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Examining Academic Success for Underrepresented Minority Science Technology Engineering and Mathematics Students within Hispanic Serving Institutions and Predominantly White Institutions

Denise Romero
University of Northern Colorado

UNIVERSITY OF NORTHERN COLORADO
Greeley, Colorado
The Graduate School

EXAMINING ACADEMIC SUCCESS FOR UNDEREPRESENTED: MINORITY SCIENCE TECHNOLOGY ENGINEERING AND MATHEMATICS STUDENTS WITHIN HISPANIC SERVING INSTIUTIONS AND PREDOMINANTLY WHITE INSTITUTIONS

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Accepted by the Thesis Committee:

_____

Rebecca Beals, Ph.D., Research Advisor

_____

Angela Henderson, Ph.D., Committee Member

Accepted by the Graduate School

_____

Linda L. Black, Ed.D.
Associate Provost and Dean
Graduate School and International Admissions

ABSTRACT

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With the higher enrollment among underrepresented minority students (URMs) in higher education, the unique challenges first generation students face has been highly studied, especially in regards to the issue of retention and academic success. That is, how do higher education institutions and professionals best academically support these students through the completion of their undergraduate degree? This paper seeks to compare the identity development of URMs within Hispanic serving institutions (HSI) and predominantly white institutions (PWI) by building on academic literature in higher education addressing identity development and achievement for URMs pursuing an education in STEM. This study offers important insights into the role of mentorship and hands-on experiences in the development of educational outcomes from 211 URMs in STEM. Using comparison of means and multiple regression models, I analyze the isolated effects of each of these concepts on the overall educational achievement of students, paying attention to the comparative effects of institution type (HSI vs. PWI) to understand the role of these cultural environments on identity development and academic success for URM STEM students. Suggestions for how to appropriately frame STEM cultural environments for the overall success of URMs is addressed.

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TERMINOLOGY/ACRONYMS

URMs: Underrepresented Minority Students

STEM: Science, Technology, Engineering, Mathematics

PWI/s: Predominantly White Institution/s

MSI/s: Minority Serving Institution/s

HSI/s: Hispanic Serving Institution/s

HBCU/s: Historically Black Colleges and Universities

PMPS**:** Promoting Minority Participation in the Sciences Program

GPA: Grade Point Average

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CHAPTER I

INTRODUCTION

There is evidence that scientific and technological innovation play a crucial role in the advancement of the nation's health, economy, and well-being for all citizens (Watkins & Mazur, 2013). With the higher enrollment among underrepresented minority students (URMs), it is essential that institutions and educators foster learning opportunities for those interested in pursuing an education in science, technology, engineering, and mathematics (STEM). Previous studies by the U.S. Department of Education, and National Center for Education Statistics have demonstrated wide gender gaps between males and females in the enrollment of STEM majors at 4-year institutions (Bae, Choy, Geddes, Sable, & Snyder, 2000). In higher education, the gap has shown a significant disproportion among underrepresented, women, and students of color (Espinosa, 2011).

Previous research has established that women of color are largely underrepresented within scientific fields and has found that they have experienced gender and ethnic microaggressions at predominantly male and white classrooms (Sosnowski, 2002). Similarly, academic literature on first generation college students and individuals of color has identified challenges they face that their peers do not (Moreno, 2016). For example, four-year institutions continuously disadvantage minority students who identify as first generation, students of color, and low income (Quaye & Harper, 2015).

These unique challenges first generation students face often have been highly studied for focus on the issue of retention. That is, how do higher education institutions and professionals best academically support these students through the completion of their undergraduate degree? Major challenges that URMs often face relate to guilt when they feel they are putting their needs before the needs of their family, in terms of financial support or the notion that they are leaving their family behind (Moreno, 2016). Hurtado (2007) demonstrated that the psychosocial navigation by URMs in STEM fields influences their personal identity development, and it is important consider the socialization of these students when examining the challenges faced during their undergraduate career.

Historically higher education institutions were created with the ideals to serve students who identified as white, males, and were economically affluent (Quaye & Harper, 2015). Most predominantly white institutions (PWIs) have a history of serving a homogenous population with attitudes and behaviors that previously provided limited access and exclusion to students of color (Thelin, 1985). Because of the historically segregated environment, many campuses often preserve long-standing benefits for a particular student group, and its legacy can impact the climate for diversity. For example, research has suggested that predominantly white colleges and universities construct a culture or climate that evoke challenges for ethnic minority students (González, 2002). Early examples of research found that Black students are often affected by the feeling of intimidation by their professors (Kraft, 1991), and Hurtado (1994) points out that URMs interactions with faculty influence their perception of the campus climate.

With the increase in diverse student enrollment, as part of their mission, Hispanic serving institutions (HSIs) have emphasized their commitment to represent an alternative opportunity, along with cultural and academic development for these students (Hurtado, 1994). Research has examined differences in outcomes for URMs in STEM who have attended PWIs as compared to students who have attended HSIs. According to Carlone and Johnson (2007), faculty practices can often discourage URMs in the sciences, which is crucial when comparing the academic development and environment of a PWI versus an HSI. Exploring the distinctions among these institutions can provide a better understanding of URM student's science identity, and its impact on their academic success.

The purpose of this study was to examine the academic development of underrepresented minority students in science fields, especially as it relates to academic self-concept, self-efficacy and science identity and their impact on academic outcomes. This study offers some important insights into the relationships in both a predominantly white institution (PWI) and a Hispanic serving institution (HSI). The role of mentorship and hands-on experiences were considered in-depth. Understanding how underrepresented minority students are developing their academic identity through STEM fields is important because it allows higher education institutions to identify their needs, and how to better support these students in order to retain them and provide opportunities for achievement in their academic aspirations.

Hypotheses

H1 Students at Hispanic Serving Institutions (HSIs) experience higher levels of positive educational outcomes compared to students at predominantly white institutions (PWIs).

H2 Research and mentorship will be positively associated with science identity and students at HSIs will report higher levels of science identity than students at PWIs.

H3 Students with higher levels of academic self-concept will also report more positive educational outcomes.

H4 Research and mentorship will be positively associated with self-efficacy and students HSIs will report higher levels self-efficacy than students at PWIs.

CHAPTER II

LITERATURE REVIEW

Inequality in Higher Education

Higher education has a long-standing culture of resistance with limited access and exclusion towards underrepresented minority students (URMs) (Hurtado, Clayton-Pedersen, Allen, & Milem, 1998; Thelin, 1985). Higher education institutions traditionally serve majority of students who come from white middle-class families and who identified as male, heterosexual, and Christian (Quaye & Harper, 2015). Since higher education traditionally serves this specific population, engagement and support of students focused primarily on this population, often referred to as primarily white institutions (PWIs). For example, student services and programming were not concerned with diverse student bodies, due to majority of students identifying within the same cultural background.

Over the years, American education has become increasingly diverse as underrepresented minority students (URMs) gained access to enrolling in higher education institutions (Ibarra, 2001). The G.I. Bill of 1944 is associated with the expansion of higher education for non-whites. It provided an opportunity of higher education to a diverse group of working class men that previously had been excluded or had limited participation (Neiberg, 2007). Resources provided by the G.I. Bill, along with the passage of the 1965 Civil Rights Movement, contributed to a significant shift in the

demographics of higher education institutions, largely as a result of increased opportunities for both women and racial/ethnic minority students. Yet, even with these changes, men traditionally received enrollment preference over women, which reduced their college choices for women (Neiberg, 2007).

Previous research has challenged the notion of equal access in higher education. For example, although the G.I. Bill extended benefits to a diverse group of people regardless of gender or race, the disproportionate distribution of benefits largely benefited white G.I.s and primarily white institutions (PWIs) (Humes, 2006; Katznelson, 2005; Olson, 1974). Opportunities for choice among colleges and universities were slim, and URMs were often steered towards menial jobs (Neiberg, 2007). With a rise in URMs entering PWIs, understanding how to get beyond traditional cultural environments that focus on the needs of primarily white students without understanding needs of students from non-traditional cultural backgrounds is necessary (Ibarra, 2001; Quaye, & Harper, 2015).

With the increased enrollment of URM students in PWIs, understanding the unique challenges these students face is necessary (Moreno, 2016). For example, a number of studies have found that PWIs continuously disadvantage minority students who identify as first generation, students of color, and low income (Quaye & Harper, 2015). For example, research indicates that often when URMs enter PWIs, they find themselves feeling disconnected and isolated within the institution. For example, studies have found that African American and Latino students find white colleges and universities to be alienating, hostile, isolating, and less supportive (Allen, 1985, 1988; Hurtado, Carter, & Spuler, 1996; Loo & Rolison, 1986). Furthermore, Smedley, Myers,

and Harrell (1993) demonstrated that ethnic minorities attending PWIs can be negatively affected by the social climate of the institution, which creates an additional burden of stress on their academic adjustment. In short, evidence suggests that the culture or climate of PWIs can create challenges or obstacles for underrepresented minority students.

