

**“IT’S NOT JUST ONE THING!” EXAMINING THE ROLE OF A STEM ENRICHMENT
PROGRAM IN FACILITATING COLLEGE READINESS AND RETENTION AMONG
UNDERSERVED STUDENTS OF COLOR**

By

Tonisha Brandy Lane

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ABSTRACT

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Advancing the success of students of color in Science, Technology, Engineering, and Mathematics (STEM) is a pressing and complex issue. There are several trends (e.g., changing demographics, an aging workforce, and globally competitive market), which make improving retention and success among students of color in STEM fields important. STEM enrichment programs have shown promise in sustaining underrepresented students’ science interests and strengthening their readiness for college level work. Thus, this study investigated how a STEM enrichment program facilitates college readiness and retention among students of color at a predominantly White, large, public, research university.

In this study, I used an explanatory, holistic case study approach to examine the strategies and practices employed in the program to support student success (Yin, 2003). The study was conducted at Jefferson State University (pseudonym), a predominantly White, large, public research university in the Midwest. The Comprehensive STEM Program (CSP, pseudonym) at Jefferson State was established in 2007 with the National Science Foundation Louis Stokes Alliance for Minority Participation (NSF-LSAMP) grant. CSP contains eight program components: a six-week academic intensive residential summer bridge program, bi-weekly advising meetings, weekly recitation sessions, selected STEM sections of math and science courses, first-year seminar, residential assignment, peer mentoring, and undergraduate research opportunity. The program capacity is 50 students.

The conceptual framework that guided this study integrated three theoretical constructs: (1) the Expertise Model of Students Success (EMSS), (2) sense of belonging, and (3) science identity. Drawing upon expert's systems theory, EMSS contends that identification of barriers, knowledge, and actions are central to understanding the student experience and student retention. The sense of belonging and science identity constructs provided additional lenses to explore how the program fostered community and academic and professional development opportunities for its participants.

To explore my research questions, I interviewed 50 individuals: 42 current and former program participants, 2 administrators, 2 instructors, and 4 recent baccalaureate recipients and former program participants. I also conducted 24 hours of participant observations and analyzed over 200 pages of documents. *A Model for Programmatic Influences on College Readiness and Retention among Underserved Students of color* emerged from the findings. This model is comprised of four major themes: proactive caring, holistic support, community building, and STEM identity development catalyst. Proactive caring was found to be a philosophy and approach used for student retention. Holistic support attended to the myriad of needs of the program participants. Community building practices created a familial atmosphere and conditions to develop meaningful relationships. STEM identity development catalysts were the ways in which the program buttressed science identity development.

This study concludes with recommendations for practice, policy, future research, and theory on students of color pursuing degrees in the STEM disciplines. The implications from this study support the need for continued federal and institutional support for STEM enrichment programs to address opportunity gaps, provide a supportive and caring environment for underrepresented groups, and bolster pathways for STEM identity development.

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I dedicate this dissertation to all of the children in Detroit who see education as a vehicle for social mobility. Keep dreaming and reaching for the sky.

Hold fast to dreams
For if dreams die
Life is a broken-winged bird
That cannot fly.
Hold fast to dreams
For when dreams go
Life is a barren field
Frozen with snow.
~Langston Hughes

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TABLE OF CONTENTS

LIST OF TABLES.....	xiv
LIST OF FIGURES.....	xv
CHAPTER 1: INTRODUCTION.....	1
Statement of the Problem.....	1
Purpose and Research Questions	3
Why the “Leaky Pipeline” Exists	4
STEM Enrichment Programs.....	7
Significance of the Study	11
Conceptual Framework.....	11
Expertise Model of Student Success	12
Sense of Belonging.....	15
Science Identity	18
Key Terms.....	22
Summary and Outline	23
CHAPTER 2: LITERATURE REVIEW	26
Characteristics of Students of Color in STEM	26
Race.....	27
Gender	30
Women of color.	31
Men of color.	31
Socioeconomic Status	32
First-Generation College Student Status	34
Factors that Influence College Readiness	36
College-Level Skills and Abilities	37
Experiences with Mathematics.....	39
Efforts to Address College Readiness	40
Factors that Influence Student Retention.....	41
Institutional Type	41
Ethic of Care.....	43
Student Engagement.....	45
Academic Advising.....	46
Developmental Education	47
Tutoring.....	49
Self-Confidence.....	50
Navigating Racial Climate	50
Peer Support	53
Faculty Interactions	54
Undergraduate Research	56
STEM Enrichment Programs	57
Minority Engineering Program.....	58

The Mathematics Workshop.....	59
Meyerhoff Scholars Program.....	60
Summary	61
 CHAPTER 3: METHODS	62
Research Design.....	62
Case Studies	62
The Research Site: Jefferson State University	65
Retention and Graduation Rates in the STEM Disciplines at Jefferson State University	65
Comprehensive STEM Program.....	66
Role of the Researcher	67
Data Collection	68
Participant Recruitment and Selection	69
Document Analysis	70
Participant Observations	70
Individual and Focus Group Interviews	71
Demographic Information	73
Data Analysis	75
Trustworthiness.....	77
Limitations	77
 CHAPTER 4: INSTITUTIONAL, STEM, AND PROGRAM CONTEXTS	79
Overview of Jefferson State University	79
Jefferson State is Our Name, and Student Success is Our Game	80
Race Relations and Racial Experiences at Jefferson State University	82
STEM Academic and Social Spaces at Jefferson State University	83
College of Life and Physical Sciences	84
The Garret A. Morgan Program	84
Modifications in teaching and learning	84
College of Engineering and Computer Science	85
Multicultural Engineering Program.....	86
Segregation in academic spaces	86
Diversity course	86
Differential treatment for academic outcomes	87
Albert Einstein College	87
Louis Stokes Alliance for Minority Participation.....	88
Comprehensive STEM Program	90
CSP's Recruitment Process and Program Components	91
The History and Evolution of the Comprehensive STEM Program	93
Comprehensive STEM Program Evaluation Outcomes	99
Summary	101
 CHAPTER 5: FINDINGS: HOLISTIC SUPPORT.....	102
Academic	103
Summer Instruction	104
Recitation	106

Academic Advising	108
Help-seeking Behaviors	111
Study Skills and Habits	113
Habits of Mind	115
Transitional	117
College Literacy	118
Time Management.....	120
Summer Program as a “Bridge” between High School and College	122
Psychosocial.....	126
Being the “Only” One	126
Dealing with Bias in the Classroom Environment	129
Intersections of Racial and Gender Bias	131
Having Difficult Conversations	134
Focus on Performance and Building Competencies	135
Reinforce Students’ Belongingness and Contribution to STEM	136
Practical.....	137
Professional.....	138
Summary	141
 CHAPTER 6: FINDINGS: PROACTIVE CARING, COMMUNITY BUILDING, STEM IDENTITY DEVELOPMENT CATALYSTS, AND EMERGENT MODEL.....	 142
Community Building	142
Familial Atmosphere	143
Peer Relationships	146
Relationships with Staff	149
Peer Mentoring Relationships	152
STEM Identity Development Catalysts	155
Competence and Confidence-Building Practices.....	156
Undergraduate Research Experiences	158
Praise and Celebration.....	162
Proactive Caring.....	165
Staff Accessibility	165
Trust	167
Positive Motivation	169
Reinforcement	171
Encouragement.....	173
Student Accountability.....	174
Emergent Model.....	177
Summary	178
 CHAPTER 7: DISCUSSION, IMPLICATIONS, AND CONCLUSION	 181
Research Questions and Purpose Revisited	181
College Readiness	182
Summer Instruction and Mastery Learning.....	183
Academic Behaviors and Cognitive Strategies	184
College Knowledge	185

Institutional Retention.....	186
Proactive Caring.....	186
Common First-Year Experience.....	188
High-Impact Practices	189
Relationships	189
Wrap-Around Services.....	190
Academic Advising	190
Recitation.....	191
Financial and practical support.....	192
Professional development.....	192
STEM Retention	192
Psychosocial.....	192
Confidence, undergraduate research, and praise and celebration	193
Connections to the Model for Programmatic Influences on College Readiness and Retention among Underserved Students of Color in STEM	194
Implications for Practice	196
A Note to Start-ups.....	196
A Note to Existing Programs	197
Specific to CSP.....	198
Diversify speaker series.....	198
Heterogeneous mix of participants	199
More variety in summer course offerings.....	200
Bolster undergraduate research experiences.....	201
Faculty	202
Implications for Policy.....	203
Federal Policy.....	203
Institutional Policy	203
Implications for Future Research.....	204
Redefining Student and Institutional Success	204
Culturally Responsive Practice in Higher Education.....	205
Alternative Lenses to Explore the Experiences of Administrators and Students.....	206
Resiliency	206
Equitymindedness.....	207
Racial microaggressions	208
Implications for Theory	209
Conclusion	210
APPENDICES	213
APPENDIX A: IRB Approval Letter	214
APPENDIX B: Participant Solicitation Letter.....	215
APPENDIX C: Focus Group Protocol.....	216
APPENDIX D: Program Participant Interview Protocol.....	218
APPENDIX E: Alumni Interview Protocol	220
APPENDIX F: Administrator Interview Protocol*	222
APPENDIX G: Instructor Interview Protocol	224
APPENDIX H: Participant Consent Form.....	225

