their true opinion, or when the researcher ignores some of the data thinking that "it does not fit," or that there is a different theoretical way of making sense of the data (Maxwell, 2013).

The first threat that existed in this study was internal validity. Greene (2007) posits that "Challenges to data quality and integrity can arise in interactive mixed methods data analysis, as the data themselves become changed, even transformed into other forms and frames" (p. 144).

Other threats that existed in this study are researcher's bias and reactivity. Researcher's bias exists when the conclusions are based on the selection of data that fits the researcher's existing theory, goals, or preconceptions, and the selection of data that "stands out" (Miles & Huberman, 1994, p. 263). To eliminate this threat, I tried to stay as objective as possible and avoided any pre-conceived theories about the success of inner city Hispanic students in the STEM dual enrollment programs.

My own influence on the setting and the individuals that I was studying is considered as "reactivity" and is problem that is usually raised for qualitative studies (Maxwell, 2013). Eliminating the actual influence of the researcher from the qualitative studies is impossible (Hammersley & Atkinson, 1995). As a result, the goal was not to eliminate it but to understand it and use it constructively.

The small sample size of the qualitative study also projects some credibility threats to the generalization of the findings. Generalization "pertains to the extent that meaning and use associated with a set of scores can be generalized to other populations" (Onwuegbuzie & Collins, 2007). In this study, the effort was not to generalize or duplicate the findings to a larger population, but to understand the factors that lead to the success of some inner city Hispanic High school students in a STEM dual enrollment program.

The exploratory design of the study helped address some of these issues. I avoided several of these issues by collecting rich and intensive data from the interviews and tried to understand the factors that influence the success of inner city students in the

STEM dual enrollment program. The quantitative strand assisted me in triangulating the results.

In addition to these threats, internal and external validity threats exists in the quantitative strand of the study. External validity is threatened when the respondents become aware of the experiment and their answers are affected by this awareness. Fink (2013) defines it as “reactive effect” or “Hawthorne effect”.

The selection of participants in the quantitative strand could have raised some internal validity concerns for the strand. Since the survey was given to two different groups (forty students each), based on the model of the dual enrollment, their motivation for the program, their history as to how they were selected for the dual enrollment program and which model they are participating in affected the internal validity of the survey data.

Another internal validity concern that I had for this strand of the study was the survey instrument in itself. Some of the questions were not valid to all the groups and hence resulted in some internal validity issues. For example: Transportation is an issue for the students who come to the college campus to take course after school, but this is not a concern for those who have participated in a yearlong dual enrollment course.

Chapter IV

Data Analysis and Interpretation

In this chapter of my exploratory sequential mixed method study (Creswell & Clark, 2011) I have analyzed the data collected over a period of two semesters. The first section of the study covers the first phase of this study, which was conducted as a qualitative study. In this strand of the study, three-step, in-depth interviews were conducted with four participants. The purpose of this phase was to understand the lives of my four participants and reach a comprehensive understanding of the factors that have supported the success of my four participants. Findings generated from the qualitative strand were then used to develop the survey instrument for the quantitative phase of the study, which led to the construction of the second section of this chapter. Data from both phases were then mixed in the final analysis of the study and is documented in the last section of this chapter. The main focus of this chapter is analyze data to answer the following research questions.

Research Questions

The following research questions will guide the study:

1. What factors support the success of Hispanic high school students from inner city school districts in STEM dual enrollment activities at a local community college?

2. How do these factors support the success of Hispanic high students from inner city school districts in STEM dual enrollment activities at a local community college?

Sub questions:

I. What academic factors support the success of Hispanic high school students from inner city school districts in STEM dual enrollment activities at a local community college? How do they support the success of these students?

II. What social factors support the success of Hispanic high school students from inner city school districts in STEM dual enrollment activities at a local community college? How do they support the success of these students?

III. What cultural factors support the success of Hispanic high school students from inner city school districts in STEM dual enrollment activities at a local community college? How do they support the success of these students?

IV. What role do economic factors play in supporting the success of Hispanic high school students from inner city school districts in STEM dual enrollment activities at a local community college?

V. What environmental factors support the success of Hispanic high school students from inner city school districts in STEM dual enrollment

activities at a local community college? How do they support the success of these students?

Mixed Method Question:

I. To what extent and in what ways does the quantitative data on the factors supporting the success of inner city Hispanic high school students in STEM dual enrollment triangulate the qualitative findings on the same?

Qualitative Data Analysis

In this section of chapter IV, I have introduced my four participants for the qualitative study. A brief narrative about these participants will help the audience to get a glimpse of personalities, family, and background of the sample population in this section. Further in this section, I have discussed all the themes that were developed during the analysis of the qualitative data. Themes and findings are divided under five main categories and each category corresponds to a research sub question. Following is the list of themes.

Academic Factors

Theme 1. Influence of after school activities.

Theme 2. Dual enrollment as ladder for future success in higher education

Theme 3. Self-Efficacy for STEM courses in high school.

Theme 4. Role of STEM high school teachers.

Social Factors

Theme 5. Friends and their influence.

Theme 6. Role of mentors in dual enrollment success.

Theme 7. Motivation to get a better life.

Theme 8. Taking leadership roles at high school.

Cultural Factors

Themes 9. No STEM culture at home.

Economic Factors

Theme 10. Free dual enrollment credits

Environmental Factors

Theme 11. Unlimited parental support.

Theme 12. Realization of a better life beyond the inner-city life.

The Four Participants

Frank, the first Hispanic robotics team leader. Frank is a very serious student who is passionate about pursuing a successful career as an engineer. He is determined to leave the inner-city life and live the American dream. He wants to own a home and provide a comfortable life for his parents. Frank's inspiration for education is his parents. He does not want to live the hard life of his parents. He wants to leave the inner-city life and explore the life beyond it.

At age four, Frank entered the United States as an undocumented immigrant with his mother and father. His parents grew up on the outskirts of Lima, the capital of Peru. Initially, Frank lived with his grandmother in Paterson, NJ as his parents went back to Peru. His father was deported while his mother stayed in the United States and acquired the legal immigrant status. Frank's mother raised him and his three siblings, mostly on her own. After a long wait, Frank's father has now returned to the United States and is preparing to file for citizenship.

Both parents have high school diplomas from Peru. Frank's mother wanted to go to college to become a nurse; however, she had to drop her aspiration when she got pregnant. Neither of Frank's parents is fluent in English. His mother works as a caregiver for elder citizens, and his father works as a laborer in a warehouse for "Toys R Us." Although his parents live paycheck to paycheck, they have never forced Frank to work after school; rather, they want him to be diligent in his academic pursuits.

Frank is the third of the four siblings. His two elder sisters have completed their degrees in communication and are married with children. Frank mentioned that his elder sisters had crossed the border several years before he entered the United States. He does not have a close relationship with his sisters as they were married when he was still in elementary school. Presently, Frank lives with both his parents and a younger brother in an economically underserved area of a city in northern New Jersey.

Frank is an ambitious and hardworking student. He has acquired nearly 30 STEM college credits over the period of four semesters. At the time of the interview, he was accepted in the Engineering Program at a major Ivy League college in the North East and

is excited to move away from inner city life. His first introduction to technology was when he was a young boy and saw his sisters playing video games.

The high school academy that he attended is one of the 12 main academies of a large inner city school district and focuses on STEM curricula. The goal of the academy is to offer new opportunities to develop STEM interests. Frank headed the robotics team at this high school and participated in several robotics competitions. He was always a hard-working student and worked hard on placing himself at college level on the Accuplacer test to qualify for STEM dual enrollment courses.

Luis, the engineer. A very well spoken high school Latino, Luis wants to be an Industrial Engineer. His final goal is to work as a human factor engineer after finishing his master's degree.

Luis was born in the United States. He lives with his mother and grandmother, while his father lives in a different household. He gets to spend time with his father on the weekends. Both parents were born and raised in the Dominican Republic. Both parents immigrated to the United States as teenagers and became legal citizens. Luis's grandmother, who lives with him and his family, has practically raised him and his siblings.

Luis's mother works as a teacher's aide and his father works in a factory. His mother has attended a community college and earned a few credits towards an associate's degree; however, she was never able to finish her degree because of family responsibilities. Because of her college experience, Luis's mother is fluent in English and has become a great asset for Luis's success in high school and in dual enrollment. His

father understands English but is not fluent in speaking. Their household is primarily Spanish speaking.

Luis is the oldest of the three siblings. He has a younger brother who lives with him and a half-sister. Luis's interest in STEM, robotics and engineering has influenced, his brother's interest in these fields, as well. Although Luis's brother is still in middle school, he is learning programming at an advanced level.

Luis began his STEM dual enrollment courses in his junior year. His first attempt at Accuplacer was during the fall of his sophomore year and he was not able to place at the college level in mathematics. Because he did not initially place in college-level mathematics, Luis realized the importance of improving his abilities in math and relevant topics to become successful at college. He studied very hard over the summer and placed at college level in mathematics after his second attempt. So far, Luis has completed nineteen STEM dual enrollment credits and has become one of the most successful students in the program.

Luis attends one of the largest high school academies in a large inner city school district. His high school academy is one of the 12 high school academies in the district. Each academy has a different curriculum focused to serve the interests and needs of the student population. However, admission to these academies is based on a lottery system; students are accepted on a random drawing, not their academic interest. Luis was placed in the Architecture, Construction and Trade focused academy, which is housed in a building with three other academies. One of these academies is Science, Technology,

Engineering, and Math, which became one of the leading factors that supported Luis's after-school activities, including dual enrollment activities, at the local two-year college.

Because his high school academy is located in the same building as the STEM focused academy, Luis was able to join and participate in the after-school program, the Robotics Team. The Robotics Team introduced him to a new world of higher education and provided him the experience he needed to excel. In addition to his robotic team and STEM dual enrollment activities, Luis is also involved in community service and attends various STEM related programs in neighboring universities.

Esther, the graphic designer. Eighteen-year-old Esther is out of the ordinary. She calls herself a tomboy but is a very shy and pleasant girl. Born and raised in an economically underserved area of a large city in northern New Jersey, Esther is not interested in boys or makeup like several of her school friends and cousin. Esther wants to establish herself as a well-known graphic design artist. Her natural talent for drawing and painting led her to pursue STEM dual enrollment courses in graphic design. She is a very determined girl, who wants to give herself and her parents a life full of comfort and luxury.

Esther comes from a family of ministers, who have high moral standards and expectations. Her grandfather retired as a priest from a local church; this church was her initial home for several years. Both parents were born and raised in El Salvador. They came to the United States in their early twenties and had struggled through the initial years of their marriage. Esther mentioned that they were only able to survive because of the support provided by extended family and her grandparents. All her aunts and uncles

live in the neighborhood and are very helpful. Most of her cousins are her age and some of her male cousins are pursuing engineering degrees. Higher education is valued highly among the family.

Esther's father is a high school graduate from El Salvador and her mother has some college experience in the United States but was not able to finish her degree because of her immigration status. In the initial years in the United States, her mother worked as a teacher at the local church school for very low wages. Now her mother works as both a secretary at a First Presbyterian Church and a housekeeper on the weekends. Her father works as both a maintenance worker at a school and a part-time priest at a local church. Both her parents are fluent in English.

Esther was born in the United States and is the oldest of four siblings. She has a younger brother and twin sisters. She mentioned that she was homeschooled until third grade; her parents did not feel comfortable enough to send her to the public school system because of the supposed drug use and gangs associated with the school system. In addition, Esther's parents could not afford the expensive private school tuition.

In high school, Esther was accepted in the county's technical school. She struggled in math, so placing at college level on Accuplacer was one of the biggest challenges Esther has faced in high school. She worked hard while earning both her high school diploma and 30 STEM college credits, all while helping her mother with cleaning jobs on the weekends. Esther is now registered as a matriculated student in a STEM discipline at the local community college.

Jessi, the astrophysicist. Jessi is one of the most successful and youngest dual enrollment students. He calls himself a "regular guy" with high aspirations. He wants to become an astrophysicist and teach at either California Tech. or Carnegie Mellon. Jessi was born in an inner city hospital in New Jersey. He was no exception to the crowd around him in his early years of middle school in an economically and academically deprived neighborhood of a vast. Jessi considered himself a very lazy person. He says he had no aim in life until he began attending high school where he met motivated students who became his role models and mentors. Instead of going to the county tech school, he chose to attend one of the local high school academies; it was close to his house, so he would not have to get up early in the morning to ride the bus to school.

Jessi's mother and father both emigrated from Puerto Rico, when they were still young, in search of a better life. His father worked in construction. However, their life in the United States was difficult. Although Jessi's mother earned an associate's degree from Puerto Rico, neither of his parents attended school or college in the United States. Jessi is the youngest of the four siblings. None of his older brothers has succeeded in academics so far. The oldest brother died a couple of years ago because of drug abuse. His second brother was "subpar at high school," never went to college and makes his living as a construction worker. Currently, Jessi lives with his 18-year-old third brother and his mom. He referred to his mom as being very old and old fashioned who is not at the best stages of life at this point. She worked as a nurse assistant in one of the local hospitals; however, she is no longer working. The only source of income for the family is welfare money. Jessi did not mention the role of his father in his life.

Spanish is the predominant language of the household. In fact, Jessi took it upon himself to learn some English. He attended ESL classes and speech therapy until seventh grade. Jessi did not travel out of his large inner city until he went on a field trip to New York City during his freshman year of high school. He mentioned that he always focused on math, since it was easier than English.

Now a sophomore, he took his first college course as a freshman in high school. Because of his natural talent in math, several exceptions were made for him that allowed him to participate in the program. So far, he has earned 12 college credits through his participation in the STEM dual enrollment program.

Jessi attends a high school that has a robotics team, and participation in the robotics team has made all the difference in his life. Jessi's membership to the team helped him understand his true potential and encouraged him to go beyond his limits as a student. In addition to his STEM dual enrollment and robotic team activities, Jessi participates in the upper bound program at a local university.

Qualitative Findings and Major Themes

The twelve interviews with the four participants introduced in the previous section have generated some interesting findings. Some of the findings were similar to the findings in the literature, while others were surprisingly contradictory or new.

Academic Factors

Theme 1: Influence of after school activities. Participation in after school STEM activities and summer STEM camps sparked interest in various STEM fields for

these students. These workshops also played a major role in strengthening their desire to earn STEM dual enrollment credits and in keeping them engaged in these courses.