Organizational Culture in Higher Education

It is important to understand the organizational culture of higher education institutions when examining the academic success of URMs, especially in terms of how the organization influences identity development of students within the organization. Often times, higher education institutions focus their attention on recruiting a diverse student body while developing retention strategies however, not enough attention is placed on examining what happens to these students when they are on campus (Beals, 2016). That is, how do higher education institutions take the initiative to understand how institutional contexts promote or inhibit the academic success of URMs?

Traditionally, higher education institutions have placed a value and privilege on middle class families while disadvantaging those from non-traditional backgrounds. Research has shown that URMs entering a white dominated environment often find themselves as outsiders and feeling like they do not belong (Seymour & Hewitt, 2000). Despite their personal cultural values and beliefs, URMs often adjust their identity in order to fit into the institutional culture.

Student identity development is associated with the broader university environment and mission. Research has shown URMs enter higher education institutions with challenges and it is unreasonable to accept that these students must mold themselves

into the institution just to fit in or be academically successful. The overall organizational culture of an institution can hinder or encourage academic success for URMs. According to Barr and Tagg (1995) knowing how students learn, understanding their challenges, and faculty-student interactions are essential in promoting the academic development of students. It creates a space for students to feel acknowledged, supported, and validated as a student. The overall mission of institutions should not just be about enrolling these students but identifying how institutional contexts can be reframed to promote the inclusion of all students on campus. Primarily, the university context needs to emphasize the development of identity–including academic self-concept, self-efficacy, discipline specific identity– for all students, regardless of background.

Importance of Hispanic Serving Institutions

With the number of Latino students continuing to grow, Hispanic Serving Institutions (HSIs) have played a great role in enhancing their access to URM students and fostering success in higher education (Santiago, 2006). According to the federal government, HSIs are defined as nonprofit institutions of higher education with 25 percent or more total undergraduate Hispanic full-time equivalent student enrollment (U.S. Department of Education, 2018). While HSIs are not specifically established to only serve a particular population and rather emerge as a result of changing demographics, they represent a critical pathway for Latinos to take part in higher education (Santiago, 2006).

What is distinct about student experiences at HSIs compared to PWIs? URMs are drawn to HSIs because of its accessibility, and affordability, which is a crucial role in enhancing students' academic and professional development (Allen, 1985, 1988).

Additionally, students at HSIs tend to be more satisfied with their sense of community, and with student and faculty interactions in comparison to students at PWIs (Outcalt & Skewes-Cox, 2002). The academic literature on HSIs has revealed that these institutions promote more inclusive climates which fosters a relationship between URMs and the institution (Abraham, Lujan, López, & Walker, 2002; Zamani, 2003).

Based on this literature, I propose the following hypothesis:

H1 Students at Hispanic Serving Institutions (HSIs) experience higher levels of positive educational outcomes compared to students at predominantly white institutions (PWIs).

Underrepresented Minority Students in Science Technology Engineering and Mathematics

Previous research has shown a concern over the number of students enrolling in STEM majors at colleges and universities (Daempfle, 2003; Seymour & Hewitt, 2000). Data from the National Center for Education Statistics indicate a gap among underrepresented minority students in STEM enrollment and degree attainment (Whalen & Shelley, 2010). Minority students, particularly African Americans and Latinos, pursue degrees in STEM at a lower rate in comparison to their White and Asian peers (Snyder & Hoffman, 2001; Snyder, Hoffman, & Tan, 2006). One explanation for the discrepancy between URM students who enroll in STEM majors and the number of them that complete their degree focuses on the environmental factors external to the college classroom that impact URMs motivation to pursue STEM degrees. Research indicates that financial burdens contribute to the high rates of dropping out compared to their peers in the same field (Whalen & Shelley, 2010). Since racial/and or ethnic background and social class are inherently interconnected, (Zambrana & MacDonald, 2009) these students

are often the first in their family to experience higher education, and have unique needs associated with receiving the adequate institutional support to succeed.

Furthermore, an intersectional approach to understanding the needs of students is essential (Shields, 2008). For example, women in STEM fields have reported lower levels of self-confidence which ultimately leads to lower levels of career aspirations (Rogers, 1993) and ultimately higher levels of attrition. Beyond this, women often experience lower levels of self-confidence associated with unique classroom experiences, including lower levels of engagement within the classroom for a variety of reasons (Henes, 1994). Additionally, women of color in STEM confront challenges such as experiencing gender and ethnic micro-aggressions in predominantly male classrooms (Sosnowski, 2002) as a result of the academic culture that is reinforced by white men (Espinosa, 2011). Seymour & Hewitt (2000) demonstrated that unique challenges such as feelings of isolation, invisibility, and feeling like they do not belong is associated to their gender and ethnicity.

A number of strategies have been developed in an effort to meet the needs of URMs in higher education. For example, evidence has suggested that mentoring has a positive effect on sustaining the participation of student in the sciences as well as the engagement in research projects (Pfund, Pribbenow, Branchaw, Lauffer, & Handelsman, 2006). A great deal of previous research on mentoring has focused on the effects research opportunities provide to undergraduate students. It has been shown that students who engage in research programs display a growth in scientific self-efficacy, and scientific identity (Hurtado, 1994; Laursen & Swartz, 2010).

Science Identity

The psychosocial navigation by URMs in STEM fields influences their personal academic identity development which is a powerful notion when students integrate to the university culture (Hurtado, 2007). Students entering higher education institution learn how to navigate the institution and through their social interaction they begin to develop their academic identity. How a student navigates their field is in turn a direct reflection of their own self-identity reflection. Students navigate through a series of questions and self-reflection during the first stages at an academic institution in order to identify who they want to be and how they want to be perceived (Hurtado, 2007). URMs entering STEM fields explore how their own self-identity influences their scientific identity.

Science identity refers to the discipline specific identity development that occurs for students pursuing a STEM field degree. Both academic identity, and science identity represent how students view themselves within their field and can impact their professional development through the opportunities the institution fosters. A model developed by Carlone and Johnson (2007) focuses on the experiences of women of color in higher education who persisted at a PWI (Espinosa, 2011). The model places an emphasis on how these women developed and made meaning of their gender/racial, ethnic, and academic identities while pursuing a STEM career. The model addresses how these women distinguished their success in science related fields. Science identity is developed throughout time as the student learns and makes meaning of their personal experience through the STEM field.

There are three main components that embody a strong science identity-competence, performance, and recognition, which are affected by one's self-identity

within race, gender, and ethnicity (Carlone & Johnson, 2007). For example, a student with a strong science identity is competent and therefore can demonstrate knowledge and understanding of science materials. This student shows eagerness while understanding the scientific world, puts their skills to practice and has the necessary skills to perform and interact in various scientific settings. Furthermore, the student recognizes themselves, and in addition others recognize their work and can identify them as a "science person". Based on the model one cannot claim an identity on their own. For example, someone with a strong science identity may consider themselves highly within the scientific world, but also has to be considered highly by others within the dimensions of competence, performance, and recognition (Carlone, & Johnson, 2007). Identity is formed through the combination of past experience and interactions. It is not just about how some individuals feel and see themselves, but also how others recognize them.

Based on this literature, I propose the following hypothesis:

H2 Research and mentorship will be positively associated with science identity and students at HSIs will report higher levels of science identity than students at PWIs.

Academic Self Concept

As students immerse themselves in their academic journey a personal conception is adopted that measures a student's self-perception about their ability and confidence to continue with their academic career (Correll, 2001). Academic self-concept is defined as "attitudes, feelings, and perceptions relative to one's intellectual or academic skills" (Lent, Brown, & Gore, 1997, p.308). According to Correll (2001) one must feel competent in their skills in order to continue pushing themselves and commit to pursuing a career. She refers to this concept as a "self-assessment" (Correll, 2001, p. 1700) task

that is legitimized when a there is a positive reinforcement. For example, when a student receives positive feedback from their instructor it is more likely for their self-confidence to increase due to the positive praise they have received for their work. Previous research has established that URMs enter higher education institutions with challenges, and when these students enter STEM field majors they have a higher risk of not finishing a science related degree (Plecha, 2002). The relationship and interaction that they establish with their professors can reaffirm their skills and allow them to know they are adequately putting their skills into practice. However, this requires that professors be available and able to interact with their students in a meaningful way.

Research has shown when students build a connection with their professors and allow for a mentorship relationship to occur it is more likely a students' academic self-confidence will increase (Plecha, 2002). The interaction between faculty and students is a key component to academic self-concept because when students seek feedback from their professors it allows them to learn and improve their overall skills, while reaffirming their sense of belonging. This research is correlated with Astin (1999)'s work who shows academic engagement between faculty and students is a positive indicator of academic performance as well as, integrating students to campus. The benefits of such interactions can allow for the development of a positive self-concept, which can ultimately influence student's confidence in academia.