REFERENCES	226
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LIST OF TABLES

Table 3.1	Student Participants.....	74
Table 3.2	Aggregate GPAs, Math Placement Scores, and First Semester Math Grade.....	75
Table 3.3	First Semester Math Course.....	75
Table 4.1	White-Black and White-Hispanic Graduation Rate at Big Ten Universities.....	82
Table 4.2	CSP Program Development.....	99
Table 4.3	Retention and Graduation Data of Program Participants.....	100
Table 4.4	Math Placement Increases and Course Movement.....	100
Table 7.1	Program Components and Emergent Model.....	196

LIST OF FIGURES

Figure 1.1	Conceptual Framework.....	22
Figure 2.1	Percentage of STEM Degree Completions, 4-Year and 5-Year.....	28
Figure 3.1	Retention Rates in the STEM Disciplines at Jefferson State University.....	66
Figure 4.1	Undergraduate Race and Ethnicity at Jefferson State University.....	82
Figure 6.1	Model for Programmatic Influences on College Readiness and Retention among Underserved Students of Color in STEM.....	177
Figure 7.1	Model for Programmatic Influences on College Readiness and Retention among Underserved Students of Color in STEM.....	195

CHAPTER 1: INTRODUCTION

Statement of the Problem

Advancing the success of students of color in science, technology, engineering, and mathematics (STEM) is a pressing and complex issue. There are several trends (e.g., changing demographics, an aging workforce, and globally competitive market) which making improving retention and success among students of color important. First, approximately 50% of the United States population will be comprised of people of color by 2050 (U.S. Census Bureau, 2004). This demographic shift has implications for policies, practices, and outcomes in postsecondary education. There are systemic barriers that hinder students of color from completing their STEM degrees (Bayer, 2012). With support from governmental agencies and private industry, the creation of special programs improved institutional conditions such that more people of color could earn STEM degrees (George-Jackson & Rincon, 2012). However, shrinking budgets and increasing deficits threaten the sustainability of these government programs at a time when greater numbers of students of color are attending college (George-Jackson & Rincon, 2012). Minority STEM degree attainment remains relatively low. Only 2.7% of African Americans, 3.3% of Native Americans and Alaskan Natives, and 2.2% of Latinos who are 24 years old have earned a first degree in the natural sciences or engineering (National Academy of Sciences [NAS], 2010). These factors contribute to the concerns of higher education administrators and the national concerns for the development of future STEM professionals.

Second, an aging workforce coupled with a declining domestic interest and participation in STEM poses a national challenge. Fewer American college students are pursuing degrees in STEM. College students who begin in STEM programs are often “weeded out” early due to poor teaching, lack of appeal, or loss of interest (Jiang & Freeman, 2011; Seymour & Hewitt, 1997). This phenomenon reduces the number of STEM graduates and eligible professionals available to

assume existing and future jobs. As more “baby boomers” retire without an educated populace to fill their positions, lobbyists continue to pressure government to increase H-1B visa allotments (Yang, 2013). An H-1B visa is a non-immigrant visa allowing a U.S. company to hire a foreign professional for a “specialty occupation” for up to six years (United States Citizenship and Immigrant Services, 2009). A specialty occupation requires a specialized expertise of high degree. These individuals are usually hired for the technology sector to perform work in information technology or computer engineering (Mithas & Lucas, 2010). Many of the individuals employed have at least the equivalent of a 4-year U.S. Bachelor’s degree. National Action Council for Minorities in Engineering (NACME) posits that (2008) “although outsourcing and offshoring may be here to stay, depending on foreign countries to fill our requirements is not a long-term and tenable practice” (p.4). Experts also suggest relying on foreign professionals has implications for national security and economic prosperity (NACME, 2008; NAS, 2010). Thus, involving more domestic individuals of color in STEM careers would be a more sustainable solution.

Third, as a globally competitive market emerges the U.S. needs enough scientists and engineers for knowledge production and technological innovation. In the U.S. only 32% of students receive their degrees in science and engineering compared to Germany at 36%, China at 59%, and Japan at 66% (National Science Board, 2004). In 2004 alone, China graduated approximately 500,000 engineers, India 200,000, and the U.S. 70,000 (National Science Board, 2004). As many countries outperform the U.S. in STEM graduation rates, it becomes increasingly difficult to maintain prominence in science and engineering. This shortage in STEM talent affects job creation for Americans and stifles discovery in health, environmental science, and technology. STEM is tied to so many vital areas of life that failing to promote diversity of participation poses a threat to our national well-being (Palmer, Maramba, & Dancy, 2011).

Moreover, the federal government, private sector, and higher education have a vested interest in developing a talented pool of diverse individuals. These stakeholders believe attracting and retaining people of color in the STEM fields will meet this need.

Significant attention has been devoted to the recruitment and retention of underrepresented minorities in the STEM fields (Babco, 2003; Chubin et al., 2005; NAS, 2010). Yet, the retention and graduation rates of underrepresented groups are consistently lower than majority graduates. Only 15% of African American, 16% of Hispanics, and less than 1% of Native Americans earn a STEM bachelor's degree in six years, compared to 30% of Whites and 31% of Asian and Pacific Islanders (Chen, 2009). Among other factors, the lack of academic preparation poses a significant obstacle for many underrepresented groups pursuing STEM degrees (NAS, 2009, 2010). For instance, in 2012, less than 40% of African American, Native American, and Hispanic high school graduates who took the ACT met the College Readiness Benchmark in mathematics and science (ACT, 2012). The “substantial variation in K-12 mathematics and science education across schools, districts, and states” with different resources and student expectations play a critical role in preparation for a STEM college curriculum (NAS, 2010, p. 5).

Purpose and Research Questions

The purpose of this study is to understand how the strategies and practices employed in a STEM enrichment program facilitate college readiness and retention among underserved students of color in STEM. Many of these kinds of programs exist across the nation, but relatively little is known about how they help students prepare for and persist in the STEM disciplines. Descriptive studies and evaluations provide contextual information about the operations of the programs and student outcomes, yet few studies use a theory-driven approach to support empirical evidence about the program.

Additionally, this study seeks to generate new models for understanding how STEM enrichment programs influence the institutional environment in a manner that creates pathways to the STEM disciplines for underserved students of color at Predominantly White Institutions (PWIs). Given their underrepresentation in the STEM disciplines, there is much to be said about why they leave the STEM disciplines, but few studies explore what environmental factors contribute to their retention.

Thus, this study will focus on two research questions:

- How does a science, technology, engineering, and mathematics (STEM) enrichment program facilitate college readiness and retention among underserved students of color at a predominantly White, large, public, research university?
- What strategies and practices support academic and context-specific knowledge attainment, sense of belonging, and STEM identity development?

Why the “Leaky Pipeline” Exists

African American, Hispanic/Latino, American Indian, and Pacific Islander racial/ethnic groups are underrepresented at all levels of higher education, and especially in STEM fields and careers (Gonzales et al., 2004). There is a plethora of programs and interventions designed to recruit, retain, and graduate students of color in STEM, yet there is still a relatively low level of representation of domestic ethnic minorities participating in educational and professional contexts. Only 36% of people of color hold a bachelor’s degree in STEM (NCES, 2009), and less than 30% contribute to the STEM workforce (Strauss, 2011). Some scholars suggest there is a “leaky” pipeline preventing people of color from engaging in STEM starting in primary and secondary schools (George, Neale, Horne, & Malcolm, 2001).

Students of color disproportionately attend urban schools that are underperforming, under-funded, and under-resourced (Neckerman, 2007). Low-achieving or academically at-risk

students at these schools are often tracked into remedial courses that contain students with a range of needs and abilities (Bahr, 2010). These students are disproportionately Black and male, and this system leads them down a path of disengagement and underachievement (Palmer, Davis, Moore, & Hilton, 2010b). Of the 36% of African American males who graduate from high school many of them are functionally illiterate and/or in need of additional remediation (Palmer, et al., 2010b). In general, only 33% of Black males attend postsecondary education (Strayhorn, 2008). Many Black males who matriculate to college are enrolled in remedial math courses (Bahr, 2010). In many cases, students in remedial math courses will have to retake the course up to six times before they are eligible to transition to the next course. At each educational level, there are impediments, of a cumulative nature, that make it difficult for minority students to gain access to opportunities in STEM.

Black and Hispanic students, with high grade point averages and standardized test scores, are less likely to pursue STEM degrees in college because of “poor teaching in STEM courses, lack of encouragement from teachers and parents, and self-perception of their own inability to be successful in STEM majors” (George, et al, 2001, p. 13). According to President Obama, “more than 20% of high school students in math and more than 60% of students in Chemistry and Physics are taught by teachers who do not have expertise in these fields” (NAS, 2009, p. 9542). In urban schools the numbers are even more daunting; approximately 40 to 50% of those youth have math teachers without the adequate background to teach the subject (Lippman, Burns, & McArthur, 1996). This teacher shortage is expected to worsen over time. By 2015, more than 280,000 math and science teachers will be needed across the country (NAS, 2009). President Obama would like to restore “science to its rightful place,” but America will come up short if there is not a serious commitment to educating all of its nation’s citizens with a rigorous, comprehensive science education (NAS, 2009, p. 9541).