All four participants have actively participated in after school activities, such as joining a robotics team at their high school, attending after school hands on STEM workshops, attending summer camp at the state four-year colleges, and joining programs like Upward Bound. All of these activities exposed them to various STEM fields and encouraged them to look in to the STEM topics a little further by pursuing a STEM dual enrollment course at the local community college. Frank mentioned,

> When STEM dual enrollment classes aren't available I usually just stay for robotics and help the team out. I don't know about the traditional after school programs but other programs that I attended include Upward Bound program on Saturdays. I had SAT preps some Sundays and sometimes during the week and then there were a few big programs like going to Princeton, go to Columbia, going to Stephens and the Shadow programs.

Frank continued,

> I guess what really helped me solidify the fact that college was where I needed to go was when I joined the robotics team freshman year and that's when we started being taught that there's a whole other world that we can be exposed to if we are high in our education. …. And it helped me paint a picture in my mind of where I wanted to be and that all it would take from me would be some hard work and dedication so these programs actually helped me see what's beyond Paterson, what's beyond this life. Most people here—they don't understand what they

> could have because they're used to seeing everything in the city they live in but when you take them to places like Montclair, which is only a couple of minutes away or in New York City, they are shocked because they don't know that this is something that is out there. They're not aware of the opportunities that are out there. These programs gave me awareness and I want to now achieve that life for me.

Luis gave credit to his participation in the upward bound program at a four-year state college for his inclination to STEM college courses,

> Well, I just wanted to try something new because before that I wanted to get into like psychology and social work and things like that because I thought I wanted to help people and work with people. But I got into this program called "Upward Bound Math and Science" at Ramapo College and through there, since it was a math and science program, we did a lot of focus on lives and math and some of the main principles they spoke about was engineering and a future career in that. And there, I met students who were already part of the robotics team so they encouraged me to join and to just check it out.

As a result of participating in these after-school and summer enrichment programs, these four students discovered careers options in the STEM fields and became familiar with the experiences of college students pursuing a STEM major. These college experiences motivated the students to develop a competitive edge with their classmates at their local schools and with the students attending various school districts throughout the state. After school STEM programs provided much-required awakening for these

students that led them to pursue and retain in STEM dual enrollment programs. Frank mentioned:

> In freshman year, I took a program in summer in Princeton and I got to know what actual difficult classes are like. That huge contrast actually scared me into thinking that am I able to do this kind of work consistently for four years? That's when the opportunity to take college classes arrived for me. That's when I told myself, if I want to be prepared for what's after the Paterson school system, which I know isn't providing me with top level education as other systems may, I have to take this challenge.

Luis talked about his experience as follows:

> So I joined as a sophomore on the robotics team, and once I joined the team I was exposed to all this engineering, all of these robots and everything that had to do with that, I just became automatically hooked. That exposure was mainly what drove my interest in engineering. …… Then I realized that to become the engineer that I want, that there were certain courses that I would have to take and in the beginning I wasn't yet sure if that's exactly what I wanted to do. So I wanted to experience courses such as computer concepts and some advanced level math because at the high school I wasn't getting that same challenge.

Jessi also spoke about what influenced his trajectory:

> I never was really tech savvy. I would just bug around with the computer and then I was looking at these specifications. I didn't know what GH meant. Oh 2.5 GH what does that mean? So I did some studying and I was like, "hmm, that's

> interesting," even though I didn't quite understand. It gave me a basis to study more and then when I came to the robotics team we did a whole bunch of college workshops at PCCC and these topics were revisited.

Esther addressed the programs that led her to discover and nurture her interests:

> I attended a bunch of afterschool and summer workshops with STEM program and it was all fun. They were really interactive and I learned a lot. My favorite was the Rockets and the electronics. I really enjoyed soldering and putting together the part of the toy car. Although I was not interested in becoming an engineer, these workshops kept me engaged with the program.

It is usually difficult for students to come to college campuses after school or attend intensive summer programs at various four year colleges, however it is one of the most effective approach for engaging these Hispanic high school students from inner city school districts in STEM dual enrollment program.

Theme 2: Ladder for future success in higher education. All the participants viewed Dual enrollment as a ladder to higher education and college success. They understood that these college courses would save them time and money while providing them with the required training and rigor that they need to be successful as a matriculated college student. Although these courses were not easy for most participants, they continued to put in their hard work to save time and money.

Frank remarked:

> So these classes actually helped me see all the options I had, instead of the few that I was informed about in high school. It opened up a whole new world for me…. It helped me realize what it can provide for me. It's a much more comfortable living and I get to meet a lot of people that have already succeeded. Getting to know because most people here they don't understand what they could have because they're used to seeing everything in a box.

He further added:

> The way it helped, it allowed me to get a bigger workload and learn how to deal with that. Because during the time I was in dual enrollment, of course, I had my high school work, but on top of that I had the work I had to do for college to try to get a good grade, and that amount of work at first was daunting. It was stressful because it was more work than I was used to. But over time I was able to find good study habits, time to put away time in order to do that extra work, and it allowed me to deal with a bigger workload than I would have if I didn't do the dual enrollment.

Luis mentioned:

> Well first of all, it would be just being able to sit through a college class, being able to be in the college environment, being able to interact with professors the way one should. I got the opportunity to learn that now before even making it to college. Being able to manage my time because I have high school work and college work I have to be able to manage how I'm going to study for both and

how I'm going to be able to do my homework for both so once I get to college managing my time isn't going to be a problem.

Jessi mentioned:

> Dual enrollment classes helped me become disciplined. I have to work hard to finish my assignments. Even though in the classroom people think that I'm smart, but they don't see the effort I put behind closed doors. They don't see me reading my notebook, they don't. I don't try to hide the studying, but I just keep it under because I want to balance the social aspect along with academic aspect. I want to do it because I want to get ahead of people around me. It is worth doing it.

Esther mentioned:

> My family has prayed a lot for opportunities like this. Dual enrollment has helped me save lot of money and time. Since the courses were in the afternoons, my parents or whoever was available did have time to drop me off so I could take the courses. The resources such as tutoring, the library, even blackboard helped a lot. The professors were very fair and considerate. They were the ones that did point out other resources which tutors to go to, which workshops would be best to help you pass this class, or what time they would be available. Even they were available during office hours. They would say you could come stop by; we will help you with whatever questions you need or whatever questions you have.

She further added:

> There was this class I believe it was a strain… computer concepts. With designing web tools and design and web design, there were lots of assignments that were very hard for me to complete. A lot of the times I'd get frustrated and I would always want to get, it was more of at first getting it over with as soon as I got it but then those grades didn't come back so well. Then later on I started taking my time. Whenever I would get frustrated. I would take a break or wait until I had some way of getting tutoring. So, yeah taking a step back for a while is always a good idea when you're frustrated so that was a class that challenged me but I passed it.

It is clear from the excerpts that although it was not easy for any of the four interview participants to earn these college credits, even then they saw the importance of this opportunity and continued to work hard to earn these credits so that they cannot only earn the college credits, but can also earn the much valued college experience, save time and money to earn these credits after high school graduation.

Theme 3: Self efficacy for STEM courses in the high school. Another important theme that emerged from the interviews was their 'self- efficacy' for STEM courses, which ultimately helped them succeed in STEM dual enrollment courses. Because of their self-efficacy for math, placing at the college level in Elementary Algebra Accuplacer or taking Dual Enrollment Math courses did not appear as a daunting task to them at first. Their initial struggle with Accuplacer placement or College Level Math courses made them aware of their strengths and weaknesses and ultimately led them to success. Luis mentioned,

> Math came really easily to me. I'm able to understand it very easily. It's apparent when I talk to my classmates that I understand anything a lot faster than most people in my class. So I guess that level of me being able to do it easily kind of narrowed down my career choices to something related to math and science because it came so naturally to me. I think that is one of the biggest motivators and why I want to be a computer scientist.

Luis further mentioned that he was interested in STEM dual enrollment since his sophomore year. Although he always considered his math skills strong, he was not able to place at college level in math when he took Accuplacer exam by the end of his sophomore year in high school. He mentioned that this experience "woke me up because that made me realize that I had to focus more. It was a wakeup call as it was surprisingly challenging." After he worked hard during a summer long workshop to prepare for the Accuplacer exam at the local community college, Luis was placed at the college level in Math and English, which led him to take STEM college course in the fall of junior year.

Jessi did not struggle with Accuplacer like other three candidates. He was placed at college level math in the freshman year of high school. STEM dual enrollment courses have kept him busy and interested in academics, as the high school science and math courses do not challenge him at all. He has a natural aptitude for science and math courses and finds them very interesting. He mentioned,

> The first college course I took was college algebra and it was harder than I thought. I was actually struggling whereas now at school I am in Algebra II ….I'm going to be honest, I fell asleep every day and I still got the highest grade.

> It's just easy. My science courses, math courses are. It's probably because I love them but I just find them to be incredibly easy. That's why I would like more math, more science courses in STEM dual enrollment just to challenge myself, push myself to that extra level.

Esther stated, "I always liked science and math courses but was not sure of my true abilities in Math. When I was placed at college level after preparing for Accuplacer, I became confident about my abilities to do math." She further added, "Especially with the graphic design courses. The professor would be going through the lesson and I would be thinking to myself I kind of already learned this."

The literature review on math and science abilities of students and its correlation to their interest in STEM careers and majors is highlighted in this theme. All four participants indicated great level of comfort with science and math courses before even they attempted college entrance exam. Their attitude towards their abilities in math led them to succeed in the challenging college experience.

Theme 4: Role of STEM high school teachers. Their science and math teachers played a significant role in promoting interest in STEM dual enrollment for these inner city Hispanic school students. Three out of the four students stated they were very fortunate to have STEM teachers, from elementary school to high school, who made their STEM courses fun and innovative while challenging them to do better in their classes. Luis mentioned about the influence of his science and math teachers,

> One person that really inspired me during my middle school years was this really amazing science teacher I had. We used to call him Mr. G. He made science really

> fun. You could tell everybody in class enjoyed the way he explained it. He explained the most amazing things for us like why the sky is blue or why the ocean is salty. He made it fun and he really took a twist. Most teachers would just give you worksheets and tell you to work things out but he gave you his eyes to look through and I think that's really what made me like science.
>
> I had a math teacher called Mr. Gallo. He was Latin, I believe, and he also made math really fun. He was a goofy teacher and everybody liked being involved in activities and everything, and he really helped people understand math and not to be afraid of it. Because these days, a lot of people when they don't understand math right away they kind of give up on it and that was me for a little bit. Calculus was a really hard endeavor, but with hard work you can get through it.

Jessi's middle school and high school science and math teachers inspired him. Science and math became easy because of these teachers at various grade levels. Jessi feels that he has a special bond with his math and science teachers, which inspires him to give his best to them. He mentioned,

> I always found my math and science teachers very interesting. In high school, I have a teacher named Mr. Coronado. He's a very well-rounded teacher, a very good teacher, and he's my favorite teacher. He's a math teacher and I just always kind of bonded with him over math. He teaches pre-calculus and I would always ask him about various other topics even though it wasn't relevant to the class he was teaching me, but I would always ask him math questions.

> Mr. Gotts was probably my favorite teacher of all time. He just taught physics in such a way that I wound up loving the subject. I got an A in his class but he always challenged me. It was never easy whether it was extra physics problems or just a little side project, and he still challenges me to this day even though I don't have him. Last week, Friday, he gave me a toy motor to build and I was like …. what to do with this? Then he just guided me, and I just had such a good bond with him. So science and math teachers they're the main reason why I challenge myself every day. They challenged me but I just see that they won't always be there and so I have to challenge myself. They played a big role in the student I am today.

Esther also received support from her science and math teachers at the high school to pursue STEM dual enrollment. She mentioned,

> Science was not hard. I liked science. Math was challenging but the teachers that I had made the difference. They have helped me with all the problems that I had If they weren't available, they would push me to go to tutoring after school. But most of the times after school was when I had the courses for STEM. But I managed…. My shop teacher, when I mentioned STEM Dual Enrollment college courses, he said that it would be better than taking a sport after school. So yeah, he liked the idea of getting ahead with college classes.
>
> For me my teachers did a great job because, especially my shop teacher, he really taught me everything I needed to know about the software and programs. I'd also

> enjoyed it so when I came here and started taking the graphic design courses it was a piece of cake. So I was tested and tried before I came here.

The support and influence of math and science teachers from elementary grade levels to high school levels have been highly discussed and recommended in the available literature, as discussed in chapter II, for generating interest of Hispanic students in science and math courses.

Social Factors

Theme 5: Friends and their influence. One of the most important themes that emerged during my interviews with the four participants was "friends and their influence" on the success of STEM dual enrollment participation.

All four participants were clear about their choice of friends. Each participant mentioned that they have different types of friends: some of their friends are interested in STEM, while others are not STEM focused. In addition, each group of friends has a specific role in their lives. The ability to differentiate between friends played a major role in the success of these students in the STEM dual enrollment program. Frank mentioned,

> I have friends all over the spectrum from very successful people, intelligent people to people that don't really know what they want to do with their career choices. I even have some that do partake in drugs and they do the stereotypical patterns and things but I try to look past that because in their core they are actually good people.

Jessi described his friends as follows,

> I've always had a very consistent amount of friends usually around three, two or three. I like having not many friends. It gets complicated. So I also have types of friends. So right now I have three friends, so one of them is the funny guy because he has a sense of humor and then there's another one Nick, he's knowledgeable. I can talk to him about anything whether its math, science I can talk to him about anything and then there's another one like the person who would do something I would never do like we'll go out, we'll explore. We once went to Manhattan and I was like, " huh I would've never went here on my own." So, yeah, those are the types of friends I have.

All four participants enjoyed spending time with their childhood friends, because these friends understand them and support their participation in STEM dual enrollment pursuits. Their childhood friends have acted as a support system during the tough dual enrollment periods and helped these inner city high school students taking STEM dual enrollment courses cope with stress. Frank mentioned,

> I have an inner circle of friends that I try to keep no matter what I do… so having to take these classes and stuff if they are actually my friends I usually keep them. Well most of them don't have the same mindset as me …..but they were never really detrimental to my college classes. They never told me not to do it or they never tried to take time away from me because they understood it was important to me and being my friends they would allow me to keep doing it and some of them actually very supportive . Some would go to classes with me.