Based on this literature, I propose the following hypothesis:

H3 Students with higher levels of academic self-concept will also report more positive educational outcomes.

Self-Efficacy

Like self-concept, self-efficacy can predict and explain one's capability to engage in higher education. Self-efficacy focuses on the student's convictions and their beliefs that they can perform tasks within their academic duties (Schunk, 1981). The concept places more on an emphasis on student's ability to apply their skills, and what they believe they can accomplish with such traits. According to Bandura, (1997) past experiences with academic material can indicate self-efficacy judgement. Success can highly influence and strengthen self-efficacy, while failures can undermine a student's ability to engage with the material. If a student holds self-confidence and are capable of interacting with the academic material, they are more likely to continue their academic journey. With regards to scientific majors, students enter a fast pace field that requires commitment and attention. URMs enter college at a wide variety of stages, but their ability to acknowledge they can accomplish a task is a crucial component of their academic scientific careers.

Based on this literature, I propose the following hypothesis:

H4 Research and mentorship will be positively associated with self-efficacy and students HSIs will report higher levels self-efficacy than students at PWIs.

CHAPTER III

METHODOLOGY

Sample-Promoting Minority Participation in the Sciences

Funded by the National Science Foundation, Promoting Minority Participation in the Sciences (PMPS) is located in the Southwest and serves across 4 states, including Arizona, Utah, Nevada, and Colorado. Program evaluations since 1991 demonstrate that PMPS successfully graduates underrepresented students in STEM fields. PMPS operates by funding small, individual research projects written by faculty who provide undergraduate students the opportunity to work on their research projects and present in regional and national research conferences. Once faculty proposals are awarded money, the faculty mentor supports students through all personal, professional, and academic mentoring. As a requirement of being funded, all faculty and undergraduates are required to submit project reports. PMPS works with undergraduate and graduate students from all levels. The admission criteria for PMPS are flexible. For example, there are no GPA requirements for students to receive admission into the program like many other research opportunity programs for undergraduates.

For this research, I used secondary data that was provided by the PMPS program. As part of their 2012-2016 evaluation, PMPS had distributed an online survey to all students within each of the 4 schools PMPS serves using *Opinio* online survey software. A total of 211 students completed the online questionnaire. Survey questions were

developed primarily from themes that emerged from an in-depth interview project with program students and faculty (Beals & Ibarra, 2015, 2017) as well as some from the Freshman Survey using the UCLA Higher Education Research Institute (HERI) questions (Eagan et al., 2017).

Participant Demographics Information

Promoting Minority Participation in the Sciences

Descriptive demographic information, including gender, race, family income, and future plans are presented in the following Tables 1 and 2. To summarize, a total of 211 student respondents participated in the PMPS student survey. Out of the 211 students, there were a total of 112 students who belonged to a PWI, 24 males and 84 females. Out of the 211 students there were a total of 99 students who belonged to an HSI, 26 males and 73 females. Of the 211 student respondents, the primary self-identification included 78 Hispanic or Latino, 18 Black/African American, 7 American Indian, 5 White, and 4, Asian American.

Table 1

PMPS Student Gender

PMPS Student Gender	Predominantly White Institution	Hispanic Serving Institution
Male	24	26
Female	84	73
Total	112	99

Table 2

PMPS Student Race/Ethnicity

Race	Frequency	Valid Percent
Hispanic or Latino	78	65%
American Indian	7	6%
Asian American	4	3%
Black/African American	18	15%
White	5	4%
Other	8	7%
Missing	91	43%
Valid N	120	100%
Total N	211	

Table 3 summarizes total family income for students participating in the PMPS program at both PWIs and HSIs. Students in the PMPS sample were primarily from lower income backgrounds. A majority (63%) of PMPS students at both PWIs and HSIs

indicated a total family income between $10,000 and $30,000, with an additional 8% indicating less than $10,000 in family income per year at PWIs and 5% in this income range at HSIs.

Table 4 summarizes respondent's parental education for students participating in the PMPS program from both a PWI and an HSI. Students in the PMPS primarily identified as having parents with just a high school degree. A majority (49%) of PMPS students self-identified parent 1 and 43% identified parent 2 between some high school and high school degree. Additionally, 27% of students in the PMPS program identified as having parent 1 with at least a higher education degree (Bachelors or more) and 28% as having parent 2 with at least a higher education degree.

Table 3

PMPS Student Total Family Income

Total Family Income	Predominantly White Institution	Hispanic Serving Institution
Less than $10,000	8	5
$10,000-19,000	19	21
$20,000-29,000	44	42
$30,000-39,000	18	17
$40,000-49,000	3	6
$50,000-59,000	4	4
$60,000-69,000	4	5
$70,000-99,000	-	-
Total	100%	100%

Table 4

Parents Education

Parents Education	Parent 1	Valid Percent	Parent 2	Valid Percent
Some High School	29	21%	29	21%
High School Graduate	38	28%	30	22%
Some College	19	14%	23	17%
Associates Degree	8	6%	10	7%
Bachelor's Degree	24	18%	21	16%
Master's Degree	7	5%	11	8%
Ph.D.	6	4%	5	4%
Don't Know	6	4%	6	4%
Missing	74	54%	76	56%
Total N	137	100%	135	100%
		Total N = 211		

Table 5 provides insight to PMPS student respondent's desired degree. Students in the PMPS program primarily identified as desiring to continue with their higher education. A majority (62%) of PMPS students at both PWIs and HSIs indicated they desire a Ph.D. and an additional 20% indicated they desire a master's degree.

Table 5

PMPS Student Desired Degree

Desired Degree Percent	Predominantly White Institution	Hispanic Serving Institution
Bachelor's Degree	3	12
Master's Degree	24	16
Ph.D.	64	59
Professional Degree	9	12
Total	100%	100%

Dependent Variable

Educational Outcome

One item from the survey, GPA on a 4.0-point scale, was used to measure educational outcomes. GPA was used to measure this construct, on a continuous scale from 0 to 4.0. A series of multivariate linear regression models were performed in order to assess the impact on variation in GPA influenced by academic self-concept, science identity and self-efficacy among students participating in the program at PWIs and HSIs.

Independent Variables

Academic Self-Concept, Science Identity, Self-Efficacy

To examine the factors that influence educational outcomes for URMs from HSIs and PWIs participating in the PMPS program, I included measures for three major concepts: academic self-concept, science identity, and self-efficacy. Each of these concepts were measured using three separate indicators for the concept.

Indicators related to academic self-concept were selected from the PMPS program survey data where student respondents were asked to "rate their traits as compared with the average person" ranging from below average to above average for mathematical ability, self-confidence, and drive to achieve.

Indicators related to science identity were selected from the survey data where student respondents were asked to "indicate the extent to which they agreed or disagreed with statements related to their abilities and skills" for three types of science identity indicators: as a result of the PMPS program, I became more confident in my abilities as a scientist, I feel confident working independently on my research, I feel like I have a basic knowledge to run a research lab.

Indicators related to self-efficacy were selected from the survey data where student respondents were asked to "indicate the frequency over the past year in which they performed the following actions indicating self-efficacy: seek solutions to problems and explain them to others, integrate skills and knowledge from different sources and experiences, support your opinion with a logical argument.

Table 6 provides insight to descriptive statistics for both PWIs and HSIs. This table shows the central tendency measures and standard deviation for all dependent and independent variables. Additionally, the descriptive statistics for all variables across all institutions displays the scale range which is used in the survey to measure educational outcomes. For example, variable GPA was measured on a continuous 4.0 scale. Furthermore, variable math ability was measured on a scale with a range of 1 (high) and 3 (low).

Table 6

Descriptive Statistics for All Variables Across All Institutions

Variable	Central Tendency	Standard Deviation
GPA Measure: 4.0 scale	3.30**	.307
Academic Self-Concept		
Math Ability Measure: Likert scale 1 (high) – 3 (low)	3*	.586
Drive to Achieve Measure: Likert scale 1 (high) – 3 (low)	3*	.460
Self-Confidence Measure: Likert scale 1 (high) – 3 (low)	3*	.582
Science Identity		
Confidence in Abilities as Scientist Measure: Likert scale 1 (low) – 5 (high)	4*	.751
Confidence in Working Independently in Lab Measure: Likert scale 1 (low) – 5 (high)	4*	.825
Basic Lab Knowledge Measure: Likert scale 1 (low) – 5 (high)	4*	.944
Self-Efficacy		
Seek Solutions to Problems Measure: Likert scale 1 (high) – 3 (low)	1*	.421
Integrate Skills and Knowledge Measure: Likert scale 1 (high) – 3 (low)	1*	.373
Support Opinions with Arguments Measure: Likert scale 1 (high) – 3 (low)	1*	.503

*Measures of central tendency: median
**Measures of central tendency: mean

Hypotheses

H1 Students at Hispanic Serving Institutions (HSIs) experience higher levels of positive educational outcomes compared to students at predominantly white institutions (PWIs).