Another leak in the STEM pipeline is the early identification and preparation of gifted and talented children in minority or low-income school settings (Worrell & Erwin, 2011). The consequences of poverty-stricken environments such as limited resources, low student self-concept and motivation, and low expectations of students' abilities prevent teachers from preventing teachers from identifying students with high ability (Burney & Beilke, 2008). Prospective gifted and talented students need early exposure and preparation in foundational skills necessary to pursue an advanced, college preparatory curriculum later in their educational endeavors (Burney & Beilke, 2008). These factors are usually atypical in schools with high minority and low-income student populations (Kozol, 2012). Adequate support, caring, and encouragement are critical to the success of any student, especially students of color, but these attributes are often lacking in high poverty communities (Burney & Beilke, 2008). Living in poverty is not deterministic of underachievement; however, limited resources create unique hardships for students in these environments (Neckerman, 2007).

Underrepresented students who have access to advanced placement (AP) and honors courses, may attend high schools where the curricular standards are not parallel to their non-minority peers (Seymour & Hewitt, 1997). Intensity and quality of secondary school curriculum is one of the most important factors in bachelor degree completion for students of color (George, et al., 2001). Taking mathematics courses beyond Algebra II (i.e., trigonometry, pre-calculus) is particularly vital for Black and Hispanic students (George, et al., 2001). Only 33% of students from low-income backgrounds take math beyond Algebra II compared to 72% of their affluent counterparts (Adelman, 2006). Some college aspirants are even counseled out of taking AP courses by their high school counselors (Kozol, 2005, 2012). Instead they may be encouraged to enroll in vocational education courses (Kozol, 2005, 2012).

Studies show students of color enter higher education with the same level of interest in the STEM fields as their majority counterparts, but they persist in these majors at a lower rate than their majority peers (Anderson & Kim, 2006; Moore, 2006). In particular, Hispanic and African American students struggle in the last years to complete bachelors' degrees in STEM (Anderson & Kim, 2006). They are less likely to be deterred from pursuing a STEM degree in their first year of college because of experiences with "weeder" courses (Alexander, Chen, & Grumbah, 2009). In fact, the majority of underrepresented students do not leave the STEM disciplines until they reach junior status (Anderson & Kim, 2006). Understanding barriers and facilitators that shape the experiences of underrepresented minorities in STEM fields may prove helpful in increasing their retention and graduation rates. The proposed study will investigate how a STEM enrichment program can address college readiness and retention among underserved students of color.

STEM Enrichment Programs

In the 1970s and 1980s, minority programs offices were developed in natural science and engineering colleges to provide opportunities for minority students to transition into and succeed in the STEM fields (Shehab, Murphy, & Foor, 2012). Over time, structured programming including academic advising, mentoring, and tutoring was established to reduce attrition among students of color (Tsui, 2007). According to Tsui's (2007) literature review on increasing diversity in STEM fields, features of successful comprehensive include the following: recruitment strategies, assistance with admissions process, academic advising, tutoring in math and science courses, and summer experiences (Tsui, 2007). Unfortunately, some STEM enrichment programs cannot offer all of these services due to financial constraints and limited staffing. Some of these programs serve up to 400 students including new and recurring students. The staff typically consists of a director, assistant director or coordinator, and an administrative

assistant (Shehab, et al., 2012). The lack of staff also contributes to the quantity and quality of service that can be provided to the students.

The student population served varies such that there is intrusive programming for first year students and a provision of a few services throughout the duration of a student's college career (Burke & Mattis, 2007). Some programs have specialized assistance for each stage of the degree attainment process including internship, undergraduate research, and graduate school preparation opportunities (Hrabowski & Matton, 2009). These programs are often more costly to run. On average, programs cost \$1 to 3 million annually to operate placing them at risk for elimination during periods of fiscal restraints (Koenig, 2009; Watford, 2007). Many of these programs serve 50 students or less each year. George-Jackson and colleagues (2011), point out how these programs have been financially supported:

Programs were funded by a variety of sources including hard funds (i.e., committed campus, college or department level funding), soft funds (i.e. grant support, sporadic campus, college or department level funding), and corporate funds (i.e. support from the industry). The majority of programs were funded by a combination of these sources; few relied on a single source of funding (p.2).

Many STEM enrichment programs have proved to be a good return on investment. Successful programs have shown promise in sustaining science interest and strengthening preparation for college level work among students of color (Koenig, 2009; Mervis, 2007). Also, research indicates that students of color who participate in comprehensive STEM programs are more academically and socially integrated than students who do not participate in these programs (Chubin et al., 2005; Gasiewski et al., 2010).

STEM enrichment programs such as the Meyerhoff Scholars Program and the National Science Foundation Louis Stokes Alliance for Minority Participation (LSAMP) have garnered national attention for making significant strides in increasing the number of students of color pursuing STEM degrees. The Meyerhoff program is located at University of Maryland-Baltimore

County, and LSAMP is a national program available at a variety of colleges and universities across the United States. Most notably, Dr. Freeman Hrabowski, president of University of Maryland, Baltimore County, was recognized for his foresight and leadership contributing to a substantial number of African American PhDs in science and engineering who were Meyerhoff scholars (Steele, 2010). Though the Meyerhoff Scholars program has received much praise for the program and its students, critics assert the success of its program is a result of its “cherry picking” approach to student selection (Staples, 2006). Many of the students in the program have high standardized tests scores, strong high school GPAs, and substantial involvement in pre-college programs (Summers & Hrabowski, 2008). The rationale for only selecting “high-achieving” Meyerhoff scholars is that without such an intervention these students would still be unlikely to complete college or earn a STEM degree.

There are a growing number of students enrolling in higher education from first-generation backgrounds and underperforming, under-resourced high schools. As a result, many more students will begin their college careers in developmental math classes (Bahr, 2010). Research shows developmental math starters can still be successful with intentionally designed support. Unfortunately, there has been a shift in the mission and purpose of STEM enrichment programs from providing opportunities for all interested students of color to rewarding merit resulting in an increasingly rigorous selection process and qualification requirements of student participants. For instance, in a study conducted on STEM enrichment programs, researchers discovered that a substantial number of programs no longer admit academically underprepared students (Rincon et al., 2010). The administrators who were interviewed for the study stated that funding shortages and limited staff and resources contributed to decisions to exclude these students (Rincon et al., 2010). Rincon and her colleagues (2010) argue that this practice is contradictory to the historical objectives of large, public, research universities who have traditionally served more marginalized

students. Moreover, not only are these policies and practices harmful to individual students, but the overemphasis of meritocratic admissions requirements counteracts national goals to diversify the STEM educational and vocational pipeline (Babco, 2003; Chubin, May, & Babco, 2005).

The national priority is to encourage students from diverse backgrounds to pursue STEM degrees, which may require working with less prepared students (NAS, 2009). In fact, Historically Black Colleges and Universities (HBCUs) admit more academically underprepared, underrepresented students, yet these students are more likely to earn degrees in STEM disciplines. Furthermore, the literature shows that when students with marginal competencies are provided with the appropriate academic resources in a structured environment students overcome deficits (Seymour & Hewitt, 1997) and persist at higher rates than were initially expected according to institutional data and student trends (Burke & Mattis, 2007).

Previous studies that have investigated STEM enrichment programs have found it difficult to determine why these programs contribute to successful outcomes of their students. For instance, Watson and Froyd (2007) studied engineering intervention programs, and developed three categories of classification: 1) Interventions focused on community building by creating and sustaining networks to encourage peer support; 2) Interventions focused on cognitive development that are designed to assess deficits in academic ability and methods to improve them; and 3) Interventions that concentrate on vocational interests and exposure to careers and practice. Watson and Froyd (2007) contended that determining the effectiveness of an intervention may be challenging, because of the difficulty in extrapolating the factors that are impactful in achieving student success. Additionally, there is an overall lack of empirical studies that *explain* rather than *describe* STEM enrichment programs.

Significance of the Study

Numerous students of color enter higher education interested in pursuing a STEM degree; unfortunately, many of these students are underprepared to complete the rigorous curriculum. This lack of preparation necessitates institutional support to facilitate college readiness through pre-freshmen programs and student retention. Purposefully designed STEM enrichment programs can be instrumental in helping STEM students of color overcome academic and context-specific barriers. However, more scholarship is needed on STEM enrichment programs not only to describe what these programs do, but to explain how these programs assist underrepresented students and why they employ particular strategies and practices to do so. Such findings may help in establishing best practices and replication of services at other institutions.

Conceptual Framework

Previous scholars who have investigated how STEM enrichment programs support student retention employed Tinto's (1987, 1993) model of student departure as a conceptual framework (Fulilove & Treisman, 1990; Maton & Hrabowski, 2000; Stolle-McAllister, Santo Domingo, & Carillo, 2010). Specifically, these studies cite "academic and social integration" as the primary factors for the success of students of color in STEM. This framework has been highly criticized for several reasons: (1) it is not an appropriate framework for students of color, because it promotes complete separation from previous family and friends which are typical sources of emotional support for this population. (Kuh, Kinzie, Schuh, & Whitt, 2010); (2) it does not account for non-cognitive variables which may be a better predictor for student success for non-traditional students (Sedlacek, 2004; Melguizo, 2010); (3) the model was not tested for its ability to predict student success rather the framework was developed based on Durkheim's work on egotistical suicide; and (4) it does not address institutional involvement in student retention; student success is placed on the onus of the individual. These arguments substantiate the need for

another conceptual framework to explain how STEM enrichment programs might support retention among students of color.