However, the STEM dual enrollment participants do not spend most of their time with their childhood friends. They like to spend their time with peers in their classes. Most of the participants mentioned that they are surrounded by peers who have similar STEM interests, who have a positive influence on their STEM dual enrollment achievements. Frank mentioned that one of his closest friends is a Hispanic with an interest in a STEM career. More specifically, Frank's friend wants to be an electrical engineer and has attended several dual enrollment classes with him. Being friends with people who have similar interests encouraged these STEM dual enrollment students to be their best. Frank further mentioned,

> I have lot of friends. Most of them being also intelligent people because I'm usually in honors and AP classes and you usually make friends with the ones in your classes…. I like to be surrounded by people that know what they want to do, people that have a plan. Because for me people like that are your friends for the long term. And you want to be friends with someone who has his life together, so you will enjoy their company more.

Luis and Jessi indicated that the biggest factor to their success in STEM dual enrollment is their friends from the robotics team who took these classes with them or were also interested in pursuing this program at a later stage. These groups of friends proved to be the ultimate support system for the success of the inner city high school students in STEM college courses. The group became a support system for each other who participated in the STEM Dual enrollment. Luis mentioned:

> Well a lot of my closest friends are my friends who are on the robotics team so a lot of them we are all on the same path. A lot of us …we're all applying to colleges at the moment. A lot of us are basically done. We are taking the same dual enrollment courses. We're sticking together as a pack we keep making sure with each other where we have each other focused see because if I'm doing something and somebody else is falling behind and I have to make sure the same and they'll do it for me as well. If they see me falling behind on any kind of work then they'll motivate me to go back and finish off what I was doing.

Jessi began taking dual enrollment courses during his freshman year of high school. He gives the full credit of his success in the STEM dual enrollment to his Robotic team members who identified his potential and influenced him to be successful and his friends who helped him become successful in the STEM dual enrollment courses. He said:

> When I was placed at college level on Accuplacer, I was just a freshman. My friends who pushed me for it they were freshmen at the time, but they were happy for me. Even though none of them passed they all seemed to support me and they told me to go ahead and just do it and I did it and I haven't looked back since and these people kept pushing me. The people in my class like Berlin Sarita - they tell me to study for the exam and make sure I do the homework; Not only does it remind me but it makes me think oh! Let me recheck that, let me revisit that. It just makes me go a step further.

It was a struggle at first because the pacing was totally different. Not only was I transitioning to college classes, I was transitioning to high school so the pacing was much slower, it was not personal but with the help of my fellow robotics members they really taught me, “hey you need to write down your notes this way and you need to study that way” and on my first test I scored a 76 but on the rest of them I scored 90’s. So it really shows that it’s never too late to turn around and without the help of my peers I don’t think I would’ve succeeded.

Jessi further emphasized that his social network and his friends were the main reason behind his success:

Well my social group is filled with people who are just like me. I just took inspiration from them. They wanted me to be the best version of me that I could be so I took these classes and they helped me along the way. Whether it was with homework, board assignments, or just getting through with the time management and the stress they always helped me along the way.

What helped me stay in the courses was my social net. One of the difficulties I had was adapting to the study, the style of teaching that the professor brought and it really, it got me off my game. I was expecting something totally different it was much faster, it was much less personal. He didn’t come to me and explain it so I had to make inferences, I had to make the decision, or I had to study even harder and I had to be able to basically absorb that knowledge very quickly.

When I started to drift off and my grade was starting to get lower so a friend of mine, Mohammed, he was in my college class and me and he had gotten the same

> grade, which was a pretty low grade. So we decided that even though I didn't have to go to tutoring, to math tutoring, I still went and he supported me all the way and I would stay with him extra hours just in case and we would just study and he would help me and I would help him and that really helped me and there were other robotics members that helped me. Luis showed me how and also Jarrod Mendel. He was very quick with the math so I needed to get set up with him.

The healthy competition among the friends also helped these students deliver their best for their academic goals. For Jessi, this competition helped him realize his abilities in math, and he was motivated to improve in every grade thereafter. Jessi talked about his friend Ken as follows:

> I had never been competitive academically but he was; we just competed from the start. So in sixth grade I failed a test called the NGS. It's a math and literacy test and I basically failed it but the next year, he always pushed me to greater heights because he was probably the best person I've seen at math. He was so talented and I didn't envy him but the way he mastered it just gave you something to brag about so me and him ended up doing the NGS, and in my seventh grade year, I almost scored a perfect score and then in eighth grade year me and him scored perfect scores.

All of the students expressed that they spend most of their time with people who have similar interests. Having peers with the same mind set was a great asset in retaining these four participants in the STEM dual enrollment program. Although the majority of

the participants' friends did not participate in the STEM dual enrollment courses, many are on college track and plan to attend college after high school. Some of their friends are interested in the STEM majors. For some of the participants, their friends became an inspiration, which helped them to pursue STEM dual enrollment and consider higher education. Frank mentioned,

> Most of my friends are going to college. Right of the top of my head I can't think of any that aren't because I tend to have friends that have similar mindsets as me what they want, what they know what they want to do with their lives.

Esther mentioned that one of her cousins, who is also her close friend, was the reason she gathered confidence to attend college and take her first dual enrollment course. In her words,

> He was moral support because going by myself to class the first days are usually unnerving for me but I got used to it and a class with him would give me a little more confidence. I use to feel awkward and he would kind of take over some of that awkwardness.

To conclude themes, I can say that these four participants have clearly categorized their friends and know the importance of each group of friends. The strength lies in the fact that all participants can see the negatives and positives of their friends but recognize their goal. For these students, friendship is important but not more important than achieving their goal of success in life.

Theme 6: Role of mentors in the dual enrollment success. All four participants gave credit for their dual enrollment success to their mentors. Whether they were teachers, administrator at school, or peers, mentors were helpful in promoting and ensuring that these students were registered for their dual enrollment classes every semester. In addition, their mentors continued to encourage their participation in activities that helped in retention of these successful inner city high school students in STEM dual enrollment program.

According to the available data, high school students are generally insecure about their math and science abilities, and under peer pressure, they tend to do even worse. Mentors can help these students identify their true abilities and lead them to success. This was quite evident in the success of my participants in the STEM dual enrollment program. Mentors provided inspiration and encouraged these successful STEM dual enrollment students when their relationships with their mentor grew beyond the classroom setting, and beyond graduation, to a life full of opportunities and success. In most cases, these mentors were like a "third parent" to the students and provided them the guidance required to be successful in STEM dual enrollment course. The role of their mentors was not limited to academics and extended to the everyday life matters. Mentors provided these students with the confidence and the encouragement that they needed to succeed in their STEM dual enrollment pursuits. Frank mentioned,

> Mr. C provided me the encouragement for STEM dual enrollment courses and other things that I did during my high school, which lead me to go to Columbia University. My parents never really mentioned college to me. I know they wanted me to be successful but the idea really arose with the robotics team and my

> friends there. I think very early on Mr. C knew that I was I guess out of the ordinary when it came to grades and my way of thinking. I did not really care what most people thought about me it was just my own goals and how I wanted to complete them. I showed it in the robotics team working hard, speaking to other teammates, and eventually speaking to him and telling him that I needed to pay off my college or get a really good deal and he gave me a bunch of steps that I needed to do. Go to programs, volunteer, take college classes, and the more I got involved with that the closer I got to him and he gave me personal advice; how to work with other people, how to behave at home. He was really a really good mentor to me.

Luis discussed how his mentor provided him with fun after-school opportunities and ensured he was on a college track by attending various STEM opportunities that were available:

> That's why he makes sure we're always going into enrichment programs or always making sure we're doing good in our dual enrollment courses because he wants to know that as well as we're having fun in robotics and building robots, but he wants to make sure we're ready for college as well…. He prepared us slowly into being ready for college so everything just came; comes pretty easy for us now the whole college process. Nothing is surprising to us as opposed to a regular senior in a school district as ours.

Jessi gave credit to his peer mentors who identified his true potential and encouraged him to become an active member in the robotics team and to participate in

the STEM dual enrollment as early as a freshman. In the interview, Jessi also explained how this mentor became his role model and he kept following his footsteps on the road to success:

> Carlos told me I see potential in you and no one had ever told me that. I was in a strange position because I had to battle against my own self-interests. I wanted to be the lazy kid who's in the corner and a person who actually saw something in me and I was at a crossroads. I could take this large undertaking and I could do all the hard work or I could just sit back and do nothing. The way I saw other people, the way they looked at Carlos, they looked at him not only like a leader but like someone they respected and I really wanted that because ever since I was a kid, I want to inspire people, I wanted to change people's life and I just decided no matter what it takes I need to succeed and following his words I pushed for the college class and I got it.

Esther gave credit to her uncle, a graphic designer finishing his degree in Computer Science and Graphic Arts, for mentoring her to pursue the STEM dual enrollment courses at the local community college. Esther mentioned,

> Having a mentor is really helpful. My uncle pushed me for these courses and I am glad he did. He is my mentor. Mentors are supposed to help in that way showing you the options and then telling you which one would be the best for you because of your current situation. My uncle did exactly that for me. It is very important that you have a relation of trust with your mentor. It was easy for me, since my mentor is my uncle. For others, that can be challenging. They have to

develop a relationship first. If you really get to know the mentor then you could create kind of a friendship to take down barriers of you're afraid to ask this or yeah when you get to know them. It's not going to be as, you're not going to feel uncomfortable asking them and getting to know things that you should be asking about.

Theme 7: Motivation to get a better life. Student motivation is impacted by student' desire to participate in the learning process. However, the reasons or goals that underlie student involvement in academic activities play a major role as well. Self-motivation to improve their lives and achieve their goals by participating in STEM dual enrollment is another important theme that emerged from the interviews with the four participants. Important factors to their success were determination to live more successful lives than their parents and understanding the importance of higher education. Frank mentioned,

> The option of not going to college was with me but I felt like education and college was the way to actually make it in the world. There are very few instances where that's not the case. I always wanted to go to college.

He further mentioned,

> There is time and place in life for everything and I feel like at this stage in my life I just want to focus on education. My first idea was to create something with my two hands. … Then I wanted to be an audio engineer and then a mechanical engineer from my cousins because they loved cars and they talked to me about it, so I wanted to be a mechanical engineer and it was just in high school where I

> wanted to become an electrical engineer until I started actually researching what they do and I did not think it was something I wanted to be. So I chose something that I really feel passionate about which is computers. I want to works with the physical aspect, the hardware and then program, actually creating applications people can use.

He also added:

> STEM dual enrollment kind of gave me motivation to want to take time out to write applications and essays because I wanted more of that feeling that there's more opportunities out there and I feel a lot of kids here don't get that initial exposure. That they're here most of their lives and then when it's time to actually leave the city they don't know what to do.

Luis mentioned,

> Well I personally think it's my motivation. Since I know I want to become an engineer, I know I want to have the upper hand when it comes to my high school education and even my further college education. So I know the only way to do that was to come through the dual enrollment STEM program. I knew it would benefit me greatly.
>
> I knew it would be a great time investment but I was willing to give that sacrifice because a little bit of time can cause for a great idea of education on my part so that's why I guess I'm just personally more motivated because I know what I want. I have a set plan for myself. I'm not too sure if other students do.

Jessi's explanation for continuing participation in STEM dual enrollment program was philosophical,

> My motivation to stay in STEM dual enrollment program has never been consistent. It's always been a day to day thing. There's always something new whether it's just keeping a promise to myself or it's fulfilling the role I have taken. Success isn't easy to achieve and every day I 'm like it gets harder but there's always something new that keep me going for these classes.

> No one ever pushed me to do better in these dual enrollment courses. My mom never really pushed me to the high level. I always pushed myself, it was always a thing with that I want to be the best for me not for my parents, not for anybody else but for me. I want to be good for me.

For Jessi, the STEM dual enrollment classes are a way to bring the best out of him, which proves to be a big motivation for him to continue to succeed in these college courses. He continued,

> In high school in these classes, I don't pay much attention it's because they are very easy for me. But college courses they push me to the best version of me so I always find myself either helping someone or actually being helped or do the very best.

Jessi further explained,

> Well my abilities, I think my abilities are Okay. They are not where they should be though especially for where I want to be. I want to be a theoretical physicist so

> it's going to be a tumultuous road especially considering all the math courses I'm going to be taking. It's going to be hard. Calculus would just be the beginning of it, differential equations…..and what not. There's lot of math ahead and that's why I study hard for where I'm at now with the college courses but just because this is easy doesn't mean the college courses ahead will. So I think I am capable of getting as in high school courses but that means nothing to where I see myself going.

All four participants feel that there is more in life than the inner city in which they were raised. This success can be achieved only through education. They all found that STEM dual enrollment allowed them to earn free college credits and led them towards a successful career and life. Frank mentioned,

> During my STEM dual enrollment program experience, I met a lot of really smart people that really showed that there is a lot more to life than just in our city and not going to college like a lot of people in our city tend to do was not with me, I felt like education and college was the way to actually make it in the world. There is very few instances where that's not the case.

Jessi, who once considered himself a lazy person and had no desire to continue college education after high school, is one of the most successful STEM dual enrollment students. Jessi enrolled in these classes while still a freshman, which required self-discipline and motivation. He found a new world through his after-school experiences, which motivated him to come out of the inner city life of poverty. He thinks that he became a very different person when he became part of his robotics team and STEM dual

enrollment program; since then, he wishes to give the best of himself to the program. In Jessi's words:

> When I'm in college, when I'm taking dual enrollment courses it's a whole different side of me. I'm focused, I'm prepared, I'm punctual but when I'm old regular me I'm just a regular person telling just bad jokes and just walking around. I know I have to come out of this poverty and education is the way.

Esther mentioned that once she learned about the STEM dual enrollment program from her cousin and uncle, she wanted to be part of it. She said, "Seeing the opportunities I have that my parents didn't have it kind of makes me want to do it so that my future self can say thank you."

Understanding their family financial situation and determination to come out of poverty were motivating factors that helped these students retain in the STEM dual enrollment program. The participants were not satisfied with the hard working life of their parents, and they don't want to live the same life as their parents. They believe that higher education is more important for them than enjoying their adolescence and youth with friends. Frank elaborated,

> I wish my father had an easier job because I know he's straining to get us money. When I grow old I don't want to have a similar life as my father. I want to have a house, a car, a vacation with my family every year. And I know I can do it if I concentrate on my education.

Luis mentioned,

> My mom works as a teacher's aide, her life is not that difficult, but my father works odd hours and it is sometimes very difficult. I have seen life outside this city life and I want to live that life. I want to achieve the highest level of education and be independent and have a good life.