H2 Research and mentorship will be positively associated with science identity and students at HSIs will report higher levels of science identity than students at PWIs.

H3 Students with higher levels of academic self-concept will also report more positive educational outcomes.

H4 Research and mentorship will be positively associated with self-efficacy and students HSIs will report higher levels self-efficacy than students at PWIs.

CHAPTER IV

RESULTS

In order to compare educational outcomes at PWIs and HSIs, I start by presenting the results of independent sample *t*-tests. Following this, I present Pearson correlations to assess the relationships among academic self-concept, science identity, and self-efficacy with educational outcomes, looking at institutions all together, PWIs and HSIs. Finally, to get a better idea of the factors that impact educational outcomes the most across all institutions, PWIs and HSIs, I present a series of multivariate regression models.

Descriptive statistics using *t*-test for quality of means is presented in Table 7 for all variables among all institutions. Students participating in the PMPS program at a PWI have a mean GPA of 3.31. Likewise, students participating in the PMPS program at an HSI have a mean GPA of 3.28. GPA means among both institutions are not statistically significantly different than each other. Essentially students participating in the PMPS program have relatively equal GPA's across all institutions. These findings may be due to the positive educational experience students are developing among institutions, which may be due to the similar approaches the program is implementing regardless of the institution.

Among students participating in the PMPS program, variable drive to achieve shows a mean of 2.95 for students at a PWI and a mean of 2.83 for students at an HSI. Based on the results below, this means that there are statistically significant differences in

the means – students at PWIs had higher mean for drive to achieve than students at HSIs. Students participating in the PMPS program at a PWI indicated higher levels of confidence as a scientist with a mean of 4.19 and a mean of 4.02 for students participating in the PMPs program at an HSI. Additionally, students participating in the PMPS program at a PWI indicate higher confidence in their basic abilities to run a lab with a mean of 3.85 as compared to students from an HSI with a mean of 3.61.

Based on the results below, there are statistically significant differences in the means – students at PWI's had higher mean for drive to achieve than student at HSIs, higher confidence in their abilities, and higher ratings on knowledge to run a lab. No other statistically significant differences were found among all other variables.

Comparing Means Across Institutions

Table 7

Sample Descriptive Using t-test for Equality of Means

Variables	Primarily White Institution		Hispanic Serving Institution		
	μ	SD	μ	SD	t-test
GPA	3.31	.289	3.28	.327	.477
Math Ability	2.61	.599	2.49	.612	.166
Drive to Achieve	2.95	.376	2.83	.535	.069*
Self-Confidence	2.71	.564	2.62	.601	.268
Confidence in Abilities as Scientist	4.19	.691	4.02	.808	.107*
Confidence Working Independently	4.00	.805	3.97	.851	.791
Basic Lab Knowledge	3.85	.893	3.61	.988	.063*
Seek Solutions to Problems	1.14	.399	1.19	.444	.399
Integrate Skills and Knowledge	1.13	.342	1.17	.405	.463
Support Opinions with Arguments	1.23	.484	1.30	.524	.308

*=<.10, **=<.05, ***=<.01

Correlations for Key Variables

After looking at the differences in means across institutions, I examined the relationships among these variables within each institution group. To analyze the relationship among factors that influence educational outcomes, I first present results of Pearson correlations among my independent variables with GPA. Table 8 presents Pearson correlations for the key variables used in the central analysis for students participating in the PMPS both at PWIs and HSIs. The table provides insight into the

indicators of academic self-concept, science identity, and self-efficacy and their influence on educational outcomes.

As predicted, the bivariate analyses show that students participating in the PMPS program who reported higher levels of academic self-concept also reported more positive educational outcomes. Drive to achieve had the greatest impact ($r=.18$; $p<.01^{**}$). There is a positive relationship among the variables, as student levels of drive to achieve increases GPA increases.

When separating the sample into PWIs and HSIs, I found self-efficacy indicators were most significantly associated with GPA for students at PWIs. Students participating in the PMPS program at PWIs experience higher levels in ability to seek solutions and also experience an increase in GPA. Within self-efficacy variables, seeking solutions had the greatest impact ($r=-.28$; $p<.01^{**}$). Comparatively, for students at HSIs, correlations show that students participating in the PMPS program who reported higher levels of academic self-concept also reported more positive educational outcomes. Among academic self-concept variables, drive to achieve had the greatest impact ($r=.27$; $p<.01^{**}$). There is a positive relationship among the variables, as student levels of drive to achieve increases GPA increases for those participating in the PMPS program at HSIs. These specific findings were important as I tested the hypotheses because they indicate variables that measure academic self-concept and self-efficacy have a positive impact on student educational outcomes.

Table 8

PMPS GPA Correlations

Correlation GPA	All Institutions	Predominantly White Institution	Hispanic Serving Institution
Academic Self-Concept			
Math Ability	.05	.08	.02
Drive to Achieve	.18***	.05	.27***
Self-Confidence	-.03	-.06	-.00
Science Identity			
Confidence in abilities as a scientist	.01	.06	-.04
Confidence working independently in a lab	-.04	-.02	-.06
Lab Knowledge	-.05	.01	-.11
Self-Efficacy			
Seek Solutions	-.17**	-.28***	-.06
Integrate Skills	-.10	-.19**	-.02
Support Opinions	-.04	-.08	-.00

*=<.10, **=<.05, ***=<.01

Important Relationships amongst Independent Variables

Table 9 presents Pearson correlations for the important independent variables used in the central analysis for students participating in the PMPS both at PWIs and HSIs. The table provides insight into the variables and its impact on one another. Many strong relationships were found among the variables. Table 9 shows that for many of the independent variables there is a strong positive relationship with one another. Both PWIs and HSIs reported strong relationships between variables. For example, as self confidence levels increased students also experienced an increase in their mathematical

ability among all institutions. These findings suggest that the PMPS program is positively influencing student participation at all institutions and it supports the hypotheses that research and mentorship lead to higher levels of student development. Correlations show collinearity was not an issue in the analysis.

Table 9

PMPS Interesting Correlation Relationships

Correlations	All Institutions	PWIs	HSIs
Drive to Achieve – GPA	.18***	-	.27***
Self-Confidence – Math Ability	.50***	.50***	.42***
Self-Confidence – Drive to Achieve	.24***	.27***	.21**
Conf/Work/Indep[1] – Conf/Abilities[2]	.50***	.71***	.32***
Lab Knowledge – Conf/Abilities	.45***	.59***	.31***
Lab Knowledge – Conf/Work/Indep	.71***	.71***	.70***
Integrate Skills – Seek Solutions	.54***	.49***	.58***
Support Opinion – Seek Solutions	.32***	.44***	.22**
Support Opinion – Integrate Skills	.25***	.33***	-
Lab Knowledge – Math Ability	-	.20**	.20**
Lab Knowledge – Self-Confidence	-	.21**	-
Seek Solutions –Math Ability	-	-	.27***

*=<.10, **=<.05, ***=<.01

1 Confident working independently in a lab

2 Confidence in abilities as a scientist

Linear Regression Models

In order to better understand how academic self-concept, science identity, and self-efficacy influence educational outcomes across the institution groups, I considered a series of multiple regressions using GPA as my outcome variable. Table 10 examines how various indicators of academic self-concept, science identity, and self-efficacy influence variation in GPA among students participating in the PMPS program at both PWIs and HSIs.

Looking at factors associated with educational outcomes across all institutions I ran three models. Model 1 provides insight to academic self-concept and its influence on GPA. Model 2 provides insight to academic self-concept, science identity and its influence on GPA. Finally, Model 3 provides insight for all indicators, academic self-concept, science identity, and self-efficacy and its influence on student GPA.

Model 1, which examined how indicators measuring academic self-concept were associated with educational outcomes, suggests math ability was an important factor influencing GPA across all institutions. When accounting for other academic self-concept variables, math ability had the greatest impact on GPA ($B=.07$; $p<.01$). Overall, models that take into account various academic self-concept variables explain only 4% of the total variation in GPA amongst individuals in the study ($R^2=.04$).

Model 2, which examined how indicators measuring academic self-concept and science identity were associated with educational outcomes, suggests drive to achieve was an important factor influencing GPA across all institutions. When controlling for other academic self-concept variables, drive to achieve had the greatest impact on GPA ($B=.20$; $p<.05$). Overall, models that take into account various academic self-concept and

science identity indicators explain 5% of the total variation in GPA amongst individuals in the study (R^2=.05).