As a result, I will draw upon several bodies of literature that support learning, growth, and success in the undergraduate experience. The literature provides both theoretical and practical perspectives concerning how underrepresented students succeed in STEM disciplines. There is a body of work that has to do with the kinds of knowledge that a student needs to succeed in a college setting (Bahr, 2010; Moore, Madison-Colmore, & Smith, 2003; Seymour, 1997; Treisman, 1992; Tsui, 2007). The literature also argues that their sense of belonging such as feeling cared for or connected to the university is a vital aspect related to their success (Hausmann, Ye, Schofield, & Woods, 2009; Hurtado & Carter, 1997; Locks, Hurtado, Bowman, & Oseguera, 2008; Strayhorn, 2012). Lastly, some literature points to science identity development as an important factor for student retention. Students who establish a sense of identity and see themselves as a scientist or an emerging scholar are more likely to persist (Cheemers, Zurbriggen, Syed, Goza, & Bearman, 2011; Eagan et al., 2013; Hurtado, Cabrera, Lin, Arellano, & Espinosa, 2009; Hurtado et al., 2011; Merolla & Serpe, 2013). The literature would suggest these are the streams of work that provide support and an experience that leads to success for STEM students. Thus, this study will apply the Expertise Model of Student Success (EMSS) (Padilla, 2009), sense of belonging (Strayhorn, 2012), and science identity (Carlone & Johnson, 2007), to understand how one STEM enrichment program aids in the retention of underserved students of color (see Figure 1.1).

Expertise Model of Student Success

This study investigates strategies and practices employed in a STEM enrichment program that address college readiness and retention among underserved students of color. Padilla's (2009) Expertise Model of Student Success (EMSS) is helpful to such an investigation as it

incorporates concepts relevant to organizational theory and teaching and learning principles. Organizational theory examines structures, policies, and institutional factors (i.e., key stakeholders) that advance and/or hinder the goals and objectives of an organization and its participants in the organization (Morgan, 2010). Teaching and learning principles reflect the active process of receiving and applying knowledge to pursue purposeful action (Lattuca & Stark, 2009). Organizational theory and teaching and learning are addressed in this framework in the concepts of barriers, knowledge, and action. In order for students to succeed in college they must be aware of the structural barriers and information or individuals that can help them overcome these conditions. Furthermore, EMSS will be employed as a theoretical lens examine how the STEM enrichment program accounts for factors (i.e. organizational, teaching/learning) that contribute to the retention of students of color.

The Expertise Model of Student Success is a theoretical model that “presents a particular understanding of student success by bringing together a set of concepts and the relationships that connect them” (Padilla, 2009, p. 8). Raymond Padilla (2009) designed this model to counter previous frameworks that had emphasized student attrition. He asserted that previous frameworks focused on student departure to ascertain methods for retaining students. However, this approach inhibited scholars and practitioners from exploring what contributed to successful student outcomes (Padilla, 2009).

Padilla’s model is based on Harmon and King’s (1985) expert systems theory and a qualitative research study. Harmon and King (1985) contended that compiled knowledge, a composite of theoretical and heuristic knowledge, needs to be accessible and useful for problem solving. Padilla applied these concepts to the college experience of Hispanic students asserting that successful college students (i.e., persistent students, college graduates) are experts who have used compiled knowledge to solve problems in the institution (Padilla, 1991).

In a study with Hispanic community college students, Padilla (1991) used the “unfolding matrix” with focus groups of successful students. The matrix was used to capture examples of barriers that students faced while earning their college degrees. Based on the identified barriers, students were then asked about knowledge acquisition and action taken to overcome these barriers. EMSS is based on four assumptions:

- 1) higher education scholars and administrators have been unable to determine why some students succeed and some students fail
- 2) the campus experience introduces challenges to students impeding their ability to matriculate and graduate
- 3) students who matriculate and graduate, also known as successful students, are experts at being students
- 4) to overcome institutional challenges embedded in the campus experience students must take effective actions (Padilla, 2009, p. 26).

These assumptions are the foundation for the Expertise Model of Student Success. They establish a baseline for the parameters of what is known about the student experience in postsecondary education including: “the barriers that students encounter, the knowledge they use to identify effective solutions, and the actions they take to actually overcome the barriers” (Padilla, 2009, p. 28).

Padilla (2009) posited that college educators are familiar with two elements of the college student experience, student inputs and outputs. Student experiences and backgrounds coming into the institution and their outcomes of graduation or attrition are known or can be determined qualitatively or quantitatively. However, the campus or institutional experience that students encounter is relatively unknown. In fact, Padilla (2009) asserts there are barriers in the institution that hinder students from being successful. To overcome these barriers, students must acquire a combination of heuristic and academic knowledge.

According to Padilla (2009), students begin their college careers with *initial* knowledge about the college experience, but they must acquire *total* knowledge (i.e., academic and

heuristic) to successfully complete college. Academic knowledge is campus independent. It includes information garnered from classroom learning such as laws, axioms, principles, and theories. In contrast, heuristic knowledge is campus dependent; this knowledge can be obtained through experiential learning. Heuristic knowledge may be considered the “rules of thumb” at a given institution. They include navigating financial aid or understanding the academic advising system (Padilla, 2009).

Moreover, successful students will realize what gaps exist in their knowledge base, both heuristic and academic, and take effective actions to ascertain that knowledge and complete necessary tasks to advance within the institution. The proposed study will utilize this framework to uncover the barriers that influence retention among students of color, the knowledge and actions necessary for success, and how the STEM enrichment program accounts for this information in their program development and support of students.

Sense of Belonging

Drawing upon Maslow’s (1954) hierarchy of needs model, Strayhorn (2012) posited that “...sense of belonging refers to a students’ perceived social support on campus, a feeling or sensation of connectedness, the experience of mattering or feeling cared about, accepted, respected, valued by, and important to the group (e.g., campus community) or others on campus (e.g., faculty, peers). It is a cognitive evaluation that typically leads to an affective response or behavior” (p. 3). Thus, an emotional connection to an environment and the people within it can motivate an individual to pursue purposeful actions and produce successful outcomes. In a college setting, these actions may include studying and attending class regularly, and outcomes may include earning good grades and persisting in college.

Hurtado and Carter (1997) utilized Bollen and Hoyle’s (1990) first dimension of perceived cohesion (i.e., an individual’s perceived connection to a social group), referred to as

sense of belonging in college student literature, to investigate how this construct was realized in the third year of college for Latino students. Unlike Tinto's (1993) revised framework, Hurtado and Carter (1997) pointed out that membership was not enough, but the cognitive notion that an individual played a role in the group's outcomes elicited an emotional response. Students who had frequent conversations with peers outside of class about coursework had a greater sense of belonging. Also, participation in religious and social-community organizations had the most significant impact on sense of belonging for Latino students (Hurtado & Carter, 1997).

Scholars assert that sense of belonging contributes to positive academic and social outcomes (Hausmann, Ye, Schofield, & Woods, 2009; Hurtado & Carter, 1997; Locks, Hurtado, Bowman, & Oseguera, 2008; Strayhorn, 2012). In a quantitative study using a national, multi-institutional data set, Locks and colleagues (2008) found that positive interactions with diverse peers contributed to a greater sense of belonging for students transitioning into college. Similar findings were discovered for Latino students and their interactions with diverse peers in the residence halls (Johnson, et al., 2007). Additionally, the quality and frequency of these interactions enhanced a student's sense of belonging. Programs that create opportunities for engagement among diverse students are essential for providing a supportive environment. Research also suggests that these opportunities may translate into student retention and academic achievement (Hausmann, et al., 2009).

Students who have a sense of belonging transition better into their institutions. Johnson and colleagues (2007) examined sense of belonging among first-year undergraduate students. It was discovered that students who made a "smooth social transition" from high school to college felt a greater sense of belonging in their institutions (p. 537). While survey items for smooth social transition included getting to know peers and roommates and making new friends, smooth academic transitions reflected experiences such as communicating with instructors outside of

class, finding academic help when it was needed, and forming study groups. Moreover, there has been much debate in the literature and practice concerning individual and institutional responsibilities in student retention at the collegiate level (Bowen et al., 2009; Harper, 2010; Museus, 2011). This study uncovered that faculty, staff, and peers play critical roles in creating supportive environments for students transitioning into college. Thus, Johnson and colleagues' (2007) findings "suggest that a more appropriate goal may be attending to students' sense of belonging through nurturing a mutual responsibility shared by the institution and individual" (p. 537).

Students experience a greater sense of belonging following participation in summer bridge programs (Strayhorn, 2012). Qualitative data suggest several features of the program contributed to this change in sense of belonging. For instance, Strayhorn (2012) highlighted that the summer bridge program began with an "elaborate opening ceremony" with administrators, faculty, and staff present to greet and welcome the students with encouraging and motivating words (p. 55). The peer engagement, faculty interactions, and participation in meaningful activities provided in these programs add to the experience of making students feel they matter and are cared about. In this study, Strayhorn (2012) also discovered that,

Students longed for the structure, sense of community, togetherness feelings, or connections that the summer bridge program afforded even after the program had ended and the Fall semester began. Almost half shared that they felt on their own or unsupported after the summer ended. (p. 57)

This discovery might suggest that an extension of these programs throughout, at least, the first academic year in college can lessen some of these feelings.