Jessi described,

> None of my family members is living a comfortable life. My brothers did not go to school and they work at pity jobs. I don't want that life for me. I am working hard during my high school years. By taking college classes I am speeding up. I want to have my degrees as soon as possible to come out of this life of hardships.

Esther stated, "My parents survived because we have extended family to help us, but I don't want to depend on others. I want to be successful in life and I know education is the only way to it."

Theme 8: Taking leadership roles at high school. Another important factor that played a role in the success of these inner city students to become successful in dual enrollment courses at college was the leadership opportunities that they got at their after school STEM efforts. Two of them served as their robotics team captain and they considered STEM dual enrollment as a prestigious and elite thing to be part of and tried to motivate their followers by being successful in their endeavors.

Frank mentioned, "I was the captain of the team so that needed my constant attendance. Since I became captain of the robotics team it gave me real confidence about my abilities to perform at STEM dual enrollment courses, and also to compete at other levels."

Jessi, the youngest of the participants, thinks that his performance in the dual enrollment may encourage other students in his high school academy to participate in the STEM dual enrollment. He is a leader and wants to help others succeed by setting a good example for them:

> … it's fulfilling—the role I've taken. Success isn't easy to achieve and every day I'm like it gets harder, but there's always something new. Also, it's nice seeing the new people on the robotics team getting into dual enrollment because I can lift them in. There are a few new students who've asked me how are the college classes and I achieved a pretty decent grade and I was like it wasn't all that bad if you study and, yeah, I think that's a good portion of my motivation.

Esther mentioned,

> I joined the upward bound program last summer and I was the group leader for my group at college. That gave me too much pride. I wanted to continue to do well in the program and maintain the reputation. This inspired me to continue to works hard in my STEM dual enrollment classes at college.

Cultural Factors

Theme 9: No STEM culture at home. STEM is not a big thing for any of their families. All four participants unanimously agreed that their parents never mentioned it or were never involved in it. However, achieving higher education goals was always important to them. The STEM culture at school and from the peers inspired the participants' attendance in STEM dual enrollment. Frank mentioned,

> That kind of thing never really existed in my culture. I don't think many people paid mind to what you did as a profession. Rather how you helped each other. My parents never really pushed me to be a doctor, never pushed me to be an engineer. My sisters, as I said, they went into arts career. That never really mattered to them. There was nothing culture related.

He further added,

> I think it has to do with how most kids don't know what they want to do and when you have that mindset and in combination with that you have to go to college that is the popular thought nowadays, it can be difficult. If you go into college not knowing what you want to do, it isn't easy to go into courses such as mathematics, or engineering out of a whim then it is to go into something Arts related or something communication related when you don't know what you want to be exactly.

Luis mentioned,

> Yeah I mean because the culture that I have at home is really all that we have until we're grown enough to start seeing things for ourselves. So, in my case, mainly the person in the house who would be doing most of the engineering would probably be my father but since at home I didn't live with my father I never got to see him working on a car or something like that and that's something I never became curious of. My mother, she was a teacher's aide. She is a teacher's aide so all she did was school work and school based after taking care of people, so that's all I saw. That's all I was exposed too.

He further mentioned,

> My parents…they don't really know too much about the STEM field but they now know from me. They know from what I tell them that that is the field that's new and is fresh and that's going to be going on for the next however many years so I always keep them excited about it so they just encourage me to follow and pursue my own dreams.

Jessi mentioned,

> Well it's—I think a lot of it has to do with culture because me being a Latino the culture in my household was much different from that of an Asian or a white person or anyone else. My mom, she didn't have a background in mathematics; she cared about my academics but not to the level of that of my peers. Maybe Latino's aren't pushed or maybe there are less opportunities for them but I think they're just as capable.

Additionally, chance, not culture, has influenced my participants to pursue STEM dual enrollment and a STEM career. Luis mentioned,

> I heard mention of STEM and I heard mention of Engineering but it was not like, "oh I don't know about it," so it doesn't bother me, it doesn't affect me at all. Until I finally knew what it was, what exactly it was. That's when all the interest came because before then if someone would mention engineering I would think of maybe an auto mechanic or something.

He further added:

> So I joined as a sophomore in the robotics team and once I joined the team being exposed to all the engineering, all of these robots and everything that has to do with that I just became automatically hooked…. My parents have no idea what I do in the robotics team.

Jessi mentioned,

> When I think about a city like Patterson this being majority Latino. A lot of them don't even know about STEM. It just never crossed their mind. There are opportunities out there for them but no one's told them and to be honest I could have been one of them. I could've just walked around being uninformed. There's a very little chance, it's very likely that I could have just been another odd person just drifting by. If I would have never took the path I took, I don't think I would even be taking these courses. It's hard to forget that not everyone knows about STEM and there are always opportunities out there but it's hard looking for them. How are you going to ask a question you don't know to ask so?

Although there was no STEM culture at home, the students participated in STEM dual enrollment due to their STEM culture at their high schools and the influence of their peers. Frank mentioned,

> My parents never really inspired me for STEM career or courses. After I started Robotics at school, I started participating in a lot of programs outside of high school and they were from Mr. C and also from Mr. Rodriguez of Montclair Upward bound program. Those two people were the main people that helped me

> find programs outside of high school and also from friends that know about programs usually send me links or something.

Luis mentioned,

> Well most Latino kids' parents are immigrants and many time they look to their parents for inspiration. But there is none. I looked at my father for inspiration. He is a carpenter and musician and that's what I really wanted to be until I joined and met robotic team members who happened to be mostly Asians at that time.

Jessi mentioned,

> It seems like the Asian's their parents always pushed them. You have to get all A's. You have to; I had an Asian friend, well she cried because she got a B in an Algebra II class. She cried. That is something that I would never ever imagine myself doing and even though I got an A in that class in my sleep but it was just the fact that even if I did get a B there's always a next time. I guess they just have high standards for themselves; it's not there for us. There is no such push from our parents or families.

Economic Factor

Theme 10: Free dual enrollment credits. Although all four participants come from low-income families, none of the participants worked after school to support themselves or their families. The participants are aware of their low socioeconomic status, but do not consider it as a negative factor in the fulfillment of their higher

education dreams. The free cost of STEM dual enrollment credits played a big role for the success of these students. Frank mentioned,

> Definitely. I don't think I would've been able to afford any extra classes. My parents aren't very well off and I got a full ride because of my parents' situation so I need to take any opportunities I can that don't involve a lot of money…..I understand my financial limitations and I don't want to burden my parents at all.

Jessi mentioned,

> Well that's sort of a main problem with college education. I remember during fifth grade one of my teachers brought up college because he was revisiting his master's in education and then he mentioned college and then one of the kids were like oh what's that? He was like "something very expensive" and that just put an imprint in my mind that wow! College is some daunting task, it's really expensive. So if these college credits weren't free I don't know if not only that I would've taken the opportunity but also if I was going to be able to afford it.

He further added, "My mom brags about my college classes … but she is not able to pay for them… Right now our economic situation—me and my mom is—we're getting by but it's kind of rough."

Esther stated, "I don't think I could have taken dual enrollment courses if I or my parents had to pay for them. The fact that these were free classes I took full advantage of them."

In addition to the no-cost factor of the STEM dual enrollment courses, these students and their families understood the importance of taking STEM dual enrollment courses instead of working after school. Frank mentioned,

> I quit my job June of last year because the amount of money I was getting wasn't enough to compensate for the time I was not using for schoolwork and I wanted to focus more on that. That and I don't really live an illustrious life. I don't really need expensive shoes or expensive technology so I usually just help out at home and do my schoolwork.

> I understand my financial limitations and I don't burden my parents at all… I usually don't like accepting money from my parents unless it's a necessity and if there's holidays coming up I usually ask for a present or two but I'm not really a person that will get angry if their parents don't give them money or everything that they want.

Luis mentioned,

> Yeah, most definitely, because I know it is a great benefit. Because of my situation at home and with my mother, I don't think she would have been able to pay the cost for some of these classes. I mean, we get the bill at home sometimes and she even gives me a crazy look like do I have to pay this and I'm like no it's alright. So I know that would've been really detrimental because if those, if we had to pay for these classes then I probably wouldn't have been able to take them. So it is really beneficial that they're free.

Jessi mentioned,

> Would a job help me? Maybe. If I had money, if I actually had my own money I think I could just… I'm just better with money because when I have money and I can buy the things I want, so I think I'd be better off probably buy a few notebooks, definitely want a box of pencils – I always lose my own. I think overall money would help. But a job, I think, would balance out because money is good but you have to put time in. So I think it would balance out. I don't think it would help.

Esther mentioned,

> I always think about how my parents made a lot of effort for me to learn, and probably getting ahead with these STEM dual enrollment courses would take off some of that financial worry. If I have an after school job … that probably could have helped them in a short term, but the amount of money I have saved in college classes cannot surpass the earning that I will have from any job.

All four participants help their parents by talking care of their siblings in their parent's absence. They have learned how to maintain balance between education and responsibilities. Frank mentioned,

> Between that and also having a little brother, it's a lot of time you have to allocate. But maintaining a balance between high school, college and home was never difficult for me. The way I balance it is I usually, as soon as I get an assignment from a college class, I usually do it immediately. So I can free up time for any time I need for babysitting.

Luis mentioned,

> Well I'd like to believe that having more money doesn't mean that you can have a better education, but from things I have observed in the way things are sometimes it is because personally in my experience before I took the SAT and all of that I would have to be searching for programs where I can get free SAT tutoring or some kind of extra help as opposed to in a town over such as Wayne where students have both parents earning income, earning a good income where they can pay for a tutor. They can buy SAT books to help their kids where my mother she couldn't. She probably would have loved to but she couldn't. So I feel like sometimes having more money can just be a little extra help.

Jessi has an interesting relationship with his mother because of their economic status. He thinks that she could have had a better life if she had gone to college and had continued to work. He is not ashamed of his economic status but is longing to come out of this life of poverty. He understands the importance of having extra money, but he also understands the importance of earning these STEM dual enrollment credits, which can take him a longer way than the little money that he can make from petty jobs.

Esther mentioned,

> On the weekends my mother clean houses and I help her by talking care of my three younger siblings. We don't have lot of money, but I think we are comfortable right now.

She further added,

> Taking the STEM dual enrollment program was definitely a good idea, I was able to finish almost the freshman year of college for free using this opportunity. I

tried to tell my other friends about it but they preferred to work after school then putting more effort in the college courses.

Environmental Factors

Financial concerns, family responsibilities and full-time work commitments have all been shown to be factors external to the college that "pull" Hispanic students away from college in general and especially from STEM fields.

Because science, engineering, and mathematics courses often require longer hours of study and is usually perceived as difficult by many students, environmental factors such as presence of a role model, family support, being surrounded by like-minded people, and determination to change their future has greatly helped in retaining my participants in the challenging STEM dual enrollment college courses.

Theme 11: Unlimited parental support. Parental support proved a major environmental and socio economic factor in the success of the four participants in STEM dual enrollment program. Each participant expressed their gratitude to their parents to help them succeed in the STEM dual enrollment courses. Their parents provided them help by providing them transportation to college to take their STEM dual enrollment courses, providing them the required space, or by just letting them do what they wanted to do and be there for them.

As evident by the interviews, parent's low education level was not a hindrance to the success of my four participants' pursuit of earning STEM dual enrollment credits. None of four participants has college-educated parents; however, their parents support their success in the STEM dual enrollment classes. Although their parents did not fully

understand what their children were achieving, nor did they play a role in developing the college aspirations among their children, they were still supportive of their efforts. Frank mentioned,

> My parents never mentioned college or college classes to me. I feel like the biggest reason they did not mention it is because they did not know how they would be paying for it… I believe they have a very vague view because they aren't informed as I am. Throughout my application process I did it mostly solo. I did it with the help of teachers at school, Mr. Sythe or Mr. C and the only time I really needed them was for signature or for tax returns…..They don't really understand what that means. When I tell them programming and coding they kind of see technology and think that it works like magic but it's difficult explaining to them that there's other logical processes to making it happen. So they're very proud of what I decided to do which is technology, they just don't really understand what it is. However my mom was my biggest support for my STEM dual enrollment. The big help that came from that was the fact that she was just there.

Parents provided support by being present for their children during Parent Teacher Association meetings, college dual enrollment orientations, signing required documentation, and providing them the physical and metaphorical space to study. Frank mentioned,

> It doesn't necessarily mean she has to understand and listen to everything that's going on, but the fact that she's there gives that motivation to me. That's saying

> that she does care that I do want to continue my studies. And she was able to put that time to be there with me instead of being too afraid saying that I won't understand anything because that's not the issue.

He further added:

> I have a very good relationship with my parents. That being said, throughout my high school life I've wanted space to myself and privacy that most teenagers want, and my parents are very good at providing that. They were kind enough to give me my own room, give me space to do any work I need to do. …I don't think it's a matter of education. I feel that the parent's role is to just give that support and push for the student to study.

Luis mentioned,

> Personally, if I didn't have my mother always telling me, "oh make sure you have your homework done" or "make sure you're going to class at night" or even the fact that she's picking me up and giving me rides back and forth. If I didn't have that than I probably wouldn't be as motivated as I wanted too.

Jessi lives with his mother who has been unemployed for several years. She does not understand what Jessi is achieving, but she is proud of Jessi. He mentioned that his mother's pride motivated him,

> My mom—she doesn't understand much of it, but yeah, she encourages me to be the best version of me. She doesn't know that that includes doing robotics, doing college classes. She sees me doing the work but she was never like, "oh you have

> to do this, you have to do that." She's involved, but not much, so, like I said, I was always the more independent child. So I looked out for the things I got. I found out about robotics because I was on the STEM website because I didn't know much about the academy …so I was just lost. And then I went like, "huh you have to have a 3.5 GPA?" That's higher than the one I have now. So I was just like this could be a challenge and this is just going to push me that much farther. And then the college classes, I didn't even know I was going to be taking college classes until after I passed ACCUPLACER. So, yeah.

Parents supported them by providing transportation and space to study and concentrate in their college courses. Esther mentioned,

> My parents and extended family always drove me and my cousin from school to college and then picked us in the evening from college and drove us back home. This was a great help. I don't drive and without the transportation, I can never come to college to take dual enrollment courses.

Theme 12: Realization of a better life beyond the inner-city life.