Model 3, which examined how indicators measuring academic self-concept, science identity, and self-efficacy were associated with educational outcomes across all institutions and suggests that student's ability to seek solutions, was an important factor influencing GPA. When controlling for other self-efficacy variables, student's ability to seek solutions had the greatest impact on GPA (B= -.18; p<.05). This relationship is statistically significant and the regression coefficient (-.14) suggests as students ability to seek solutions increases at the student level, so does GPA. Although the coefficient is negative it does indicate both variables are moving in the same direction (lower number for self-efficacy indicates high levels of self-efficacy). Model 3 does support my anticipated relationship, and it is important to examine the academic opportunities institutions are fostering with relation to the PMPS program. These findings support the positive impact the PMPS program is having on URMs. Students self-initiative and ability to apply their skills further encourages positive educational outcomes. Overall, the models that take into account various academic self-concept, science identity and self-efficacy variables explain 7% of the total variation in GPA amongst individuals in the study (R^2=.07) and show to be significant (p<.10).

Altogether analyses in Table 9 suggests academic self-concept and self-efficacy are attributed to higher levels of GPA among students participating in the PMPS program regardless of whether the student is at a PWI or an HSI. The adjusted R-square in the model summary table demonstrates 3 % (Adj R-square= .03) of the variation in GPA can be attributed to three variables, academic self-concept, science identity, and self-efficacy.

Overall, factors such as math ability and drive to achieve were significantly associated among student's educational outcomes as a result of participating in the PMPS program. These findings correspond with previous literature, which argues that students who participate in research programs display a growth in academic development and self-efficacy (Hurtado, 1994; Laursen & Swartz, 2010).

Table 10

Linear Regression Predicting GPA for PMPS Students (N=209)

	Model 1		Model 2		Model 3	
	Academic Self-Concept		Science Identity		Self-Efficacy	
	b (SE)	β	b (SE)	β	b (SE)	β
(Constant)	3.0***		2.1***		3.2***	
Academic Self-Concept						
Math Ability	.04***	.07	.05	.08	.06	.10
	(.05)		(.05)		(.05)	
Drive to Achieve	.13	.20	.13**	.20	.12*	.18
	(.05)		(.05)		(.05)	
Self-Confidence	-.07	-.11	-.06	-.10	-.06	-.10
	(.05)		(.05)		(.05)	
Science Identity						
Conf/Abilities[1]	-	-	.02	.05	.02	.04
			(.03)		(.03)	
Conf/Work/Indep[2]	-	-	-.01	-.01	-.01	-.04
			(.04)		(.04)	
Lab Knowledge	-	-	-.03	-.07	-.02	-.07
			(.03)		(.03)	
Self-Efficacy						
Seek Solutions	-	-	-	-	-.14**	-.18
					(.07)	
Integrate Skills	-	-	-	-	.01	.01
					(.08)	
Support Opinion	-	-	-	-	.02	.02
					(.06)	
R^2	.04		.05		.07	
R^2 Change	.03		.02		.03	
F	3.0		1.7		1.7	
N	209		209		209	

*=<.10 b = Unstandardized coefficient
** = < .05 se = Standard error
***=<.01 B = Standardized coefficient

[1] Confidence in abilities as a scientist
[2] Confidence working independently in a lab

In order to examine if there were differences between PWIs and HSIs for these relationships, I ran the same regression models while separating the students into which particular institution they were at. Table 11 examines these relationships for students at PWIs. Looking at factors associated with educational outcomes in Table 11 I ran three models. Model 1 provides insight to academic self-concept and its influence on GPA. Model 2 provides insight to academic self-concept, science identity and its influence on GPA. Finally, Model 3 provides insight for all indicators, academic self-concept, science identity, and self-efficacy and its influence on student GPA.

Model 1, which examined how indicators measuring academic self-concept were associated with educational outcomes at PWIs, suggests there were no important factors related to academic self-concept influencing GPA. Overall, models that take into account various academic self-concept variables explain 3% of the total variation in GPA amongst individuals in the study (R^2=.03). Model 2, which examined how indicators measuring academic self-concept and science identity were associated with educational outcomes, suggests there were no important factors influencing GPA at PWIs. Overall, models which take into account various academic self-concept and science identity variables explain 4% of the total variation in GPA amongst individuals in the study (R^2=.04).

Model 3 examined indicators measuring academic self-concept, science identity, and self-efficacy which were associated with educational outcomes, suggests that student's ability to seek solutions was an important factor influencing GPA. When controlling for other academic self-concept variables, self-confidence had the greatest impact on GPA (B= -.19; p<.10). This relationship is statistically significant and the

negative regression coefficient (-.11) suggests that as student's self-confidence increases, GPA increases. Although the coefficient is negative it does indicate both variables are moving in the same direction (lower number for self-confidence indicates high levels of academic self-concept). When controlling for other self-efficacy variables, student's ability to seek solutions had the greatest impact on GPA (B= -.25; $p<.05$). Seek solutions also had a greater impact on educational outcomes than did self-confidence. This relationship is statistically significant and the negative regression coefficient (-.20) suggests that as ability to seek solutions increases at the student level, so does GPA. Although the coefficient is negative it does indicate that both variables are moving in the same direction (lower number for ability to seek solutions indicates high levels of self-efficacy).

Model 3 supports my anticipated relationship, and for students in the PMPS program at PWIs, self-efficacy is important in the academic development of these students. It is important to examine why self-efficacy development is an important predictor in the positive educational outcomes of URMs. The influence of institutional structures significantly influences student's self-capabilities because of the characteristics associated with student backgrounds. Research has shown that the relationship between students and the institutions ultimately influences the academic development of students (Bandura, 1997). Overall, the models which take into account various self-efficacy variables explain 7% of the total variation in GPA amongst individuals in the study ($R^2=.07$) and show to be significant ($p<.10$).

Altogether analyses in Table 11 shows that academic self-concept and self-efficacy are correlated with levels of GPA among students participating in the PMPS

program at PWIs. The adjusted R-square in the model summary table demonstrates 5% (Adj R-square= .05) of the variation in GPA can be attributed to three variables academic self-concept, science identity, and self-efficacy. Among students in the PMPS program at PWIs, academic self- concept and science identity were not significant factors influencing student educational outcomes.

Table 11

Linear Regression Predicting GPA for PMPS Students at a PWI (N=110)

	Model 1		Model 2		Model 3	
	Academic Self-Concept		Science Identity		Self-Efficacy	
	b (SE)	β	b (SE)	β	b (SE)	β
(Constant)	3.2***		3.1***		3.7***	
Academic Self-Concept						
Math Ability	.09	.15	.09	.15	.09	.15
	(.07)		(.07)		(.07)	
Drive to Achieve	.06	.08	.06	.08	.04	.05
	(.08)		(.08)		(.08)	
Self-Confidence	-.09	-.16	-.10	-.16	-.11*	-.19
	(.07)		(.07)		(.07)	
Science Identity						
Conf/Abilities[1]	-	-	.06	.14	.03	.08
			(.08)		(.06)	
Conf/Work/Indep[2]	-	-	.06	-.15	-.09	-.23
			(.06)		(.06)	
Lab Knowledge	-	-	.01	.03	.03	.08
			(.05)		(.05)	
Self-Efficacy						
Seek Solutions	-	-	-	-	-.20**	-.26
					(.20)	
Integrate Skills	-	-	-	-	-.11	-.12
					(.11)	
Support Opinion	-	-	-	-	.01	.01
					(.08)	
R^2	.03		.04		.13	
R^2 Change	-.01		-.02		.05	
F	.20		.66		1.7	
N	110		110		110	

* = < .10 b = Unstandardized coefficient
** = < .05 se = Standard error
***=<.01 B = Standardized coefficient

[1] Confidence in abilities as a scientist
[2] Confidence working independently in a lab

Finally, I present the results of these same regressions models for students at HSIs are presented in Table 12. Looking at factors associated with educational outcomes in Table 12, I ran three models. Model 1 provides insight to academic self-concept and its influence on GPA. Model 2 provides insight to academic self-concept, science identity and its influence on GPA. Finally, Model 3 provides insight for all indicators, academic self-concept, science identity, and self-efficacy and its influence on student GPA.

Model 1, which examined how indicators measuring academic self-concept were associated with educational outcomes, suggests drive to achieve was an important factor influencing GPA.When controlling for other academic self-concept variables, drive to achieve had the greatest impact on GPA (B=.29; $p<.05$). Overall, models that take into account various academic self-concept variables explain 8% of the total variation in GPA amongst individuals in the study ($R^2=.10$).