Central to the present study, sense of belonging is critical to the success of STEM students. "Belonging experiences" play a significant role in the decision for STEM students to persist or leave the major (Seymour & Hewitt, 1997; Strayhorn, 2012). Strayhorn (2012) found

sense of belonging to be statistically significant in relation to self-esteem and the frequency of the interaction with diverse peers. Additionally, sense of belonging was higher for students at the end of their undergraduate research programs (Strayhorn, 2012). Qualitative evidence revealed STEM students of color who lacked sense of belonging also experienced diminished identities, self-esteem, and confidence to pursue STEM. The intersectionality of the multiple social identities that a student encompasses is linked to belonging in STEM (Carlone & Johnson, 2007; Strayhorn, 2012). Thus, gender, race, and class may influence belonging experiences or lack thereof for STEM students.

Lastly, college students in STEM who feel that they belong may earn better grades in college. Using national data, Strayhorn (2012) uncovered the following,

Approximately 70 percent of students who feel a sense of connection or support in STEM fields earn better grades of B or better, on average, whereas almost half of students who do not feel a sense of belonging in STEM have failed at least one class since declaring their major. (p. 72)

This finding supports Hausmann and colleagues' (2009) work which asserted that students with greater sense of belonging perform better in college.

Science Identity

There is a growing body of literature exploring science identity and the role STEM enrichment programs play in cultivating a student's science identity (Cheemers, Zurbriggen, Syed, Goza, & Bearman, 2011; Eagan et al., 2013; Hurtado, Cabrera, Lin, Arellano, & Espinosa, 2009; Hurtado et al., 2011; Merolla & Serpe, 2013). Carlone and Johnson (2007) first conceptualized science identity from their work investigating successful female undergraduate and graduate students of color. They discovered the saliency of three components that contributed to the strong science identity of these women: performance, recognition, and competence. Performance is the ability to conduct "relevant scientific practices" such that one

demonstrates acquisition of academic language (e.g. scientific or professional terminology) and use of tools (e.g., laboratory materials, apparatuses). Recognition entails being acknowledged as a “science person” by one’s self and “meaningful others” such as faculty or scholars in the field. Competence consists of knowledge attainment and comprehension of science content; this construct may be less observable than performance (Carlone & Johnson, 2007).

The initial science identity model was derived from both practical and theoretical sources. For instance, the scholars began with constructing a prototype of a person who has a strong science identity. They also consulted existing theories of identity. Gee’s theory of identity (2000) argues that identity formation requires both an aspiration and pursuit to be *somebody*. It also necessitates that others see the person in this manner. Thus, “one cannot... [be] a particular kind of person (enacting a particular identity) unless one makes visible to (*performs for*) others one’s *competence* in relevant practices, and, in response others *recognize* one’s performance as credible” (Carlone & Johnson, 2007, p. 1190). To test their notions about science identity, they conducted an ethnographic study of 15 successful women of color at a large, public research university to discern how they negotiated and made meaning of their experiences in the science disciplines. In particular, they investigated the women’s’ development and maintenance and relationships between science identities and racial, ethnic, and gender identities.

Moreover, Carlone and Johnson (2007) posited that science identity is “situationally emergent and potentially enduring over time and contexts” (p. 1192). Thus, more salient science identities might emerge from students of color engaging in purposefully educational activities, and these identities will be strengthened through continuous exposure to project-based exercises and contexts in which they feel affirmed in their identities. The following sections provide research to support the importance of and prospective outcomes of students who participate in

STEM enrichment programs with particular attention to undergraduate research programs and opportunities.

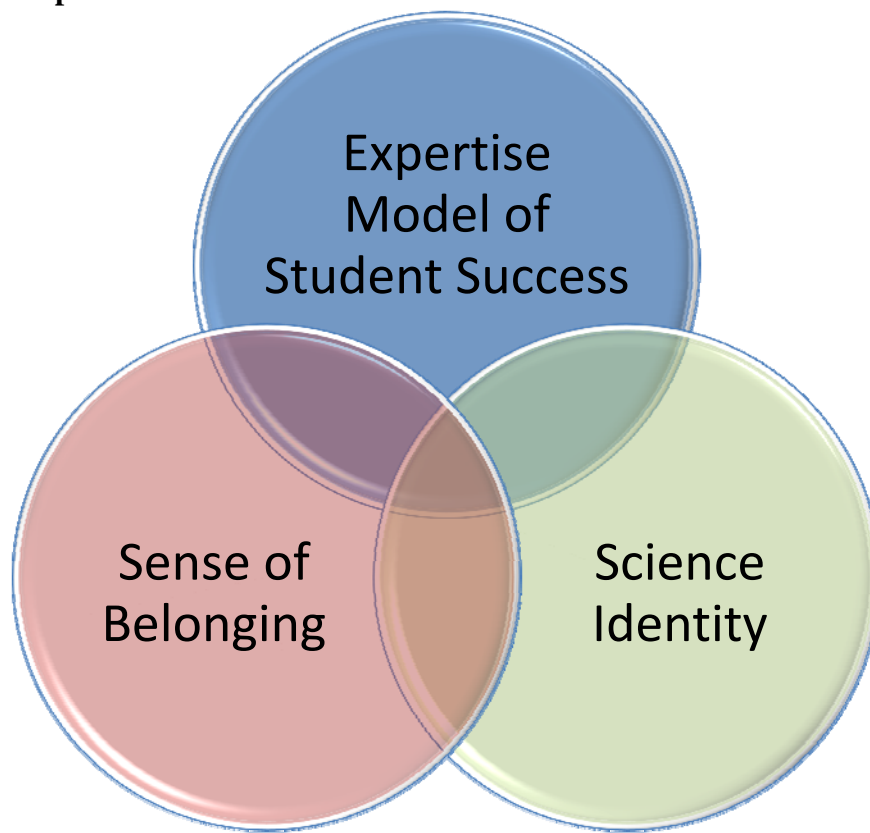
Underrepresented students who participate in scientific communities or STEM enrichment programs have more salient science identities than students who do not. In a study examining the experiences of first year Latino males in STEM, Lu (2013) found that Latino males who were in scientific communities were more connected to their major, sustained their interest in STEM, and perceived themselves as “scientists”. Latino male STEM collegians who were not a part of this community questioned their existence in a STEM major or failed to have social interactions with other STEM students (Lu, 2013). Scientific communities may include social interactions in laboratory work, team-based projects, and general course assignments. Furthermore, involvement in scientific communities creates experiences where students can develop and reflect upon shifts in their science identity.

Building social relationships is critical to developing one’s science identity. Once preparation has been addressed (if necessary at all), underrepresented students may become disinterested in STEM programs, because many of them lack the kinds of networks necessary to succeed in the courses and after degree completion the profession (Merolla & Serpe, 2013). For instance, Treisman (1992) discovered that Black students underperformed in their math courses in comparison to Asian students, largely because they did not study with other students. Once he established a structured program to facilitate interactions around the common interest of succeeding in mathematics, many of the Black students outperformed Black non-participants and the general student body in the college of engineering of Engineering (Treisman, 1992).

Studies show underrepresented students who participate in undergraduate research are more likely express intentions to pursue graduate or professional education (Eagan et al., 2013) and subsequently enroll in these programs (Carter, Mandell, & Maton, 2009; Merolla & Serpe,

2013). Using inferential statistics, Eagan and colleagues (2013) were able to demonstrate that participation in undergraduate research significantly influenced minority students' intentions to enroll in graduate education more than other factors such as faculty support and retention in science. These findings may have to do with the holistic nature of undergraduate research programs which catalyzes the socialization process of becoming a scientist. Undergraduate research programs help students build important networks for academic and professional success and science identity development (Carlone & Johnson, 2007; Merolla, Serpe, Stryker, & Schultz, 2012; Hunter, Laursen, & Seymour, 2007). Unfortunately, the researchers also discovered a relatively low participation rate of 20% of underrepresented undergraduate students in structured research programs (Eagan et al., 2013). Given the findings of this study, researchers argued that postsecondary institutions should do more to ensure there is an equitable representation of underrepresented students in these types of programs through addressing impediments to access and STEM pathways. The current study provides an example of institutional agents (e.g., program directors, faculty, and staff) dealing with the barriers that inhibit access to these types of programs for underrepresented students.

Figure 1.1 Conceptual Framework



Note. This Venn diagram illustrates the integrated conceptual framework undergirding the current study. Each circle represents a model advanced to understand institutional and/or STEM retention among students of color: the Expertise Model of Student Success (EMSS) (Padilla, 2009), Sense of Belonging (Strayhorn, 2011), and Science Identity (Carlone & Johnson, 2007).

Key Terms

The following terms appear frequently throughout this document. Some of these terms can be defined in a variety of ways. These definitions provide some clarity about the usage of these terms in the context of this study.

College readiness. College readiness is the combination of the skills, knowledge, disposition, and behaviors essential to successfully engaging in the academic, social, and cultural collegiate environment.