Determination to come out of the inner-city life of poverty and hardships and live the American dream also proved to be a major factor for the success of these inner city dual enrollment participants in STEM dual enrollment program.

One of the reasons that contribute to poor academic performance and lack of interest in demanding academic subjects of inner city students is in their involvement with the negative forces of their surroundings. Many students who register for the STEM dual enrollment courses drop out within a few days or never show up for their classes

because the surroundings take precedence over the academics. The surroundings of these students include association with gangs and drugs; even if these students are not directly involved, gangs and drugs still have lifelong adverse effects on their personalities. It was evident from the interviews that these successful STEM dual enrollment students are motivated by their surroundings and even the worst peer pressure was not able to deter them from their goals. When asked how he has battled with negative forces such as crime, drugs, violence and peer pressure in order to stay on track with their STEM aspirations, Frank replied,

> I try not to think about my life in the city, but I imagine how hard my parents might have worked or what happened to them. My mom she got pregnant at seventeen in Peru with my sister, but she still continued her education as much as she could. And then she got pregnant with my other sister and it wasn't me that she had to drop out of college with, it was my sister. She was pregnant then so she had to drop out. She was around her twenties at that time and after that I suppose she thought that college was no longer an option. So she worked to try to get us to the U.S. because she understood that there may be more opportunities here because over there if your parents aren't educated you have a lot less of a chance of a chance of being educated. At least here in the US, there is free school and a bunch of benefits to minorities.
>
> I wish my father had an easier job because I know he's straining to get us money. I don't want to let my child feel sorry for the way I built my life.

Luis mentioned,

> Life in this city was an inspiration because it helped me understand what I didn't want. I didn't want to surround myself with people that support that or are part of it. I didn't want to live my life in a city like this where poverty and violence is prominent. I wanted more for myself and my family. So it helped me keep going. Saying that if I accomplish what I want too I'm not going to have to deal with this anymore…. There are people in school that will tease you for wanting to be educated or what not, but I never paid mind to it so it has never really hindered me in any way. It has actually made me push harder because it makes me want to prove that I am smart

Taking dual enrollment classes prepared them to compete with students from affluent school districts, which is much required to adjust in higher education setting. This experience is required for these students to full fill their desire to live a better life. Luis elaborated this thought as he mentioned:

> In reality when I think about it sometimes it is really intimidating. Knowing that I'm competing against the seniors from all the high schools in the country and trying to get into these top select schools. But I see it as coming from Patterson. Coming from this district it is, I don't know, a lot of Patterson students because of the environment we're in we have a certain kind of toughness to us. So I see this challenge, but it's something I know I can overcome. It's intimidating for sure but I know if I apply myself, if I work as hard as I can, then I can make it right.

Jessi mentioned,

> I'm going to say I stayed away from it simply by chance. It just something about me I just never played into the crowd. I was always kind of a loner. I always had one or two friends but I never had a large group of friends. I wasn't outgoing. So somehow these friends they had other intentions. They weren't interested in smoking and drinking and then, later on, when I was in my teen years, my mom would always tell me, "don't smoke, don't drink." And then there are other things like health class. And also the vision I have for myself in the future just wasn't the same as the kids I had seen drinking and smoking and doing all these other bad stuff. That was just wasn't in line, and I just decided that not only did I not want to be with that crowd but I just didn't want that for my future. I don't want to live in this city for the rest of my life. I have seen the world outside it and I want to be part of that and this will happen through higher education for me.

Ester mentioned,

> My mom wanted to study further, but she did not have the resources and then I was born. My parents were struggling to bring food to the table. Seeing the opportunities I have that my parents didn't have it kind of makes me want to do it so that my future self can say thank you.

These participants have not rejected their reality, in fact they have an awareness of their surroundings and want to make a difference in their lives and the lives of their loved ones by making use of the opportunities provided to them in the form of STEM DE.

Quantitative Data Analysis

Survey Development Procedure

Several themes emerged from the analysis of the qualitative data sets. The themes were categorized in similar categories as in the first phase of this study such as student's background and parental information, economic factors, environmental factors, cultural factors, academic factors, and social factors based on the five research sub-questions. These categories served as the six headings for the large-scale sections within the instrument. Each section had several questions based on the themes that have emerged from the qualitative data sets, totaling 60 questions on the survey instrument. It is important to note that not all codes were represented as survey response items. Only the items that were most represented in the qualitative data sets were selected as survey response items so that the survey remained as short as possible and measures only the most salient constructs from the qualitative data sets.

The first section of the survey was focused on the student's general information and backgrounds. It asked questions related to their school district, grade level, birth place, their parents' education level, their legal status in the United States, their parent's legal status in the United States, parent's language fluency, education level, the family's socioeconomic status, and questions related to their STEM dual enrollment program participation. The second section of the survey inquired about their economic status and value of education to uplift them in the economic class. The third section of the survey had questions to understand the environmental factors that have supported the success of these students in the STEM dual enrollment program. The fourth section of the survey

was focused on academic factors and asked questions related to their motivation, their science and math abilities and preparedness and efficacy, and the summer and after school activities. The next section of the survey included items reflecting the home culture, their childhood activities, and their parent's involvement and support in their academic pursuits. The last section of the survey was designed to understand their social life, the role of a mentor, role models, leadership roles, and their peers and how these peers have influenced their STEM dual enrollment participation.

Sampling and Response Rate

The sampling frame for this study consisted of all the inner city Hispanic students registered for STEM dual enrollment courses under a HSI STEM grant for spring 2016 semester at Passaic County Community College. The other criterion for the students to participate in the survey was at least one semester of dual enrollment before this semester. Eighty students were eligible to take the survey. The survey was sent via email to the eighty eligible students. Seven of these emails were returned as "undeliverable," resulting in a sampling frame of 73 students. Qualtrics.com was used to conduct this survey. Of these 73 possible respondents, 53 completed the survey, resulting in a 61.3 % completion rate.

Instrument Reliability and Validity

Validity is the extent to which scores generated by an instrument measures the characteristics or variable they are intended to measure for a specific population (Onwuegbuzie et al., 2007). The first threat that exists is internal validity in this study. To test the instrument reliability and validity, a pilot survey was conducted with a non-

random sampling of respondents who were STEM dual enrollment students, but not necessarily eligible sample members, based on their ethnicity. Ten students were given a survey for this pilot and all of them confirmed that the instrument is easy to understand.

The small sample size of the quantitative study also projects some credibility threats to the generalization of the findings. Generalization "pertains to the extent that meaning and use associated with a set of scores can be generalized to other populations" (Onwuegbuzie et al., 2007). Outcome validity is another threat that exists in this study, as it was difficult to interpret the meaning of scores of each item on the survey.

According to Groves et al. (2004), all survey questions should meet these three distinct standards:

> a. Content standards (e.g., are the questions asking for the right things?); b. cognitive standards (e.g., do the respondents understand the questions consistently; do they have the information required to answer them; are they willing and able to formulate answers to the questions?); and c. usability standards (e.g., can respondents and interviews, if they are used, complete the questionnaire easily and as they were intended to?) (p. 241)

To verify content, cognitive, and usability standards, survey designers often choose between five options for evaluating draft survey questions (Groves et al., 2004). In this study, I have used "expert review" and "cognitive interviews" to evaluate the three standards described above (Groves et al., 2004, p. 242).

Expert review. Groves et al. (2004) describes expert review as a technique in which "questionnaire design experts assess whether the questions meet the content, cognitive, and usability standards" (p. 242). In this study, my methodologist, who is a research faculty at Rowan University, reviewed the questionnaire twice and made recommendations regarding the wording and structure of the questions, response alternatives, use of Likert scale, number of questions on the survey, and the navigational rules of the survey. These suggestions and revisions helped in overall improvement of the survey instrument including the content, cognitive and usability standards.

Cognitive Interviews. *Pilot.* To specifically address the usability of the questionnaire, a non-random sampling of respondents who have participated in the STEM dual enrollment but were not eligible sample members were surveyed to test the questionnaire and provide feedback about the clarity of the questions and response categories and to indicate the time it took them to complete the questionnaire. This pretesting sample consisted of non-Hispanic STEM DE students (n=4), and high school graduates who participated in STEM DE in the previous years (n=4).

As a part of this pilot study, all participants (n=8) were asked the following questions regarding instrument usability:

> (a) Are instructions for completing the survey clearly written? (b) Which, if any, of the questions are confusing? (c) Do you understand how to indicate your responses? (d) Are the response choices mutually exclusive? (e) Are the response choices exhaustive? (f) Do you feel that your privacy has been respected and protected? (g) Do you have any suggestions regarding the addition or deletion of

questions, clarification of instructions, or improvements in questionnaire format? (Fink, 2013)

Participants were also asked to indicate how long it took them to complete the survey.

All participants indicated that (a) the directions were clearly written, (b) none of the questions were confusing (c) they understood how to indicate their responses, and (d) they felt that their privacy had been protected. Most of the respondents indicated that they completed the survey in 10-15 minutes.

Delimitations. This survey's sole recipients were of Hispanic descent who were registered STEM DE students from the participating school districts in the spring 2016 semester. A few emails were not sent successfully due to incorrect email addresses. The survey intended to measure only the chosen constructs found within the qualitative data sets with the small set of Likert-style response categories listed within the survey. The exploratory design of the study helped in addressing some of these issues.

Quantitative Findings

Quantitative data was analyzed using descriptive statistics. Fink (2013) states that "It provides simple summaries about the sample and the responses to some or all questions". Descriptive statistical methods include interpretable tables, graphs or single representation of a group of scores (Teddlie & Tashakkori, 2009). The frequency of each response was first calculated, which was followed by finding percentage for different variables.

To provide the detailed understanding of the survey and analyze how each question on the survey contributes to the factors affecting the success of the students in STEM dual enrollment courses, it was important that tables show each variable. Miller (2015) explains that "A univariate table shows information on each variable alone rather than associations among variable. These stables can include more than one type of numerical information for each variable". The data collected from the survey was divided in six tables based on the six sections of the survey. Each table corresponds to a sub question in the research question. Each table measures the frequency and percentage of each variable.

Table 3

Demographic characteristics of students who have successfully completed six or more STEM dual enrollment credits

Demographic Characteristics	n = 53, N = 73	
	Number of cases	Percentage In %
Grade level at the time of participation on DE		
11	30	56.60
12	23	43.40
Born in the United States	47	88.68
When did they enter the US		
Before Kindergarten	3	50.00
Elementary School	3	50.00
Learn about STEM dual enrollment from high school administrator/teacher	45	86.54
When did they start participating in the STEM DE		
Junior year of high school	41	78.85
Senior year of high school	8	15.38
What encouraged you to participate in the STEM DE		
To Save Money	28	57.78
To Save Time	18	40.00
To explore STEM	16	35.56
To become better at Math	6	13.33
To be with friends	5	11.11
All of the above	10	22.22
Mother/Caregiver raised in the US	22	42.31
Father/Caregiver raised in the US	17	36.17
Mother/Caregiver fluent in English Language	26	49.06
Father/Caregiver fluent in English Language	31	42.31
Highest level of education mother/caregiver finished		
4 year degree	11	21.15
Highest Level of education father/caregiver finished		
4 year degree	3	5.88
Family members in STEM professions	20	37.37

Note. This table projects the student background and parental information as provided by the students on the survey. A total of N = 73 students were given survey and n= 53 students responded to the survey.

Table 3 provides the demographic characteristics of the students who have successfully completed six or more credits of STEM dual enrollment. Out of the 73 (N=73) students who were given the survey, 53 (n=53) students completed the survey. According to the survey, 78.85% of the students were in their junior year, and 15.38% of the students were in the senior year of high school when they start participating in the STEM dual enrollment program. Eighty-eight percent of the students who took the survey were born in the United States and those who were not born in the United States came to the country before elementary school age. High school administrators played an important role in promoting DE courses to these students, as 86.00% of students indicated that their school administration or teachers informed them about the STEM DE. Seventy-eight percent of the students started taking these courses during their junior year in the high school, while only 5.77% of the students who took the survey started participating in the STEM DE program during their sophomore year in high school. Fifty-seven percent of the students indicated that they participated in the STEM DE to save cost for the college degree, 40.00 % participated to save time required to finish the degree, 35.56 % wanted to explore various STEM options by participating in these free college courses, 13.33% students wanted to improve their math skills, 11.11 % wanted to be with their friends, and 22.22% mentioned all of the above reasons for their participation in STEM. The survey shows that 57.69% of students indicated that their mothers were neither born nor raised in the United States, and 68.83% of students indicated their fathers were neither born nor raised in the United States. The percentage of students whose mothers can fluently speak English is 49.06%, while the percentage of students whose fathers can fluently speak English is 42.31%. The percentage of students

whose mothers have less than two-year college education is 67.30%, while the percentage of students whose fathers have less than two-year college education is 88.24%. The percentage of students who indicated that one of their family members is in a STEM-related profession is 37.73%.

Table 4

Summary of academic factors affecting the success of students in STEM dual enrollment courses

Variables	n = 53, N = 73	
	Number of cases	Percentage In %
Self –motivation to participate in STEM DE	48	90.56
Importance of student's academic goals to the parents	50	96.16
Interest in STEM careers/major	40	76.93
Spent more than 2 hours outside the class studying for STEM DE	52	100
Found math easy at high school	52	100
Found science courses easy at high school	34	66.67
Science teachers at high school helped in promoting STEM interest	23	43.39
Participation in afterschool/summer activities	5	9.4
Attend tutoring to succeed in DE courses	9	16.98

Note. Fifty-three students participated in the survey; however, not all students chose to answer all of the questions on this section of the survey.

The first sub-question on the list of research questions was asked to understand what academic factors support the success of Hispanic high school students from inner city school districts in the STEM dual enrollment activities at a local community college. How do they support the success of these students? Respondents were asked to rank their

self-motivation, interest in STEM careers, their interest in STEM careers and majors, ability to complete math and science courses, contribution of science teachers to promote STEM interest, participation in after school science activities, and attendance in tutoring for STEM DE courses. Students were asked to rank these factors on a scale from 1 to 5, where 1 indicated lowest and 5 indicated highest extent. Table 4 displays the number of responses and percentage of students who have chosen 3 or above for each of these factors. In other words, Table 2 indicates the number of cases and percentage of students who consider these academic factors as supporting their success in STEM DE. According to Table 2, the percentage of students who indicated that they were self-motivated to participate in STEM dual enrollment courses was 90.56%. The percentage of students who ranked their parents concern about their academic goals as a factor for their success in STEM DE was 96.16%. The percentage of students who indicated that their interest in STEM careers and majors helped them to do well in the STEM DE courses was 76.93%. One-hundred percent of students indicated that they spend at least two hours outside the class to succeed in the STEM DE courses. One-hundred percent of students who took the survey ranked their math abilities from average to easy. The percentage of students who ranked their science abilities from average on easy of the 5-scale question was 66.67 %. The percentage of students who indicated that their teachers have moderate to high role in promoting their STEM dual enrollment success was 43.39%. Only 9.40% of students indicated that they participate in after school activities such as upward bound program, after school workshops at two and four-year colleges, and robotics club. The percentage of students who indicated that they use the tutoring support to achieve success in the STEM DE courses was 16.98%.