Model 2, which examined indicators measuring academic self-concept and science identity were associated with educational outcomes, suggests that drive to achieve was an important factor influencing GPA. When controlling for other academic self-concept variables, drive to achieve had the greatest impact on GPA (B=.31; $p<.01$). Overall, models that take into account various science identity variables explain 10% of the total variation in GPA amongst individuals in the study ($R^2=.10$).

Model 3, which examined indicators measuring academic self-concept, science identity, and self-efficacy were associated with educational outcomes, suggests that drive to achieve was an important factor influencing GPA. When controlling for other academic self-concept variables, drive to achieve had the greatest impact on GPA (B=.31; $p<.05$). Overall, models that take into account various academic self-concept, science

identity, and self-Efficacy variables explain 10% of the total variation in GPA amongst individuals in the study (R^2=.10).

Altogether analyses in Table 12 suggests academic self-concept is attributed to higher levels of GPA among students participating in the PMPS program at HSIs. The adjusted R-square in the model summary table demonstrates that 1% (Adj R-square= .01) of the variation in GPA can be attributed to three variables, academic self-concept, science identity, and self-efficacy. Overall, factors such drive to achieve was significantly associated among student's educational outcomes as a result of participating in the PMPS program.

Table 12

Linear Regression Predicting GPA for PMPS Students at an HSI (N=98)

	Model 1		Model 2		Model 3	
	Academic Self-Concept		Science Identity		Self-Efficacy	
	b (SE)	β	b (SE)	β	b (SE)	β
(Constant)	3.0***		3.0***		3.0***	
Academic Self-Concept						
Math Ability	-.01	-.01	-.01	-.02	-.01	-.01
	(.07)		(.07)		(.08)	
Drive to Achieve	.18**	.29	.20***	.31	.19**	.31
	(.06)		(.07)		(.07)	
Self-Confidence	-.04	-.06	-.02	-.03	-.02	-.03
	(.07)		(.07)		(.07)	
Science Identity						
Conf/Abilities[1]	-	-	-.01	-.02	-.01	-.03
			(.05)		(.05)	
Conf/Work/Indep[2]	-	-	.04	.11	.04	.11
			(.10)		(.06)	
Lab Knowledge	-	-	-.07	-.21	-.07	-.21
			(.05)		(.05)	
Self-Efficacy						
Seek Solutions	-	-	-	-	-.034	-.044
					(.107)	
Integrate Skills	-	-	-	-	.025	.029
					(.114)	
Support Opinion	-	-	-	-	-.002	-.002
					(.076)	
R^2	.08		.10		.10	
R^2 Change	.05		.04		.01	
F	2.7		1.8		1.1	
N	98		98		98	

* = < .10 b = Unstandardized coefficient
** = < .05 se = Standard error
***=<.01 B = Standardized coefficient

[1] Confidence in abilities as a scientist
[2] Confidence working independently in a lab

CHAPTER V

DISCUSSION

Promoting Minority Participation in the Sciences Program Impact on Academic Success

The purpose of the present study was to compare the educational outcomes of URMs in the PMPS program from a PWI and an HSI. In comparing means across institution groups and then digging deeper into a more nuanced analysis of the relationships observed within institution groups, (all institutions, PWIs and HSIs) I was able to analyze how academic self-concept, science identity and self-efficacy contributed to variation in educational outcomes for students participating in the PMPS program and the educational experience like mentoring and research opportunities the program provides.

Overall, findings from all institutions suggest indicators such as academic self-concept and self-efficacy have a positive impact on educational outcomes for students participating in the PMPS program at both PWIs and HSIs individually. Students with higher levels of academic self-concept demonstrated more positive outcomes towards their GPA. Correlations amongst independent variables (Table 9, p. 27) present findings that support the strong relationships among the independent variables. Among all institutions academic self-concept, science identity, and self-efficacy demonstrated to have a strong positive relationship with one another. For example, as levels of academic self-concept increased students also experienced an increase in science identity and self-

efficacy. Overall, the PMPS program is having a positive impact on the students participating in the program regardless of the institution.

Findings for Predominantly White Institutions and Hispanic Serving Institutions

Findings did show that students participating in the PMPS program are achieving positive educational outcomes overall, regardless of the institution type (Table 7: Comparison of means p. 24.) However, when looking at the factors influencing GPA within each institution, there were some significant findings related to how academic self-concept, science identity, and self-efficacy work across institutions and their influence on GPA among students participating in the PMPS program at PWIs. For students in the PMPS program at an HSI, drive to achieve was the most influential factor in their educational outcomes. According to Correll (2001) students must feel competent in their skills in order to continue pushing themselves academically. Previous research has established that URMs enter institutions with challenges and those who choose to attend a Hispanic serving institution do so with the purpose of being accepted and supported (Plecha, 2002). Findings show student's educational outcomes at HSIs were associated with drive to achieve. This could be due to the perception URMs have of HSIs and their confidence to pursue an education at these institutions. Students want to feel supported, feel like they belong and ultimately the culture of an institution can impact student's self-assessment.

For students in the PMPS program at PWIs, seeking solutions to problems was the most influential factor in their educational outcomes. According to Bandura, (1997) past experiences with academic material can indicate self-judgement, and for these student's past success can reinforce self-efficacy. URMs enter higher education institutions at a

variety of stages but for these students participating in the PMPS program their ability to acknowledge they can pursue their scientific career has been crucial in their educational outcomes. This may be due to the fact that often these students feel isolated in these institutions and through the involvement of programs (such as PMPS) they find themselves being supported and the ability to persist with their education. Overall, students participating in the PMPS program have relatively high and equal educational outcomes regardless of whether the student is at a PWI or a HSI.

In this work Hypothesis 1 argued that students at HSIs would experience higher levels of positive educational outcomes compared to students at PWIs. Evidence from my analyses suggests that students in the PMPS program across all institutions were influenced by different indicators with regards to their educational outcomes. At an HSI drive to achieve was more important in predicting GPA as compared to students at PWIs. Within academic self-concept, drive to achieve demonstrated to be highly influential in the educational outcomes of all students. Overall, students participating in the PMPS program at HSIs reported high levels of drive to achieve within their academics.

Academic literature suggests MSIs promote more inclusive climates and fosters a relationship between URMs and the institution as a result of the integral role these institutions have played in the access to education for minority students (Abraham et al., 2002; Zamani, 2003). Minority serving institutions have a long-standing history of providing higher education to those who historically were denied access to traditional white colleges. Through social interactions students establish a relationship with their professors that allow them to feel more comfortable and develop a personal conception of their ability and confidence to pursue their career (Correll, 2001). The sense of

community and student-faculty interactions within the PMPS program at HSIs (Outcalt & Skewes-Cox, 2002) are likely to be a key component in the development of academic self-concept (Plecha, 2002). Overall, students participating in the PMPS program experience high levels of educational outcomes while taking into account their academic self-concept development.

Hypothesis 2, which argued that research and mentorship would be positively associated with science identity and students from HSIs would report higher levels, was not significant. Based on the regression results the findings do not support this hypothesis. Table 9 depicts positive relationships between both institutions and the positive association between levels of self-efficacy and other indicators. Overall, PMPS student's educational outcomes are influenced by self-efficacy across all institutions and PWIs, but academic self-concept is more important for students at HSIs. According to Bandura, (1997) students past experiences within academia can influence their ability to engage academically. Self-efficacy is a great indicator in predicting URMs capability to engage within the institution and their scientific career. Students who can apply the skills they learn in class are more likely to feel confident in their ability to accomplish their goals which these findings support through the educational outcomes students are experiencing in the PMPS program.

Hypothesis 3, which argued that students with higher levels of academic self-concept would also report more positive educational outcomes demonstrated being significant among students at HSIs. Table 8, which displays variable correlations and Table 12, which displays linear regression models both explain the significance of academic self-concept and its positive impact on GPA. These findings suggest that PMPS

students have high levels of educational outcomes regardless of the institution. Indicators within academic self-concept suggest drive to achieve was an impactful influencing GPA for students.

Literature suggests academic self-concept is a self-assessment by the student evaluating their competence and skills within the scientific field (Correll, 2001). For example, students who participate in the PMPS program have the opportunity to develop a mentor relationship with a faculty member in their field of interest. If the student receives positive feedback from their mentor, it is more likely that the student's self-confidence will begin to develop and increase. A positive interaction between faculty and students is a crucial component to a student's feelings towards the institution. If a student feels they are being supported and feel comfortable to seek feedback, then this allows for their academic self-concept to develop in a positive direction. These findings support the positive impact students drive to achieve has on their educational outcomes within the academic field.