Predominantly White Institution (PWI). This term indicates postsecondary institutions “whose student populations have historically been White and whose student populations remain predominantly White” (Brower & Ketterhagen, 2004).

Retention. In this study, retention corresponds to an institution’s ability to engage and support students so that they maintain enrollment.

STEM. The science, technology, engineering, and mathematics (STEM) acronym consists of academic majors, research disciplines, and occupations in the environmental, life, and physical sciences; computer sciences; all branches of engineering excluding engineering education; and general mathematics, applied mathematics, and mathematical statistics (ACT, 2012; Museus, et al., 2011).

Students (or people) of color. This term describes students who identify as Asian American or Pacific Islander, Black, Hispanic, or Native American.

Student success. Successful students “persist, benefit in desired ways from their college experiences, are satisfied with college, and graduate” (Kuh, Kinzie, Schuh, Whitt, and Associates, 2010, p. 8).

Underserved students. Green (2006) defined historically underserved students as “low-income students, those who are first in their families to attend college, and students of color” (p. 21). In the context of the STEM disciplines, this definition should also emphasize women of color and include students who have math placement below Calculus.

Summary and Outline

In this chapter, I discussed the underrepresentation of minorities in STEM as a national interest and institutional challenge. Some minority underrepresentation in STEM may be due to difficulties encountered prior to entering college and exacerbated at the college level due to institutional barriers. In some cases, STEM enrichment programs serve as a buffer to alleviate

some of the pressures faced by students of color in STEM. Yet, few studies uncover how and why these programs retain students of color especially those populations who may be academically underprepared. The chapter concluded with the Expertise Model of Student Success (Padilla, 2009), sense of belonging (Strayhorn, 2012), and science identity (Carlone & Johnson, 2007) to be used as a conceptual lens in the proposed study.

In chapter two, I review previous research on characteristics of students of color in STEM and factors that influence college readiness and retention. The chapter closes with an overview of evidence-based, successful STEM enrichment programs and a rationale for what this study adds to the existing literature.

In chapter three, I describe the aims of this study and why case study is an appropriate methodological approach. Next, I provide an overview of the research site and the specific program to be studied. Then, I address my positionality as a researcher. I conclude this chapter with my data collection methods, data analysis, and limitations.

In chapter four, I provide an in-depth overview of Jefferson State University and its STEM colleges. Then, I report on the Comprehensive STEM Program's history, development, and relationship to the National Science Foundation (NSF) Louis Stokes Alliance for Minority Participation (LSAMP).

In chapter five, I discuss, *holistic support*, one of the four major emergent themes. Chapter six contains the remaining three themes: *community building*, *STEM identity development catalysts*, and the *caring ethos*. Following the discussion of themes, I provide an overview of the *Model for Programmatic Influences on College Readiness and Retention among Underserved Students of Color in STEM* that emerged from this study.

This study concludes in chapter seven where I utilize the findings and relevant literature to answer the research questions that guided this study. Then, I provide implications for practice, policy, future research, and theory.

CHAPTER 2: LITERATURE REVIEW

There is an extensive body of literature on the experiences of underrepresented students in STEM. The literature spans journal articles, anecdotal content, scholarly studies, periodicals, editorials, and quantitative, qualitative, and mixed methods. The current literature covers an array of individual and institutional challenges and best practices for serving students of color in STEM. Studies and data that focus on individual dynamics explore social, economic, cognitive, and noncognitive factors that shape the disparate circumstances of students of color. Some of these studies disaggregate the experiences of underrepresented STEM students by gender (Ong, Wright, Espinosa, & Orfield, 2011; Malcom & Malcom, 2011; Moore, Madison-Colmore, & Smith, 2003; Palmer, Davis, Moore, Hilton, 2003), race and ethnicity (Alexander et al., 2009; Crisp, Nora, & Taggart, 2009), and major or discipline (Chubin, May, & Babco, 2005; Hurtado, Cabrera, Lin, Arellano, & Espinosa, 2009; May & Chubin, 2003). Many of the landmark studies addressing the state of underrepresented groups in STEM are orchestrated by policy institutes and federal government agencies (Babco, 2003; NAS, 2010). These studies entail implications for researchers, practitioners, and policymakers (Babco, 2003; George et al., 2001). This chapter reviews literature related to the following: characteristics of students of color in STEM, factors that influence college readiness, and factors that influence student retention.

Characteristics of Students of Color in STEM

Many studies have examined the conditions that contribute to the underrepresentation of minorities in STEM (Castro, 2012; Griffith, 2010; Museus et al., 2011). Racial and ethnic minorities may experience and need to overcome different kinds of challenges to earn a STEM degree because of their multiple identities of marginalization (Fries-Britt, Johnson, & Burt, 2013). This concept is known as intersectionality. The intersections of race, gender, class, and parental education play a substantial a role in the kinds of access, exposure, and preparation

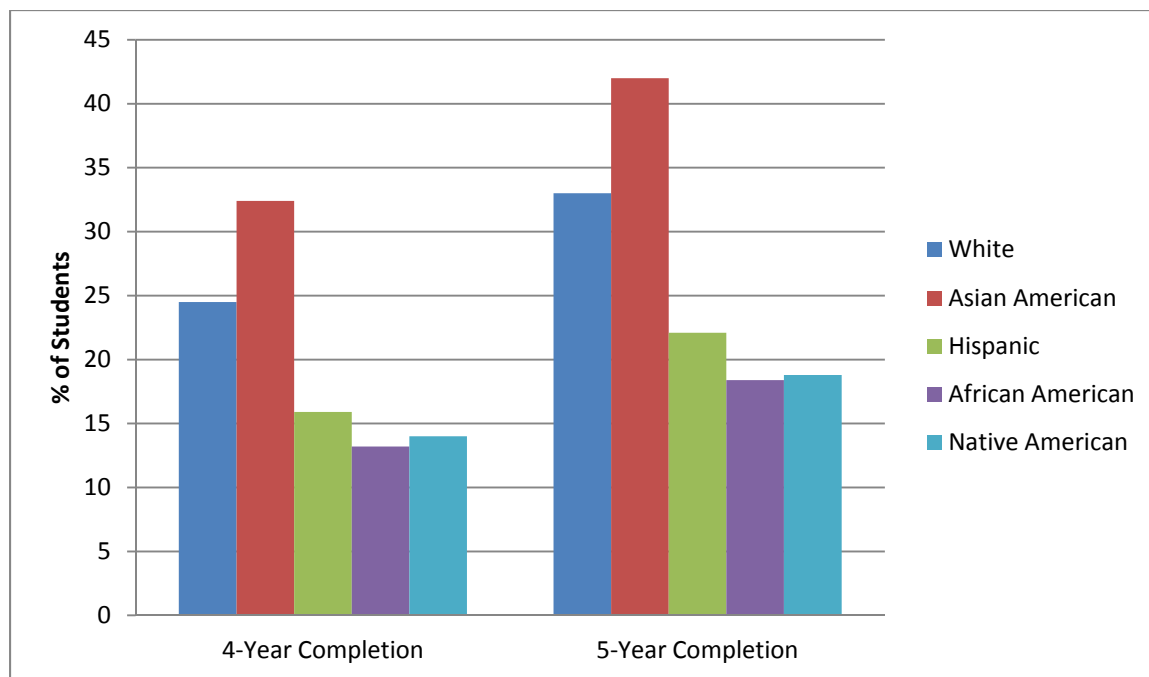
necessary for success in STEM. For instance, a woman of color from a low-income background may be least likely to earn a STEM degree due to a multitude of reasons (Espinosa, 2011). She may have attended a high school that did not offer advance math courses (Kozol, 2012). She may have internalized messages that suggested women were incapable of doing math (Else-Quest, Hyde, & Linn, 2010; Nosek & Smyth, 2011). Or, she may have lacked exposure to women of color scientists and engineers who could have served as role models (Espinosa, 2011). The literature shows that many of these factors influence whether or not underrepresented students will pursue and achieve in the STEM disciplines (Anderson & Kim, 2006; Nassar-McMillan, Wyer, Oliver-Hoyo, & Schneider, 2011). The following sections provide an overview of the research on students of color in STEM with attention to other identity factors (e.g., socioeconomic status) that affect their pursuits and success in the STEM disciplines.

Race

Current changes in undergraduate enrollment depict the growth and shifts in demographics of the U.S. college-age population (National Science Foundation (NSF), 2013). Although underrepresented minorities are less likely to attend college or graduate, they have a steadily increasing presence in higher education (NSF, 2013). Students of color who attend college are more likely to enroll part time and attend public 2-year colleges and for-profit academic institutions (Snyder & Dillow, 2011). In the sciences and engineering, the most significant increase of bachelor degree attainment for students of color has been in computer science. Since 2000, participation of underrepresented groups in engineering and physical sciences has not changed, and mathematics has decreased substantially (NSF, 2013). For instance, in 2006, African American, Hispanic, and Native American students garnered 5%, 6.9% and .5% of engineering degrees while representing 12%, 11.5% and .79%, respectively, of the total U.S. population (NSF, 2008). Throughout the STEM disciplines, students of color lag

behind their White and Asian American counterparts. A 2009 report produced by the Higher Education Research Institute at UCLA shows wide gaps in the four and five year STEM completion rates. Whites and Asian Americans who started as STEM majors have a four year completion rate of 24.5% and 32.4% respectively. African American, Hispanics, and Native Americans are 13.2%, 15.9%, and 14% respectively. Five-year graduation rates of Whites and Asian Americans are 33% and 42% respectively. Regarding African Americans, Hispanics, and Native Americans, their completion rates are 18.4%, 22.1%, and 18.8% respectively (Higher Education Research Institute, 2010). Figure 2.1 illustrates the 4-year and 5-year degree completion rates for White, Asian, African American, Hispanic, and Native American students according to the aforementioned report.