Table 5

Summary of Social Factors affecting the success of students in STEM dual enrollment courses

Variables	n = 53, N = 73	
	Number of cases	Percentage In %
Spend more than 6 hours with friends who are not part of STEM DE	20	37.74
Spend more than 6 hours with friends who are part of STEM DE	9	20.45
Spend more than 6 hours with friends who are part of AP and honors classes with them	6	18.75
Supportive non-dual enrollment friends	39	76.47
Role models for STEM careers	9	17.65
Influence of mentors	28	58.34
Leadership role at high school	23	43.40
Family responsibilities after school but no jobs	49	92.45

Note. Fifty-three students participated in the survey; however, not all students chose to answer all the questions on this section of the survey

The next section of the survey instrument was designed to understand what social factors support the success of Hispanic high school students from inner city school districts in the STEM dual enrollment activities at a local community college. How do they support the success of these students? On several questions in this section, respondents were asked to rank on a scale of 1 to 5, with 5 being the highest and 1 being the lowest to indicate how various social factors have helped them successfully continue with STEM DE, such as association with various peers and their relationship with their parents and support from friends. According to Table 5, 37.74% of students who took the survey indicated that they spend more than six hours after school with friends who are

not part of STEM DE. The percentage of students who indicated that they spend more than six hours per week after school with friends who are part of STEM DE was 20.45%. Only 18.7 % respondents indicated that they spend more than six hours per week after school with friends who are part of AP and honors classes with them. The percentage of respondents who indicated that their friends support their participation in STEM dual enrollment was 76.47%. The percentage of respondents who indicated that their parents talk to them about their career aspirations was 88.69%.

Respondents were also asked to respond to few other questions that determine how other social factors such as role models, leadership roles, mentors, and number of family responsibilities such as helping parents with talking care of siblings, household chores, after school jobs have influenced their success in STEM DE courses. Table 5 projects 17.65% students have role models for a STEM career. The percentage of students who have mentors who have encouraged them to participate in the STEM dual enrollment program and consider STEM careers was 58.34 %. The percentage of students who have leadership roles at high school was 43.40%. Forty-nine students responded that they have responsibilities at home such as taking care of siblings, household chores, after school curricular activities, and jobs.

Table 6

Understanding cultural heritage of the students and their families who have successfully completed 6 or more STEM dual enrollment credits

Variables	n = 53, N = 73	
	Number of cases	Percentage In %
Spent time at playgrounds with parents	36	67.92
Spent time at public library with parents	25	48.07
Visited Museums/zoos with parents	25	48.07
Talk to parents about career choices	47	88.69

Note. Fifty-three students participated in the survey; however, not all of the students chose to answer all the questions on this section of the survey

The survey included four questions about cultural heritage as a factor that supported the success for the qualified participants in the STEM DE. The most important question was if the students talk to their parents about their career choices and options, and 88.69% of respondents who took the survey indicated that they always talk to their parents about their education and career choices. The other three questions were designed to understand their cultural heritage. Only 48.07% students indicated that they went to zoo or museum as a child with their parents. The majority of students, 67.92%, spent their free time at the playgrounds with their parents and siblings.

Table 7

Understanding economic status of the students and their families who have successfully completed 6 or more STEM dual enrollment credits

Variables	n = 53, N = 73	
	Number of cases	Percentage In %
Average or below average economic status	45	93.75
Low economic status never restrained education	43	87.75
Consider education important to get ahead in life	50	96.15
Would pay for the DE college credits	4	7.55
Work after school	9	16.98

Note. Fifty-three students participated in the survey, however not all the students chose to answer all the questions on this section of the survey

The next part of the survey was designed to answer the fourth sub-question of the research questions: What role do economic factors play in supporting the success of Hispanic high school students from inner city high school districts in STEM dual enrollment activities at a local community college? Respondents were asked to rank their views related to their economic status on a 5-point scale; 5 was most agree and 1 being least agree. According to Table 7, the percentage of students who have completed six or more credits who view their economic status as average or below average as compared to the general American household was 93.7%. The percentage of students who took the survey and believe that their low economic status has not restrained their dual enrollment achievements was 87.75%. In addition, 96.15% of the students rank education as an important factor to succeed and change their socio-economic status. Only 7.55% students who completed the survey indicated that they would have taken the college courses even

if they had to pay for it. Although most students in this sample were from low economic backgrounds, only 16.98 % of the students work to support their families after school.

Table 8

Student's perception of their environment, parental support and peer influence

Variables	n = 53, N = 73	
	Number of cases	Percentage In %
Parental participation in the school activities	32	61.54
Parental participation in Dual enrollment effort	29	56.86
Parent's understanding of STEM dual enrollment	38	73.08
Parents provided transportation to support	38	65.39
Parents provided academic resources to support	36	70.58
Parents simply keep an eye to show support	28	53.84
Took DE classes at their high school before or during the day	44	84.61
Friends/siblings/cousins taking classes with them	20	37.73
Influence of friends/siblings/cousins on STEM dual enrollment	33	64.70

Note. Fifty-three students participated in the survey; however, not all the students chose to answer all the questions on this section of the survey

The last section of the survey was designed to understand the fifth sub-question on the list of research question: How does the environmental factors support the success of Hispanic high school students from inner city in STEM Dual enrollment program at a local community college? How do they support the success of these students? Respondents were asked to rank their experience on a 5-point scale to express their parent participation in the school activities, parents role in dual enrollment activities, parents understanding of STEM Dual enrollment, parents support to accomplish STEM dual

enrollment, and influence of friends/cousins/ siblings on STEM dual enrollment activities.

According to Table 8, 61.54% of students who successfully participated in the STEM dual enrollment program indicated that their parents participated in their school activities. Over half (56.86%) of the students who took the survey indicated that their parents participated in their STEM dual enrollment efforts and the majority (73.03%) of these students indicated that their parents had an understanding of the benefits of STEM dual enrollment for their college advancement. Most parents supported the efforts of their children by providing transportation and academic resources and monitoring their success. The percentage of students who participated in the survey who took DE classes at their high schools was 84.61%. The influence of friends, siblings, or cousins to participate in the STEM dual enrollment program attributed to 64.70% of the surveyed students. Lastly, 37.73% of these students took STEM DE classes with their friends, siblings, or cousins.

Mixed Method Findings

The main reason of using a mixed method approach in this was to provide a better understanding of the factors involved in the success of students from inner city high schools in STEM dual enrollment. In sequential mixed method studies, the addition of qualitative or quantitative strand improves one's understanding of the phenomenon and answers the research questions by suggesting modification in questions or design, by providing new hypotheses, or by exploring the reasons and meanings behind the findings of a previous strand (Teddlie & Tashakkori, 2009).

The following mixed method question was addresses in the final analysis of the qualitative and quantitative data sets:

1. To what extent and in what ways does the quantitative data on the factors supporting the success of inner city Hispanic high school students in STEM dual enrollment triangulate the qualitative findings on the same?

Demographic Description of the Participants

Frank, Luis, and Jessi were not born in the United States; they immigrated to the United States as undocumented immigrants with their parents before elementary school age. Esther was the only participant from the qualitative phase who was born and raised in the United States. The survey data indicates that 88.7% of respondents who took the survey were born in the United States and the remaining 11.3% entered in the United States before the elementary school age. Parents of all four participants were undocumented immigrants, and they struggled to achieve their legal status in the United States. The percentage of respondents who indicated that their mothers were not born in the United States was 57.69%, while 68.83% of respondents indicated that their fathers were not born in the United States. Frank and Jessi indicated that their parents speak limited English, whereas Luis and Esther indicated that their parents are fluent in the English Language. Similarly, 49.0% of students indicated that their mothers speak English and 42.31% of respondents speak English. All four participants indicated that their parents have not earned college degrees and have worked hard to survive in the United States; this was similar to the survey data, as 67.3% of students indicated that

their mothers have fewer than two years of college education and 88.24% have indicated that their fathers have fewer than two years of college education.

All four participants indicated that their high school administrators and teachers influenced their interested in STEM DE. Eighty-six percent of survey respondents indicated the involvement of their school administrators in their STEM dual enrollment achievements.

Frank, Luis, and Esther began taking the DE courses in their junior year of high school; similarly, 78% of students indicated that they took their first DE course in their junior year. On the other hand, Jessi and 5.8% of survey respondents indicated that they took their first DE course during their sophomore year at the high school.

Academic Factors

Qualitative data indicate the four participants became interested in various STEM fields as a result of their participation in after school activities such as robotics team, hands on STEM workshops, and summer STEM camps. These after school workshops and activities strongly influenced their desire to earn STEM DE credits and kept them engaged in these courses. On the contrary, only 9.4% of survey respondents indicated that they participate in any STEM-related after school activity.

All four of the interview participants viewed STEM dual enrollment as a ladder to higher education and college success. They understood that these college courses save them time and money while providing them with the required training and rigor to become successful matriculated college students. Although these courses were not easy for most participants, they continued work hard to save time and money. Similarly,

57.00% of the students indicated that they participated in the STEM DE to save money for their college degree, 40% participated to save time required to finish the degree, 35.53%. wanted to explore various STEM options by participating in these free college courses, 13.33% students wanted to do better at math, while 11.11% wanted to be with their friends, and 22.22% mentioned all of these reasons to participant in the STEM DE.

Self-efficacy for math and science courses at the high school was another theme that emerged as an important factor that has supported success of my four participants form the inner city high schools in STEM DE. Survey data also indicated that self–efficacy for math and science courses support success of survey respondents in STEM DE courses. One-hundred percent of respondents who took the survey indicated math courses at high school are easy for them, and 66.67% of the survey respondents indicated science courses at their high school quite easy.

Luis, Jessi, and Esther indicated that their science and math teachers played a significant role in promoting interest in STEM dual enrollment for them. They expressed that they were fortunate to have STEM teachers from elementary to high school level who not only made their STEM course fun and innovative but also challenged them to improve in their classes. The percentage of students who took survey and indicated that their science and math teachers at high school helped in promoting STEM interest was 43.39 %.

All four participants plan to pursue a STEM major and a STEM career. Similarly, 76.93% of survey respondents indicated that they plan to pursue STEM major and career.

Social Factors

One of the most important social factors that emerged from the qualitative analysis of the interview data was the friends and their influence on the success of STEM dual enrollment participation of my four interview participants. All four participants mentioned that they have different types of friends; some of them are interested in STEM and participate in STEM DE with them, while others are not interested in STEM majors and career. They spend time with friends irrespective of their interest in STEM; however, they have all mentioned that their friends are going to college for higher education. All four accepted that their friends act as a support system for them during the tough dual enrollment periods and help them cope with the academic stress.

The survey results correspond to similar findings: 37.74% of survey respondents indicated that they spend more than six hours with friends who are not part of STEM DE program, 20.45% indicated that they spend more than six hours per week with friends who are part of STEM DE, and 76.47% of respondents indicated that their peers are supportive of their STEM DE efforts and encourage them to do well.

All four participants gave credit of their STEM dual enrollment success to their mentors. Mentors, whether they were teachers, administrators at school or peers; were a great help in promoting and insuring that these students were registered every semester for their dual enrollment classes and continued to push them for activities that helped in retention of these students in STEM college courses. The percentage of survey respondents who agree that their mentors have influenced them continue to work on their

STEM dual enrollment courses was 58.34%. This finding leads to the conclusion that mentors play an important role in promoting STEM DE students.

Another finding from the mixed data analysis was the importance of leadership roles among the students which boosted their moral to take the STEM DE challenge. Frank and Luis lead their robotic teams and worked hard on their STEM dual enrollment courses to set an example for the others in the robotics team. Jessi thinks that he has to perform well in the college courses to encourage others to consider STEM dual enrollment. Esther took leadership roles with the upper bound program, which improved her confidence. The percentage of survey respondents who mentioned that they have some leadership role in their high school, which encouraged them to set an example for others, was 43.40%.

Cultural Factors

For Luis, Frank, Jessi, and Esther, STEM culture was not present in the home, but came from peers and school surroundings. However, their parents were involved in their education process; even if they were not educated themselves, their parents continued to support their children's higher education goals. In the survey, 88.69% of students indicated that they have spoken to their parents regarding their career goals and aspirations, which is consistent with the qualitative results.

Another factor that lead to the conclusion that Hispanic children have little STEM culture at home, is their limited participation in activities which are considered culturally congruent with the main stream culture of promoting STEM interest such as exposure to museums and visiting zoos etc. All four participants indicated that their first visit to a

museum, library, or a zoo was with their school and not with their parents. As children, all four participants spent most of their free time with their parents and siblings in the local playgrounds. The survey results indicate similar findings: 67.92% of respondents indicated that they spent most of their free time with parents at the playgrounds, while 48.07% of students indicated that they have visited a museum, zoo, or public library with their parents as children.

Economic Factors

Frank, Jessi, Esther, and Luis come from very humble families, though none of them work after school or during the summer to support themselves or their families. The participants are aware of their low socioeconomic status and their parents' struggles, but do not consider this a negative factor in their higher education pursuits. The fact that the STEM dual enrollment credits were free of cost played a significant role in promoting STEM DE credits for the four participants. The survey results triangulated the qualitative data. The percentage of respondents who indicated that their family income is below average, hence qualifying for full financial aid at college, was 93.75%. Additionally, 87.75% of the respondents believe that their low economic status is not a hindrance in their higher education pursuits, and 96.15 % of the students rank education as an important factor to succeed and improve their socio-economic status. Only 7.55% of students who completed the survey indicated that they would have taken the college courses even if they had to pay tuition; the remaining participants expressed their inability to pay for the DE credits. Lastly, 16.98% of students indicated that they work after school to support their families.