Hypothesis 4, which argued that research and mentorship would be positively associated with self-efficacy was significant among the linear regression model variables and its effect on educational outcomes. Furthermore, Table 8, which displays correlations among significant variables, suggests self-efficacy is positively correlated with other variables and all institutions. Research has established that the way in which students view themselves within their field can highly impact their professional development (Carlone & Johnson, 2007). If the student understands their field and interacts within the scientific settings, then it is more likely that they will begin to develop a positive science identity which is ultimately related to their academic self-development. If a student is

recognized within the field as someone who can perform and execute in a scientific way, then it is more likely they will experience positive feedback from others in their field while also reinforcing a positive identity. Self-efficacy is positively correlated with academic self-concept and science identity because they all analyze the academic development of students among all institutions.

Overall, the PMPS program demonstrated to be positively associated with student's educational outcomes among both PWIs and HSIs. These findings correspond with previous literature, which argued that student engagement with faculty is a positive indicator for academic performance (Astin, 1999). Students develop and strengthen their academic self-concept, science identity, and self-efficacy through the mentorship and research opportunities provided by the PMPS program.

Student Testimonials

This present study provides a quantitative examination of the educational forces that previous academic researchers have argued contribute to the academic success of URMs in higher education, such as academic identity development (Hurtado, 2007), and the importance of mentorship (Pfund et al., 2006). Examination focused on URMs academic development and its impact on student GPA. It was hypothesized that students at an HSI would experience higher levels of positive educational outcomes compared to students participating in the PMPS program at a PWI. Similarly, it was also hypothesized that research and mentorship would be positively associated with academic self-concept, science identity, and self-efficacy. Although quantitative data did not fully support all of these hypotheses, the development of academic self-concept, science identity, and self-efficacy prove to be key components in the academic progress of URMs in STEM.

Results of qualitative findings can help us understand how. Students participating in the PMPS program expressed the importance of research skills and the positive impact it had on their career.

The following quotes were captured from an open-ended survey question where students were invited to give feedback with regards to their experience with the PMPS program and its impact on their educational career. The purpose of these testimonials is to capture a deeper understanding of the students experience within the program and how they feel the program is impacting their educational journey.

A student who previously participated in the PMPS program discussed the academic impact the program had on his career during and after his academic journey while providing him the skills and resources that the student may not have had without the participation of the PMPS program.

> The opportunities to conduct research as an undergraduate were very limited (in the traditional academic environment). The PMPS program provided me the opportunity to expand my knowledge and acquire laboratory skills. I am extremely thankful for the opportunity since my research experience allowed me to find employment after graduation.

The opportunity to conduct research speaks to the programs initiative to equip URMs with the necessary skills to expand their knowledge and become experts in their field. Through mentorship and research opportunities students develop their academic identity. This program provides them the tools to learn, practice, make mistakes, and learn how to utilize these skills beyond their academic career. These opportunities strengthen URMs scientific identity and provide them the confidence needed in their field even after

graduation. For this particular student participating in the PMPS program brought positive educational outcomes beyond their educational career.

Another student participating in the PMPS program stressed the positive impact the program had for their future educational goals as well as program support they received to continue with their research and studies during their undergraduate career.

> The PMPS program enabled me to continue undergraduate research and classes at the same time. Without the PMPS program support I would have had to find an alternative job and no longer get the crucial research experience I needed to apply to graduate school. I am now attending one of the nation's best Ph.D. programs in molecular and cellular biology at UC Berkeley, even obtaining a fellowship because of the strength of my research experience. My research experience and GPA were my strongest aspects on my application.

The opportunity and resources that the PMPS program provides such as research funding and mentorship was highly impactful for this student who highlighted that their involvement in the PMPS program allowed them to continue on with their educational goals. For these students their identity is developed through the environment the PMPS fosters and faculty interactions who play a key role in this process. The PMPS program seeks to graduate URMs and with the help of the program this student was able to highlight their skills and knowledge acquired through the program while continuing their education.

This study speaks to the positive educational outcome of GPA and the positive impact the PMPS program can have on student's academics. The following student

shared the importance of faculty mentorship and the high impact it can have on students towards higher education.

> This program can change your life if you let it. It will happen gradually, you will notice your grades might improve or you might feel more confident interacting with faculty members and doing research. I participated in the PMPS program over 5 years ago, but that experience was the moment that I knew I wanted to go to graduate school and become a scientist and knowing that I had the program to support me and help me get there helped me get to where I am today.

Research has shown that support is key factor in the academic success of URMs in higher education (González, 2002). For this particular student the PMPS program was a considerable influence in their journey to graduate school. Through the participation in the PMPS program students developed their identity and strengthened their skills and knowledge and how they identify as scientists which ultimately has allowed them to continue moving forward with their academic aspirations. Table 5 provides insight into the student respondent's desired degree. Out of the 199 respondents, 62% self-identified as desiring a Ph.D. degree. These findings support the positive educational outcomes the program is having for these URMs students. Through the mixture of faculty mentors, research opportunities, research funding, and conference presentations, these students are improving their educational outcomes and moving forward with their next career interest.

Results from this study support the notion that mentorship and research opportunities foster positive academic developments for URMs. Previous research argues that URMs pursuing a STEM degree enter higher education institutions with unique challenges putting them at a higher risk of finishing their degree (Plecha, 2002), but

through the PMPS programs students have been given the resources to cultivate a one on one relationship with the faculty mentor and reaffirm their skills though research practice. Not only do these students become experts in their field but they develop and integrate their personal identity into their academic work. They way in which students visualize themselves within their field allows them to integrate into the cultural setting and continue academically. The overall organizational climate of an institution can allow for students to continue moving forward or push them out of academia. In order for these students to become successful the PMPS program has provided them the tools to develop their identity as a student and scientist.

Through current literature we know that URMs face challenges such as being first generation, financial burdens, and feelings of isolation (Whalen & Shelley, 2010; Seymour & Hewitt, 2000). Examining the impact of the PMPS program on student success is crucial for the educational development of URMs in STEM. Although the program only serves URMs pursuing a STEM degree it is fundamentally important to address the overall unique challenges URMs in STEM face. That is, how do URMs in STEM who are not a part of the PMPS program get the support they need? The results from this study can shed light on this question.

Based on the findings URMs participating in the PMPS program are being given the resources to strengthen their research skills through mentorship. There students are given the tools to be independent while conducting research of their interest. Based on the open-ended survey question testimonials these URMs are finding support through the PMPS program. Many students indicated their desire to continue their higher education and through the testimonials one can see that these students are accomplishing much

more beyond their undergraduate degree. Students expressed the impact the program has had in their personal life such as graduate school and professional jobs, setting them apart from other students with their research skills. Programs like the PMPS may be the influence that has pushed them and allowed them to continue on with their undergraduate degree. It is clear the PMPS program is creating impactful outcomes for these students and again this is academic and identity development, which is crucial for the success of URMs. Not every student in STEM will have the opportunity to be in a program that provides them research funding, one-on-one mentoring, identity and professional development and that is why higher education institutions must take the lead in identifying how to serve those who cannot be in such program. Recommendations involve an in-depth exploration into faculty-student interactions. Students spend majority of their time in classrooms and the overall climate of the institution and role of a faculty member is a crucial component to their success. Identifying the needs of students and being able to implement development opportunities such as workshops, research opportunities, and mentoring can allow students to feel connected to their institution and create a sense of belonging.

CHAPTER VII

CONCLUSION

Minority Serving Institutions

Minority Serving Institutions (MSIs) have played a critical role in the expansion of access to higher education for students from racial-ethnic minority backgrounds (Gasman, Baez, & Turner, 2008). For many years Blacks were denied admission to traditional white institutions but with the establishment of Historically Black Colleges and Universities (HBCU), whose mission is to primarily serve the African American community have paved the way of higher education for many of these students (U.S. Department of Education, 2015). Researchers have found that black students attending HBCUs find their experience to be more nurturing and report higher levels of self-esteem (Brown & Freeman, 2004). According to the U.S. Department of Education, HBCUs rank high in awarding baccalaureate degrees to black students in STEM (U.S. Department of Education, 2015). HBCUs commitment to support black students is the fundamental element that is embedded in their mission statement.

On the contrary, although HSIs emerged from the growth in Hispanic student population and play an important role in the educating Hispanic students, their mission statement is not as specific as HBCUs. Institutions with a 25 percent or more total undergraduate Hispanic full-time equivalent student enrollment are considered to be Hispanic serving (U.S. Department of Education, 2018). Unlike HBCUs, who clearly

states their commitment to the development of black students in their mission statement, HSIs are only classified as Hispanic serving only after they have a certain number of Hispanic student enrollment. This is important when understanding the academic development of URMs entering HSIs. Findings presented in this research show students participating in the PMPS program at PWIs had higher levels of drive to achieve (Table 7, p. 26) than students at HSIs. These findings are important when examining the mission of HSIs and the impact it can have on URMs who are navigating higher education for the first time or who may feel disconnected from their institutions.