Figure 2.1 Percentage of STEM Degree Completions, 4-Year and 5-Year



Source: Higher Education Research Institute, 2010

Studies show Black and Latino students begin college interested in STEM at rates higher than or equal to their majority peers, and they persist in STEM longer (Alexander et al., 2009;

Anderson & Kim, 2006; Museus & Liverman, 2010; Seymour & Hewitt, 1997). STEM switchers of color often do not leave STEM disciplines until they reach junior status (Anderson & Kim, 2006). The point at which students of color depart from STEM majors may indicate challenges with academic preparation rather than motivation. In previous studies, faculty contended that students of color left STEM disciplines because of their lack of motivation (Treisman, 1992); however, new research showed faculty believed preparation was a more significant hindrance to success in STEM (Bayer Corporation, 2012). Additionally, some department chairs asserted that if students of color were given similar academic preparation as their majority peers, they would be just as likely as majority students to complete their STEM degrees (Bayer Corporation, 2012). Preparation is only one of the many factors that influence STEM student persistence among students of color. Other factors such as the institutional environment may also cause students of color to underperform in their pursuit of STEM degrees.

Often times, administrators are unaware of the barriers that students of color deal with during their college experience (Bayer Corporation, 2012). Thus, they may choose to investigate the unique experiences of this student population (Bayer Corporation, 2012). In a study investigating the performance of students of color in pre-health gateway courses at six California colleges, researchers discovered that Blacks, Latinos, and Filipinos were earning lower grades than their White counterparts (Alexander, et al., 2009). These students were also more likely to have attended under-resourced high schools and have lower admission test scores. Through statistical analyses, researchers uncovered that gaps in academic performance existed even after they adjusted for academic underpreparedness. They suspected that environmental factors present in the institution may have contributed to the lower grades, and not just a disadvantaged academic background. These finding suggests that a positive and welcoming collegiate environment is just as important to providing academic support for students of color pursuing

STEM degrees (Alexander, et al., 2009). Moreover, the increasing number of students of color in college is not reflective of their participation in the STEM fields. Many students of color face unique challenges related to the various aspects of their identity; these elements will be discussed further in the following sections.

Gender

There are gender differences in STEM participation and attrition (Tan, 2002). Greater numbers of women than men can be found in college, but they are not as likely to be in STEM programs. In the biological sciences, women are approaching parity with men (Perez-Felkner, McDonald, Schneider, & Grogan, 2012). However, men outnumber women in engineering, mathematics, and computer science (Perez-Felkner et al., 2012). There have been several reasons cited in the literature for their absence in these disciplines. First, some scholars suggest that the low numbers of women in these disciplines is due to their interest in pursuing degrees in “helping professions” (Burke & Mattis, 2007). Some women believe that these professions do not contribute to the well-being of people in the same manner that health-related careers do (Burke & Mattis, 2007). Second, some women lack confidence in their abilities to perform well in mathematics at the collegiate level (Perez-Felkner et al., 2012). Third, women are less likely to feel a sense of belonging and more likely to have difficulties building connections with faculty and peers (Johnson, 2012). The aforementioned factors play an important role in the decisions of women to persist or leave STEM. Research shows there are interventions that can aid women in overcoming these challenges and completing their STEM degrees; however, administrators are often unaware that women are facing these barriers (Bayer, 2012).

Men and women of color experience unique circumstances as they work to ascertain their STEM degrees. Unfortunately, much of the literature on women in STEM centers on the experiences of White women (Malcom & Malcom, 2011). Scholars suggest women of color

confront an uncomfortable existence with their “double bind” status as they assert themselves in STEM fields (Malcom et al., 1976; Malcom & Malcom, 2011; Ong, et al., 2011). The double bind construct emphasizes the experience of women of color in a doubly oppressive state for being female and a person of color in White, male dominated fields. For instance, women of color find it difficult to develop relationships with faculty and peers (Johnson, 2012). Many faculty members are more concerned with relaying the subject material than establishing relationship with their students. Likewise, women of color have a difficult time establishing study groups when other minority women are not involved (Ong et al., 2011). As a result, many women of color feel alienated in their STEM disciplines and identify culturally-related groups to participate in outside of their departments (Johnson, 2012).

Women of color. Women of color have better experiences with pursuing STEM degrees at Minority Serving Institutions (MSIs) (Giguette, Lopez, Schulte, 2006; Lent et al., 2005). Several studies point out stigmas may be removed in these institutional settings, allowing women to be judged and treated based on their own merit (Giguette, et al., 2006; Lent et al., 2005). In Predominantly White Institutions (PWIs), some women of color contend that they cannot be their “whole” selves in STEM environments (Ong, 2005). They often have to change their appearance, attire, and/or mannerisms to fit it. This fragmentation behavior poses unique challenges for women of color and their struggle to thrive in STEM settings (Ong, 2005). Yet, women of color are not alone in their struggle to be recognized as equally intelligent and skilled as their majority peers. Though minority males pursue STEM degrees in greater numbers than their female counterparts, they encounter some of the same issues as women in STEM.

Men of color. Palmer and colleagues (2010b) suggested that the United States is a “nation at risk” if it is unable to close the racial achievement gap among African American males and their female and White male counterparts. Until recently, there has been a dearth of

knowledge on the successful academic experiences of African American male subsequent collegians. Some scholars posit the lack of attention to the needs of males in postsecondary education and emphasis on females may have contributed to their decline in college attendance, persistence, and degree completion and the reverse effect for the latter (Lee & Ransom, 2011). Starting in high school, African American girls outperform their male counterparts as much as nine to one in academic performance and graduation rates (Lee & Ransom, 2011). Throughout the other racial/ethnic categories, there are disparities in male college attendance and performance; however, the gaps in the African American are much more substantial even in some STEM disciplines. In 2012, African American women earned more medical degrees than African American men; the former received more than 63% of the total MDs awarded to African Americans (AAMC, 2012a). In that same year, female degree recipients altogether earned 48% of the medical degrees awarded (AAMC, 2012a). This disparity among African American males has motivated some medical schools to establish pipeline programs (AAMC, 2012b). Moreover, women still lag behind their male counterparts in many STEM disciplines, but they are reaching parity in some areas.

Socioeconomic Status

Economic factors may be the most vital component influencing college persistence and completion in modern society. Tuition rates are steadily rising, and non-loan based financial aid is not keeping pace with the changes in college costs (George-Jackson, Rincon, & Garcia, 2011). Disparities in socioeconomic status are more pronounced than ever as pre-college educational opportunities affect one's preparedness for college and subsequent college experiences (Rincon et al., 2010). Economically advantaged students are more likely to have high-quality primary and secondary education, and they are less likely to be burdened in college with the shortcomings of financial constraints such as working too many hours, lacking cultural capital, or refraining from

social engagement (Anderson & Kim, 2006; Walpole, 2003). These differential experiences have an impact on degree completion. For instance, 68% of adults from high socioeconomic backgrounds earn a bachelor's degree by age 26 compared to 9% of those from low socioeconomic backgrounds (Bowen et al., 2009). Low-income students are more likely to switch out of a STEM major, leave college, and/or take longer to complete their degrees (Museus et al., 2011). Since underrepresented minorities are disproportionately low-income, “socioeconomic factors that affect persistence may inaccurately appear to be related to racial or cultural differences” (Anderson & Kim, 2006, p. 13). Furthermore, the intersections of racial and economic minority status may create less than ideal circumstances during a student's college experience.

To counteract the disparities encountered by low-income students of color, numerous studies have shown the benefits of providing these students with financial aid (Hrabowski, 1998; May & Chubin, 2003). Some of these studies contend that students should be provided with sufficient financial aid to influence their major choices and degree completion (May & Chubin, 2003; Titus, 2006). In a qualitative study with 70 students of color, researchers discovered that participants would not have engaged in the STEM research programs if they had not received stipends (Gasiewski et al., 2010). Though these students realized the value-added of research experience to a college education many of the students had to work to pay for their education (Gasiewski et al., 2010). As one administrator suggested, the students' financial situations could impede their ability to complete a research project if they were volunteering, because they would not have the time to work, take classes, and conduct research. Moreover, adequate financial support can positively impact the outcomes of economically disadvantaged students of color in STEM.

First-Generation College Student Status

First-generation college students are less apt to attend or complete college (George-Jackson, 2010, NSF, 2013). They encounter a multitude of challenges preparing for, entering, and persisting in college (George-Jackson, 2010). Unlike some college educated parents, parents of first-generation students, who did not attend college, are less likely to be familiar with and knowledgeable about the college-going process (Adelman, 2005; Anderson & Kim, 2006). Other information that the parents may lack is navigating financial aid and helping students deal with the academic and social challenges of college life (Winkle-Wagner & McCoy, 2013). For first-generation students uninvolved with college activities or support programs the path to earning a college degree can be isolating, alienating, and overwhelming (Winkle-Wagner & McCoy, 2013). These conditions negatively influence student retention and degree attainment.