Environmental Factors

Parental support proved a major environmental and socioeconomic factor in the success of the four participants in the STEM dual enrollment. Each of the participants expressed that although their parents do not have college degrees and are often unable to help them with their academics, their parents have helped and supported their STEM dual enrollment efforts. Their parents provided transportation back and forth from the college in the evening to take the dual enrollment classes, providing space to study, or by just letting them so what they wanted to do and be there for them.

Survey results supported the qualitative findings: 61.54% of students who successfully participated in the STEM dual enrollment program indicated that their parents participated in their school activities. Over half (56.86%) of the students who took the survey indicated that their parents participated in their STEM dual enrollment efforts, and the majority (73.03%) of these students indicated that their parents had an understanding of the benefits of STEM dual enrollment for their college advancement. Most parents provided their support by providing transportation and academic resources and monitoring their children's success in STEM dual enrollment.

Frank, Luis, Jessi, and Esther have expressed their determination to fight with the inner-city environment. They all agreed that acquiring higher education will improve their lives and the lives of their families. Survey results indicated similar findings.

Chapter V

Discussion and Analysis

The purpose of this study was to investigate the factors that support the success of Hispanic high school students from inner city school districts in STEM dual enrollment and how these factors support their success.

The following research questions will guide the study:

1. What factors support the success of Hispanic high school students from inner city school districts in STEM dual enrollment activities at a local community college?

2. How do these factors support the success of Hispanic high students from inner city school districts in STEM dual enrollment activities at a local community college?

Sub questions:

I. What academic factors support the success of Hispanic high school students from inner city school districts in STEM dual enrollment activities at a local community college? How do they support the success of these students?

II. What social factors support the success of Hispanic high school students from inner city school districts in STEM dual enrollment activities at a local community college? How do they support the success of these students?

III. What cultural factors support the success of Hispanic high school students from inner city school districts in STEM dual enrollment activities at a local community college? How do they support the success of these students?

IV. What role do economic factors play in supporting the success of Hispanic high school students from inner city school districts in STEM dual enrollment activities at a local community college?

V. What environmental factors support the success of Hispanic high school students from inner city school districts in STEM dual enrollment activities at a local community college? How do they support the success of these students?

Mixed Method Question:

I. To what extent and in what ways does the quantitative data on the factors supporting the success of inner city Hispanic high school students in STEM dual enrollment triangulate the qualitative findings on the same?

Revisiting the Hypothesis

The data was collected with the assumption that although social, cultural, economic, environmental and historical factors play a definitive role in the participation and persistence of Hispanic students from inner city school districts in STEM dual enrollment; self-efficacy, after school activities, peers and several other non-cognitive

factors play a major role that lead these students to successfully participate and stay in STEM dual enrollment programs.

The results of this study indicate that the initial assumptions for the study is correct. The data collected from both phases of the study indicate that self-efficacy, which was measured by the students advocacy regarding their performance on math and science courses and highest level of math taken at the high school, participation in after school programs, involvement with like-minded peers and influence of faculty are among the major factors that contribute to the success of students in STEM dual enrollment participation. Other non-cognitive factors include support by their parents and no jobs after school.

Major Findings and Addressing the Research Questions

One of the main goals of the study was to develop new knowledge that can help educators increase the participation and retention of Hispanic students in dual enrollment programs, especially in STEM areas. In this section, I will offer a summary of this study's findings, as they relate to the two research questions.

Research Question 1: What factors support the success of Hispanic high school students from inner city school districts in STEM dual enrollment activities at a local community college?

To answer this research question, interviews were conducted in three steps with four participants to provide a better understanding of factors that support success of Hispanic high school students from inner city high schools in STEM dual enrollment program. Factors include influence and involvement of peers, parental involvement and

support, family's financial status, cultural heritage, mentors in life, leadership roles, motivation to be successful, and self-efficacy for science and math courses. All participants had earned more than 10 college credits when they were interviewed. The goal of the first interview was to become acquainted with the participants. The second set of interviews included questions about the factors that influenced the participants to participate in STEM dual enrollment. This set of interviews also attempted to discover if the students participated in after-school activities that could be a factor in promoting STEM dual enrollment. In addition, the roles and influences of various people in the participants' lives were discussed in this set of interviews. The second set of interviews also made an effort to understand the academic and environmental factors that have supported the success of these students. The third set of interviews focused on revisiting the previous two interviews and verifying the understanding that I have developed about various aspects of their life with them.

The second phase of the study was conducted using a survey instrument, which was developed based on the finding of the first phase of the study. About 73 students qualified for the survey and 53students completed the survey. This phase of the study was designed to quantify the findings of the previous phase and to generalize the findings with a larger sample population.

After analyzing all the data, I can conclude that the success of my four interview participants in STEM dual enrollment depends on various social, academic, and environmental factors. Some of these findings are consistent with the earlier finding in the literature. Astin and Astin (1992) found that the most consistent social influence on a student's choice of major is the number of friends and peers that students possess or

knew that were seeking a degree in that field of study. Collected data from this mixed method study indicates that their social network was one of the factors that strongly affected the success of these Hispanic students from inner city high schools. That is, they are mostly friends with similar minded people. Most participants indicated that their friends aspire to attend college after high school. Attending classes with their peers have supported their success in the STEM dual enrollment courses.

A solid foundation of parental support. Parental encouragement has been shown to be one of the strongest influences on Hispanic students' early educational aspirations (Arbona & Nora, 2007). Much research demonstrates that parental support is an important factor that influences a student to apply to and enroll in colleges (Gandara,1995; Gandara, 2002; Hossler et al., 1999; Hossler & Stage, 1992; McDonough, 1997; Perna, 2000). The data collected from both phases of this mixed method study confirms the positive influence of parents on the STEM dual enrollment success of the participants. The participants in this study communicated a special understanding of what parental involvement meant for their success in STEM courses and majors. Participants expressed gratitude for their parents' support in providing them space, transportation, and other resources required for becoming successful for their STEM dual enrollment courses.

Further, a family support system for minority students in developing and encouraging a student's interest in science and mathematics as a career is important (Catsambis, 1994). Participants of this study indicated that their parents are not in STEM careers and have little knowledge about the college process and the dual enrollment programs; however, the presence of their parents at various events at school or college,

checking their status for the dual enrollment, and following up on their grades and registration status have encouraged their success in their dual enrollment programs. They also indicated that their parents' pride in their achievements have encouraged them to perform better.

Hossler et al. (1999) provided evidence that having Hispanic parents with low socioeconomic levels or who lack a formal education do not necessarily lead their children to have low college aspirations. This particular factor was confirmed through the data collected in the study. The majority of the students who were successful in the STEM dual enrollment courses were of low economic status and their parents did not have formal college education.

Earlier studies have concluded that having a parent working in an engineering or physical science field is instrumental in forming the belief among Hispanic males that a career in STEM is a realistic goal (Leslie, McClure, & Oacaca, 1998). However, this mixed method sequential exploratory study data indicates that only 11.54% of students have mothers with four-year college degrees and only 5.88% of students have fathers with a four-year college degree. Only 37.7 % of students have at least one family member working in the STEM field. This study can conclude that parental educational level and interest in STEM field cannot be the sole factors for generating STEM interest among Hispanic students from the inner city high schools.

Influence of math and science teachers. Mathematical and science training at the elementary and secondary levels have influenced the academic preparation of students interested in pursuing high school mathematics and science courses and in

pursuing a STEM career (Eamon, 2005; United States Government Accountability Office, 2005). Further, there is evidence that the number of mathematics, science, and English courses taken by high school students serves as a major predictor of choosing a STEM major (Austin & Austin, 1992; Simpson, 2001). The data collected in this study supports these arguments. It was clear from the interviews and from the survey data that the majority of the students who have participated in STEM dual enrollment college courses have taken higher level of science and math course at high school level and they are confident about their abilities to perform well in math and science courses. Further, the success of the interview participants was supported and influenced by their science and math teachers from middle to high school.

Free tuition. Free tuition for the dual enrollment courses was a major influence for most of the participants attending these courses. All four participants of the qualitative phase and 92.45% of students who took survey said their families are unable to pay for these courses if they were not free of cost. Students were encouraged to take college courses each semester because they understood that STEM dual enrollment courses can save them time and money. The majority of the participants expressed that they felt better prepared for college after high school because of their participation in the STEM dual enrollment program.

Self-motivation and desire to defeat the status quo. The literature states that self-efficacy for science and math courses are another supporting factor that encourages students to consider STEM dual enrollment. The study reveals self-efficacy in a different way. Self-efficacy for these inner city Hispanic students was the understanding of the fact that they can achieve the same goals as the students from other affluent school districts.

Self-efficacy for them meant believing in themselves that they can achieve higher education if they continue to work hard. Three of the four participants of the qualitative study struggled to place at college level math test, however it was their belief in themselves that Math is not too difficult for them that they were placed after initial failures.

Besides this, another important factor that had the greatest influence on the success of STEM dual enrollment participants in this study was their motivation to be successful in life and their desire to look for better life and opportunities.

Gonzalez et al. (2003) argue that, in addition to economic circumstances, college decisions of minority and low-income Hispanic students are limited due to a lack of cultural and social capital. Therefore, these students may not have the cultural knowledge or access to informal social networks needed to seek and acquire the necessary STEM dual enrollment related information that could provide easier access to STEM dual enrollment participation and success. However, the students who participated in the study took their low socio-economic status as a challenge that they need to overcome in life. They considered achieving STEM education as a way to a successful life. Students were eager to explore available STEM career opportunities via after school programs, dual enrollment, and clubs.

In addition, the role of mentors, support from the schoolteachers, and guidance from the administration influenced the success of these participants.

No cultural bias. With the exception of a few studies (Hurtado & Carter, 1997; Rendon, 1994; Gloria & Castellanos, 2003; Padilla, Trevino, Gonzalez, & Trevino, 1997; Nora, 2004), investigators of student persistence have dismissed cultural factors. This study has provided similar results. The study participants from both phases of this mixed method research have expressed that their home culture or parents have never pushed them to take STEM courses or helped them develop interest in STEM related fields. Their interest in STEM-related after-school activities and STEM dual enrollment participation was a result of STEM environment at their high school, opportunities provided through their mentors, and influence from their peers from other ethnic groups. Through this study it can be concluded that its not always the home or racial culture that shape the academic pursuits of students, in fact the influence of academic culture that they are surrounded with help them to develop interest in STEM fields. This study provided evidence that Hispanic students can be exposed to STEM academic culture through their school and college environment, and though their social network which consist of mentors, peers and sometimes even their teachers irrespective of the home culture.

The study provided evidence that although there is very limited STEM exposure for these Hispanic students at home, the support from their peers, mentors, teachers and administration has encouraged them continue participating STEM dual enrollment opportunities.

College site distance. Another important factor that played a role in the success of STEM dual enrollment participation of several students, who participated in the study, was the distance they had to travel to come to college site to take classes. The students

who attended schools that are within the 2 mile radius were able to take several courses at the college campus in the evenings, however the students who attend school districts which are more than two miles away, were mostly registered in dual enrollment courses at their high schools. Although these courses are also taught by college adjuncts, it does not expose high school students to the college environment, expectations and rigor.

Research Question 2: How do these factors support the success of Hispanic high students from inner city school districts in STEM dual enrollment activities at a local community college?

I attempted to uncover how these factors influence Hispanic high school students to successfully earning STEM college credits through dual enrollment at a local community college. These factors might not be readily recognized by the extent literature or by the college and school personnel.

Most themes are interconnected. Through the data that I have collected and analyzed in this mixed method study, over a period of two semesters, I have understood that it is not easy to separate social, economic, environmental, cultural or academic conditions that mediate the success of Hispanic students from inner city high schools in STEM dual enrollment programs. Many important themes that have emerged are interconnected. For example, parental support can be considered environmental, cultural, social, and economic at the same time. Another theme that has emerged in the study is that most of these students don't have jobs after school, so they have additional time after school to attend college classes and finish homework. Although most parents don't understand what STEM dual enrollment exactly is, they understand its long-term benefits

of saving money and time. As a result, they allow their children attend college courses rather than work for a short time a job to support their family. This particular theme can be considered as social, economic, or environmental. Similarly, positive influence of friends on the achievement of the study participants can be considered social and environmental at the same time.

Contradictions between the Quantitative and Qualitative Data

A contrast in the qualitative and quantitative data was noticed at a few data points in the study. All four participants of the qualitative phase emphasized the influences of after school STEM activities and of friends and mentors on their success in STEM dual enrollment. In contrast, according to the quantitative data, only 9.4% of survey participants indicated that they participated in afterschool STEM activities, 20.45% of survey respondents indicated that they spent more than six hours with friends who are part to STEM dual enrollment, and only 17.65% of survey respondents credited their mentors for their success in the STEM dual enrollment.

The main reasons for these contradictions are the models of dual enrollment, which different between the qualitative participants and the quantitative survey data respondents. All four qualitative phase participants took STEM dual enrollment classes at the community college campus in addition to the dual enrollment courses offered at their high school for dual credit. On the other hand, 80% of the survey respondents solely took STEM dual enrollment courses at their high school campuses. They participated in the STEM dual enrollment course as encouraged by their high school administration and teachers, instead of their own investigation or the influence of their friends.

The distance that the students have to travel from their high school to college played a major role in opting participation in one DE model over the other. The students from high schools that are closer to the college campus were able to participate in STEM afterschool activities and DE classes at the college after high school. On the other hand, students who were in high schools more than two miles from the college preferred to participate in the DE classes at their high school only. These students only had a few occasions to participate in after school programs or summer activities at the college. However, both sets of students are important since they have fulfilled the requirements to earn college credits.

Another major contradiction in this study was the influence of history of education on the success of Hispanic students in higher education and in STEM majors. Several scholars have argued that the historical non-inclusion of Hispanics and their own resistance to English language has a negative influence on their success in mainstream education and modern STEM career. However, this theme did not emerge at all in the quantitative data collection and analysis.

Cultural incongruence is one of the factors described in the literature about the non-participation of Hispanics in the STEM dual enrollment. However, in this study the cultural incongruence did not affect the success of the participants. The interview participants mentioned the difference in their home culture as compared to their Asian and white peers but it has no negative affect on their success in the STEM dual enrollment. In fact, their friendships with Asian and white students influenced them to consider STEM dual enrollment.