This study contributes to the sociological study of how programs like PMPS can contribute to the academic development of URMs in STEM and the impact that programs can have on students who are entering higher education with unique challenges. It also adds to the existing body of knowledge on academic identity development and the importance such personal growth can have on the academic success of students in STEM. In my analysis there is evidence to support that there are contrasting educational experiences among URMs in STEM from PWIs and HSIs.

Overall, the PMPS program is having positive outcomes such as GPA, professional careers, and graduate school through research, identity development, and mentoring. These findings indicate that the PMPS program is retaining and graduating URMs in a way that empowers them and sets them up towards their next educational goal. The PMPS program has found a way to tackle that problem and find a way to support these students in higher education. It is important to acknowledge that there many other URMs who are not in STEM but are navigating a culture that was not created with them in mind (Thelin, 1985). Finding a way to support them is crucial for their retention

and success. There is an intersectional approach which must be taken in order to understand the unique challenges URMs in STEM are entering higher education with. Identity and student experiences are a considerable component in being able to understand the challenges their students face and what can be done as an institution to ensure they are setting these students up for success.

Overall, this study consisted of a small sample size and ideally a large sample size would allow for better student representation. Like the PMPS, there are many other programs higher education institutions have established to support students. Future research could allow for a comparison between programs whose purpose is to retain and support URMs. A qualitative approach that examines URMs experiences in higher education can allow for an in-depth comparison between URMs experiences at both PWIs and HSIs. Additionally, it would be beneficial for HSIs to reframe their institutional mission similarly to HBCUs in order to explicitly express their devotion to the academic success of Hispanic students. This may allow students to feel as though they are more than just another number at an institution. Bringing in a diverse student body is what institutions should work towards, but more importantly examining the role and impact the institution has on these students during their four-year journey is fundamental to the academic development of URMs. Students need to feel as though their institution cares and is devoted to them in every aspect of their success.

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APPENDIX A

INSTITUTIONAL REVIEW BOARD APPROVAL

UNIVERSITY OF
NORTHERN COLORADO

Institutional Review Board

DATE:	December 14, 2017
TO:	Denise Romero, B.A.
FROM:	University of Northern Colorado (UNCO) IRB
PROJECT TITLE:	[1158196-1] Examining Academic Success for Underrepresented Minority Science Technology Engineering and Mathematics Students within Hispanic Serving Institutions and Predominantly White Institutions
SUBMISSION TYPE:	New Project
ACTION:	APPROVAL/VERIFICATION OF EXEMPT STATUS
DECISION DATE:	December 14, 2017
EXPIRATION DATE:	December 14, 2021

Thank you for your submission of New Project materials for this project. The University of Northern Colorado (UNCO) IRB approves this project and verifies its status as EXEMPT according to federal IRB regulations.

We will retain a copy of this correspondence within our records for a duration of 4 years.

If you have any questions, please contact Sherry May at 970-351-1910 or Sherry.May@unco.edu. Please include your project title and reference number in all correspondence with this committee.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within University of Northern Colorado (UNCO) IRB's records.

Generated on IRBNet

APPENDIX B

DESCRIPTIVE STATISTICS

Descriptive Statistics

Table 13

Descriptive Statistics for All Variables Across Primarily White Institutions

Variable	Central Tendency	Standard Deviation
GPA Measure: 4.0 scale	3.31**	.289
Academic Self-Concept		
Math Ability Measure: Likert scale 1 (high) – 3 (low)	3*	.559
Drive to Achieve Measure: Likert scale 1 (high) – 3 (low)	3*	.376
Self-Confidence Measure: Likert scale 1 (high) – 3 (low)	3	.564
Science Identity		
Confidence in Abilities as Scientist Measure: Likert scale 1 (low) – 5 (high)	4*	.691
Confidence in Working Independently in Lab Measure: Likert scale 1 (low) – 5 (high)	4*	.805
Basic Lab Knowledge Measure: Likert scale 1 (low) – 5 (high)	4*	.893
Self-Efficacy		
Seek Solutions to Problems Measure: Likert scale 1 (high) – 3 (low)	1*	.399
Integrate Skills and Knowledge Measure: Likert scale 1 (high) – 3 (low)	1*	.342
Support Opinions with Arguments Measure: Likert scale 1 (high) – 3 (low)	1*	.484

*Measures of central tendency: median
**Measures of central tendency: mean

Table 14

Descriptive Statistics for All *Variables* Across Hispanic Serving Institutions

Variable	Central Tendency	Standard Deviation
GPA Measure: 4.0 scale	3.28**	.327
Academic Self-Concept		
Math Ability Measure: Likert scale 1 (high) – 3 (low)	3*	.612
Drive to Achieve Measure: Likert scale 1 (high) – 3 (low)	3*	.535
Self-Confidence Measure: Likert scale 1 (high) – 3 (low)	3*	.601
Science Identity		
Confidence in Abilities as Scientist Measure: Likert scale 1 (low) – 5 (high)	4*	.808
Confidence in Working Independently in Lab Measure: Likert scale 1 (low) – 5 (high)	4*	.851
Basic Lab Knowledge Measure: Likert scale 1 (low) – 5 (high)	4*	.988
Self-Efficacy		
Seek Solutions to Problems Measure: Likert scale 1 (high) – 3 (low)	1*	.444
Integrate Skills and Knowledge Measure: Likert scale 1 (high) – 3 (low)	1*	.405
Support Opinions with Arguments Measure: Likert scale 1 (high) – 3 (low)	1*	.524

*Measures of central tendency: median
**Measures of central tendency: mean

APPENDIX C

CORRELATION TABLES

Correlation Tables

Table 15

Correlation Matrix for Key Variables (N=211)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) GPA	-	-	-	-	-	-	-	-	-	-
(2) Math Ability	.05	-	-	-	-	-	-	-	-	-
(3) Drive to Achieve	.18***	.13	-	-	-	-	-	-	-	-
(4) Self-Confidence	-.03	.50***	.24***	-	-	-	-	-	-	-
(5) Conf/Abilities	.01	-.13	.08	.05	-	-	-	-	-	-
(6) Conf/Work/Indep	-.04	-.04	.03	.04	.50***	-	-	-	-	-
(7) Lab Knowledge	-.05	.08	.10	-.17***	.45***	.71***	-	-	-	-
(8) Seek Solutions	-.17**	.13	-.11	.02	-.18***	-.20***	.12	-	-	-
(9) Integrate Skills	-.10	-.06	-.23***	-.16**	-.07	-.20***	-.20***	.54***	-	-
(10) Support Opinion	-.04	-.11	-.15**	-.22**	-.15**	-.17**	-.13	.32**	.25***	-

*=<.10
**=<.05,
***=<.01

Table 16

Correlation Matrix for Key Variables PWI (N=112)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) GPA	-	-	-	-	-	-	-	-	-	-
(2) Math Ability	.08	-	-	-	-	-	-	-	-	-
(3) Drive to Achieve	.05	.07	-	-	-	-	-	-	-	-
(4) Self-Confidence	-.06	.50***	.27***	-	-	-	-	-	-	-
(5) Conf/Abilities	.06	.08	.14	.09	-	-	-	-	-	-
(6) Conf/Work/Indep	-.02	.09	.14	.10	.71***	-	-	-	-	-
(7) Lab Knowledge	.01	.20**	.09	.21**	.59***	.71***	-	-	-	-
(8) Seek Solutions	-.28***	-.01	-.06	-.04	-.24**	-.22**	-.09	-	-	-
(9) Integrate Skills	-.19**	-.11	-.35***	-.24**	-.33***	-.37***	-.29***	.49***	-	-
(10) Support Opinion	-.08	-.09	-.24**	-.21**	-.17	-.30***	-.14	.44***	.33***	-

*=<.10
**=<.05,
***=<.01

Table 17

Correlation Matrix for Key Variables HSI (N=99)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) GPA	-	-	-	-	-	-	-	-	-	-
(2) Math Ability	.02	-	-	-	-	-	-	-	-	-
(3) Drive to Achieve	.27***	.17	-	-	-	-	-	-	-	-
(4) Self-Confidence	-.00	.42***	.21**	-	-	-	-	-	-	-
(5) Conf/Abilities	-.04	-.33***	.01	.01	-	-	-	-	-	-
(6) Conf/Work/Indep	-.06	-.16	-.06	-.02	.32***	-	-	-	-	-
(7) Lab Knowledge	-.11	.20**	.10	.12	.31***	.70***	-	-	-	-
(8) Seek Solutions	-.06	.27***	-.15	.08	-.13	-.18	-.15	-	-	-
(9) Integrate Skills	-.02	-.03	-.15	-.08	.15	-.05	-.13	.58***	-	-
(10) Support Opinion	-.00	-.12	-.09	-.22**	-.14	-.06	-.12	.22*	.18	-

*=<.10
**=<.05,
***=<.01