Future Study Recommendations

The STEM dual enrollment programs are designed to increase the rates of high school graduation, college enrollment, and retention of STEM majors, which are ongoing challenges in the United States (Cassidy, Keating & Young, 2010). Dual enrollment courses can provide students with much required, more advanced, rigorous course work to improve high school education and prepare students for the academic and behavioral expectations of college. In addition, the programs can promote high school students motivation and engagement in their learning with more interesting classes, the opportunity to attend classes on college campus (in many cases), and experience higher expectations and success (Karp & Jeon, 2008; Lerner & Brand, 2006). In addition, students who are able to take classes on a college campus learn about and become accustomed to the college environment as they master logistical issues such as locating the registrar's office and the bookstore.

Many studies have revealed a direct relationship between participation in dual enrollment and high school graduation and college enrollment. Students who participated in dual enrollment were more likely than their non-participating peers to earn a high school diploma, to enroll in college in general, and at a four-year institution in particular, and to enroll in college full time (Karp et al., 2007). However, there is a need for longitudinal research to investigate whether the factors that support the success of these inner city high school students in STEM dual enrollment, also help them in becoming successful matriculated students in STEM majors at various colleges.

One of the goals of STEM dual enrollment program is to promote STEM careers among the Hispanic student population who are underrepresented in these majors and careers. Based on this current study, I would recommend conducting a longitudinal qualitative study to study how STEM dual enrollment has supported their interest in STEM majors and careers, the number of these students who major in STEM after graduating from high school, and how these students become successful in STEM careers after graduating from college. The study should also be designed to compare the income pattern of these dual enrollment participants in the careers they choose to the non-STEM majors.

Recommendations for Policy and Practice

To remain competitive as a nation in the technology world, it is important that we increase participation of Hispanic students in STEM majors, beginning as early as high school through dual enrollment.

Based on the understanding of various social, economic, environmental, cultural, and academic factors, several recommendations can be made to improve the participation and success of Hispanic students in STEM dual enrollment program. Although this study was conducted with inner city Hispanic students, these recommendations can be theoretically adapted to other minority students in other districts as well.

School personnel need to develop programs that can provide more opportunities for parents to get involved in their children's education. The study clearly indicates that the students perform better when their parents actively participate in their school activities. School districts should make an effort to educate parents about the financial

and timesaving benefits of STEM dual enrollment after high school graduation. These programs should also provide education about college finances and usefulness of the earned degrees.

This study further indicates that the students were successful in taking STEM dual enrollment when they had fewer responsibilities after school. Most of the students in the study indicated that they do not have a job after school, which provides them enough time to take the dual enrollment classes and to concentrate on completing homework. High schools and colleges should provide opportunities for these students so they can learn and earn at the same time. Suggestions include offering paid summer research opportunities and workshops with various STEM organizations and supporting such activities at two and four-year colleges.

After-school STEM clubs such as Robotics team, Math club or Engineering clubs at high schools and two-year local colleges can provide a safe haven for the inner city Hispanic high school students to experiment and practice the learned skills in various STEM classes. These clubs can also provide opportunities to these students from inner city high schools to learn materials that are not usually part of their school's curriculum but are required to compete with students from affluent school districts.

Peer mentoring programs that can influence the success of Hispanic students from inner cities in STEM dual enrollment programs. These programs can also enrich their cultural heritage and social networks and become successful in college.

Implications for the Community College Leaders

Community college leaders can use this study in making several decisions about their policies regarding high schools and their curriculum. It can be useful to look into opening more satellite campuses for community colleges that can serve school districts which are remote from the main campus of colleges.

It is difficult to build self-efficacy for science and math courses among students when they are in college, and hence difficult to get them interested in STEM areas. However community colleges can work on developing hands on workshops and other learning opportunities for young students in collaboration with the school districts to help build self-efficacy for STEM majors and careers among the young students.

Community colleges can also develop programs and orientations to educate parents of incoming students regarding STEM education and careers.

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Appendix A

Interview Questions

Part I

1. Tell me about you and your family?
2. When did you start taking interest in technology and other STEM related activities?
3. What do you want to be when you grow up?
4. What does your parents and siblings think about your choices for education and career?
5. How do you think college dual enrollment will help you to achieve your dreams?
6. What role did student support services such as advisement, tutoring, and mentoring played in promoting STEM interest for you?
7. How did college staff and faculty help in promoting STEM dual enrollment interest for you?
8. What role do parents and role models play in encouraging students to consider STEM dual enrollment opportunities?
9. How does peer pressure affect the participation of Hispanic students in STEM dual enrollment activities/program?

10. What after school/out-of-school activities nurture and sustain one's interest in STEM dual enrollment? How?

11. What extra-curricular activities in school inspire students to consider STEM dual enrollment activities?

Part II

1. You know very few Mexican, Puerto Rican or Dominican guys get through college; why do you think you were able to do so when so many of your Latino peers have not made it.

2. What do you think could be done to support college education for Latino youth?

3. If you think it's a question of interest and motivation, or you think something else is going on?

Appendix B

Survey Instrument

General Information and Background

1. What high school district are you currently attending?

   PCTI
   Passaic High School
   Paterson School District
   Hawthorn High School

2. What is your Current grade level?

   9
   10
   11
   12

3. Were you born in the United States?
   Yes
   No

4. If you answered "**Yes",** please ignore this question and move to question # 5. If you have answered "**No**" to the above question. Please tell us when did you move to the United States?
   Before Kindergarten
   Elementary School
   Middle school
   High School

5. How did you learn about the STEM dual enrollment program?
   High school Administration/ teachers
   Friends
   After school activities such as Robotics team or a club
   Parents /Siblings
   PCCC website

6. When did you start participating in STEM dual enrollment program?

Freshman year of high school
Sophomore year of high school
Junior year of high school
Senior year of high school

7. What encouraged you to participate in the STEM dual enrollment Program? Check more than one.
   To save money
   To save time
   To explore STEM
   To become better at Math
   To be with Friends
   All of the above
   None of the above

Parental Information

8. Are your parents currently living in the United States?
   Both are here.
   Mother yes; Father No
   Father yes: Mother No
   Both live out of the United States

9. Were your mother /caregiver raised in the United States?
   Yes
   No
   I don't know

10. Were your father/caregiver raised in the United States?
    Yes
    No
    I don't know

11. On a scale of 1-5, 5 being absolutely fluent and 1 being not fluent at all. How fluent are your mother/caregivers in the English language?
    1
    2
    3
    4
    5

12. On a scale of 1-5, 5 being absolutely fluent and 1 being not fluent at all. How fluent are your father/caregivers in the English language?
    1
    2
    3
    4
    5

13. As far as you know what is the highest level of education that your mother/ caregiver has finished and got credit for?
    Less than High School
    High School Diploma
    Some college course
    Associate Degree
    Bachelor's degree or higher
    Don't know

14. As far as you know what is the highest level of education that your father/ caregiver has finished and got credit for?
    Less than high school
    High School Diploma
    Some college course
    Associate Degree
    Bachelor's degree or higher
    Don't know
    Not applicable

15. Does anyone in your family work in any STEM related professions such as nursing, doctor's office, at an Engineering firm, etc.? Check all that applies
    Mother
    Father
    Brother
    Sister
    Cousin
    Grand mother
    Grand Father
    Other……
    None of the above

Economic Factors

16. When compared with American families, in general, would you say your family income is far below average, below average, average, above average or far above average?
    Far below average
    Below average
    Average
    Above average
    Far above average
    Don't know

17. On a scale of 1-5, 5 being always and 1 being never. Have your parents/caregivers financial status restrained your academic reach out?
    1
    2
    3
    4
    5

18. On a scale of 1-5, 5 being very important and 1 being not important at all. How important you think it is to have good education for yourself for getting ahead in life?
    1
    2
    3
    4
    5
19. On a scale of 1-5. 5 being very important and 1 being not important at all. How important do you consider to change your current financial status for a better future?
    1
    2
    3
    4
    5

20. Would you have participated in STEM dual enrollment if you had to pay for these college credits?
    Yes
    No
    I don’t know.

Environmental Factors

21. How often does your parents /care givers come to participate in your school activities?
    Always
    Very Often
    Not very often
    Never

22. On a scale of 1-5, 5 being very involved and 1 being not at all involved. How involved are your parents/care givers in your dual enrollment effort?
    1
    2
    3
    4
    5

23. On a scale 1-5, 5 being completely understand, 1 being not at all. To what extent your parents/caregivers understand the importance of STEM dual enrollment?
    1
    2
    3
    4
    5

24. On a scale of 1-5. 5 being always and 1 being never. How often your parents encouraged you to continue with the STEM dual enrollment?
    1
    2
    3
    4
    5

25. On a scale of 1-5. 5 being always and 1 being never. How often your parents provided transportation to help you continue with the STEM dual enrollment?
    1
    2
    3
    4
    5

26. On a scale of 1-5. 5 being always and 1 being never. How often your parents provided academic resources and support to help you continue with the STEM dual enrollment?
    1
    2
    3
    4
    5

27. On a scale of 1-5. 5 being always and 1 being never. How often your parents simply kept an eye on your progress in STEM dual enrollment to show their support?
    1
    2
    3
    4
    5

28. Where do you attend STEM dual enrollment courses? Check all that applies
    At my high school during the school day
    At my high school after the school day
    At the college campus after high school

If you attend STEM dual enrollment classes at the college, then answer the next three questions, otherwise skip to question # 31

29. How far is the college from your high school?
    Less than a mile
    1-2miles
    More than 2 miles

30. How do you get to college?
    I drive
    I walk
    My parents provide me transportation
    I take public transportation

31. Do you have any other friends/siblings /cousins taking these classes at the college campus with you? Please check all that applies
    High School Friends
    Cousins
    Brother

Sister
None of the above

32. On a scale of 1-5. 5 being extremely influential and 1 being not at all influential. To what extent having your friends /siblings/cousins with you in class have influenced your success in STEM dual enrollment courses?
    1
    2
    3
    4
    5

Cultural Factors

33. On a scale of 1-5. 5 being always and 1 being never. As a child, how often did you go to play ground in the neighborhood with your parents/caregiver?
    1
    2
    3
    4
    5

34. On a scale of 1-5. 5 being always and 1 being never. As a child, how often did you go to the public library with your parents/caregiver?
    1
    2
    3
    4
    5

35. On a scale of 1-5. 5 being always and 1 being never. As a child, how often did you go a zoo or museum with your parents/caregiver?
    1
    2
    3
    4
    5

Academic Factors

36. On a scale of 1-5. 5 being highly motivated and 1 being not motivated at all. How self- motivated are you to continue to participate in the STEM dual enrollment program?

1
2
3
4
5

37. On a scale 0f 1-5, five being the highest. How important it is to your parents/caregivers that you do well in your academic goals?
    1
    2
    3
    4
    5

38. On a scale of 1-5, 1 being very interested and 1 being not interested at all. How interested are you in pursuing a STEM major?
    1
    2
    3
    4
    5

39. How do you think STEM dual enrollment will help you in future?
    Help me pursue a degree in STEM field
    Save money for college
    Save me time required to finish college degree
    All of the above

40. How much time do you spend in studying for your STEM dual enrollment courses per week after class?
    0- 3 hours
    3-5 hours
    More than 5 hours

41. On a scale of 1-5 . 5 being extremely difficult and 1 being very easy. How difficult do you find your math courses at high school
    1
    2
    3
    4
    5

42. What is the highest level of math course you have completed at the high school before starting STEM dual enrollment program?
    Algebra I
    Algebra II
    Trigonometry
    Statistics
    Pre-Calculus or Above
    Not Applicable

43. On a scale of 1-5 . 5 being extremely difficult and 1 being very easy. How difficult do you find your science courses at your high school?
    1
    2
    3
    4
    5

44. On a scale of 1-5. 5 being extremely influential and 1 being not influential at all. How influential your science teachers were to promote STEM interest in you?
    1
    2
    3
    4
    5

45. Do you participate in any other after/summer school activities? Check all that applies
    Attend Upward bound program
    Attend after school workshops at various colleges and Universities
    Attend summer program at different four year and two year colleges
    Participate in Robotics or other STEM clubs at high school
    None of the above
    All of the above

46. On a scale of 1-5. 5 being always and 1 being never, how often do you attend tutoring at college to become successful in dual enrollment courses?
    1
    2
    3
    4
    5

Social Factors

47. Who encouraged you to participate in STEM dual enrollment?
    High school Administration/ teachers
    Friends
    Mentor
    Parents /siblings

48. Who would you contribute your STEM dual enrollment success to? Check all that applies
    Friends taking STEM dual enrollment with you
    High School administration / teachers
    A mentor
    College staff and faculty
    Support services at college

49. How much time do you spend with friends per week who are not enrolled in STEM dual enrollment with you?
    0- 2 hours
    3-5 hours
    6 or more hours

50. How much time do you spend with your friends, outside the classroom, who are with you in your Dual enrollment courses?
    0- 2 hours
    3-5 hours
    6 or more hours
    Not applicable

51. How much time do you spend with your friends, outside the classroom, who are with you in your AP/ Honors courses?
    0- 2 hours
    3-5 hours
    6 or more hours
    Not Applicable

52. On a scale of 1-5 , 5 highly supportive and 1 being not supportive at all. To what extent your friends, who are not part of STEM dual enrollment, are supportive of your efforts for the college courses?
    1
    2
    3
    4

5

53. On a scale of 1-5, 5 being always and 1 being never. How often does your parents/caregivers talk about your career choices?
    1
    2
    3
    4
    5

54. Do you have a role model for a STEM career?
    Yes
    No

If you have answered 'No' to the above question skip to question # 56

55. Who is your Role model? Please check all that applies
    A teacher
    Mother
    Father
    Guidance counselor
    A caregiver
    A well-known personality
    Other

56. On a scale of 1-5. 5 being highly influential and 1being not influential at all. To what extent a mentor in your life does has influenced your decision about STEM dual enrollment?
    1
    2
    3
    4
    5

57. Check all that applies in the following question. What responsibilities /obligations you have after school?
    Helping parents with talking care of siblings
    Helping parents with house hold chores
    After school curricular activities
    After school Job
    All of the above
    None of the above

If one of your answers in question # 57 is "After school job", then answer the next two questions otherwise skip to question # 60

58. Where do you work?
    On campus
    Off-Campus

59. How many hours do you usually work per week?
    5- 10 hours
    11-15 hours
    16- 20 hours
    More than 20 hours

60. Do you have a leadership role at your high school?
    Yes
    No