Tinto's (1987; 1993) Theory of Individual Departure sheds light on the conditions under which students leave institutions of higher learning. He argued that students who are unable to integrate academically and socially may not be retained (Tinto, 1987; 1993). According to Tinto, academic and social integration requires that students experience both formal and informal encounters. Formal encounters are systematic aspects of the institution's organization (i.e., class standing) while informal encounters (i.e., peer support) are interactions outside of the academic setting (Tinto, 1987). Depending on the institutional type, a first-generation student may not have acquired enough cultural capital to engage in informal encounters with faculty or students (Berger, 2000). These students may lack the language or knowledge of artifacts associated with the prevalent socioeconomic status at that institution. As a result, the student may feel less comfortable continuing their education in that setting.

First-generation college students may have a difficult time adapting to the new environment due to their lack of cultural capital (Braxton, 2000). Pre-college experiences and personal and environmental factors may hinder their ability to be successful, too (Tinto, 1993). First-generation college students' paths to higher education are shaped with uncertainty, limited information and resources, and minimal support (Choy, 2001). These students are less likely to enter college preparatory programs or take advanced courses in high school (Choy, 2001). As a result, many first-generation students are not expected or encouraged to attend college (Chen, 2005). For students who decide to pursue higher education, their parents usually do not help with the admissions process (George-Jackson, 2010). This process can be tedious including filing applications, taking standardized tests, and making institutional selections (Choy, 2001).

Once first-generation college students enter postsecondary institutions new challenges arise. These students usually experience transitional issues such as rejecting old norms, leaving behind friends and family, and experiencing stress from the lack of academic preparedness (Chen, 2005; Choy, 2001). Interventions designed to predict these challenges and develop programming to aid students in overcoming them result in better college experiences for first-generation students.

In this section, I presented some of the challenges students of color face in STEM relative to their multiple identities. This section examined the varied and disparate circumstances modern students encounter. The aforementioned issues and concerns are not indicative of all ethnic minorities in college and/or STEM. However, as postsecondary education becomes increasingly racially and ethnically diverse an awareness of the unique and varied experiences of these students is necessary to identify and institute appropriate institutional support. The experiences of students of color pose unique challenges and opportunities for institutional policy and

practices. Moreover, the findings illustrate the need for special programming to increase the retention and graduate rates of these populations.

Factors that Influence College Readiness

College readiness is one of the most pressing issues of modern higher education. Many students enter high education lacking the requisite skills to do college-level work. Additionally, students may be less equipped to navigate the collegiate system. Recent studies provide insight on the characteristics and outcomes of students who are more or less college ready. For instance, Strayhorn (2014) found that first-generation and lower-income students tend to underperform on college readiness benchmarks. Jackson and Kurlander (2013) uncovered that college ready students graduate on time. College ready students also had a .2 higher cumulative GPA, and they were 6.1% more likely to persist to their second year in college. Bettinger and colleagues (2013) contend that college readiness is one of the most predictive factors for student success. Thus, any efforts that institutions can exert to help underserved students become better prepared for college should be considered and instituted.

Policymakers, researchers, and institutional leaders have considered various strategies to address college readiness. Recent efforts have applied David Conley's (2010) framework for understanding college readiness (Baber et al., 2010). This framework contains four interactional components: key cognitive strategies, key content, academic behaviors, and contextual skills awareness. Key cognitive strategies include intellectual capabilities, dispositions, and behaviors that are critical for college-level work. Key content knowledge encompasses the foundational skills, concepts, and principles specific to an academic subject. Academic behaviors entail the activation of educationally purposeful activities such as study skills, self-management, and interpersonal skills. Lastly, contextual skills and awareness refer to "college knowledge" (p. 10).

This type of knowledge is essential for navigating the norms, cultures, and values of the college system.

College-Level Skills and Abilities

Much of what Conley (2010) argues is that college students leave high school without the fundamental skills, attitudes, and behaviors that are essential to their success in college. For instance, Bloom's taxonomy of educational objectives (Bloom & Krathwohl, 1984) provides a framework for learning goals. In the revised version, these categories are remember, understand, apply, analyze, evaluate, and create (Krathwohl, 2002). Scholars point out that in high school students may be only required to use the lowest level (i.e., remember and understand) of cognitive skills (Landis, 2013). Yet, in the first year of college, professors may expect students to use higher-order thinking skills such as apply and analyze (Landis, 2013). Additionally, within the first two years of college students may have to evaluate and create in their STEM courses (Landis 2013). This disconnect between high school and college expectations may be even more detrimental to underserved students (Kuh, 2007). For instance, McCarthy and Kuh (2006) found that more than 90% of high school students desire to attend college, but few engage in activities that will facilitate good performance in college. Results from the High School Survey of Student Engagement (HSSSE) revealed that students only study three or fewer hours per week, which is significantly less than the 13 to 14 per week average for first year students at four-year institutions (Kuh, 2007). In a recent study of Black and Latino males in a New York City school district, most students self-reported that they study zero hours per week (Harper, 2014). Moreover, interventions seeking to raise the academic achievement of underserved students must be prepared to confront and address these gaps.

Using mastery learning techniques and teaching metacognitive strategies have been advanced in the literature as methods for dealing with gaps resulting from poor pre-college

academic preparation (Guskey, 2007; Komarraju & Nadler, 2013; Malhotra & Mehta, 2015; Michael, Dickson, Ryan, & Koefer, 2010). Mastery learning allows for teachers to differentiate their teaching practices in support of student learning styles (Guskey, 2007). The mastery learning instructional process entails assessment, feedback, correctives, and enrichment (Bloom, 1983; Guskey, 2007). Specifically, Guskey (2007) posits that:

Teachers who use mastery learning provide students with frequent and specific feedback on their learning progress through regular, formative classroom assessments. This feedback is both diagnostic and prescriptive. It reinforces precisely what students were expected to learn, identifies what they learned well, and describes what needs to be learned better (p. 11).

Further, a willingness to adapt instruction to meet the needs of learners yields greater understanding of the material and an ability to learn and apply strategies for more difficult concepts later.

In combination with mastery learning, many educators teach metacognitive strategies as part of their feedback mechanism (Baker, 2013). For instance, an instructor might ask a student to consider what they might already know about a particular math problem. Throughout the problem solving period, the instructor will monitor the student's activities and help the student compare their thinking process with their outcomes (Guskey, 2007). Several studies show that these practices help students improve their aptitude and perform well in high-stakes testing environments (Dignath & Buttner, 2008; Mevarech & Amrany, 2008). Yet, relatively little is known about how these strategies might be applied in postsecondary contexts (Sablan, 2014).

Self-management (e.g., time management) and study skills are other areas that many high school students lack prior to coming to college. As noted earlier, students fail to spend adequate time studying (Harper, 2014; Kuh, 2007). Some of this stems from an inability to self-regulate or lack of awareness about what constitutes as studying (Conley, 2010; Landis, 2013). Research shows that students who are able to self-regulate persist through difficult tasks and earn better

grades (Komarraju & Nadler, 2013). Also, students with effective study skills demonstrate higher levels of academic competence (Malhotra & Mehta, 2015). Though these findings are not novel, they reinforce the importance of teaching college students these skills so that they can maximize their academic experiences. Unfortunately, underserved students are less likely to be taught these skills unless they engage in a special program (Venezia & Jaeger, 2013). What is even more daunting is that students may not know they lack these skills until they arrive to college ill-equipped to apply them (Conley, 2010).

Experiences with Mathematics

Relative to the STEM disciplines, mathematics is a critical subject area necessary for successful degree completion. Many urban schools have math and science teachers who do not possess degrees in these disciplines (NAS, 2010). Some scholars suggest that the disproportionate number of youth of color who have access to algebra is a civil rights issue warranting national attention and action (Moses & Cobb, 2002). A disproportionate number of youth of color do not encounter an algebra course until high school, which is behind their White peers who largely begin taking algebra in the eighth grade (Stinson, 2008). Parental involvement plays an important role in students of color gaining access to algebra courses prior to high school. Stinson's (2008) study indicated that students who took an algebra course in the eighth grade had highly involved parents who had a vested interest in their children's educational endeavors. This level of involvement is rare for youth of color, because they may be the first in their families to excel in educational settings.

Berry (2008) studied the successful experiences of eight African American middle school boys with mathematics. These students were deemed exemplars, because they were earning high grades in Algebra I. Many of these young men had been identified as academically gifted in elementary school and/or participated in pre-college programs that were significant contributions

to their academic excellence. Berry (2008) discovered that early educational experiences, self-efficacy, support systems, and positive math and academic identities were vital elements to these students' performance. While this study provides a necessary counterstory to the cultural deficit thinking, the participants in this study had been mathematically strong throughout their education such that their success reinforced their sustained performance. The likelihood that these students will persist in STEM degrees is very strong. Yet, few students of color experience encouragement and positive reinforcement about their academic competencies.

Efforts to Address College Readiness

Conley (2007) suggests that secondary schools should better align to college standards. Thus, some school districts have instituted various strategies to improve college readiness (Conley, 2007). For instance, UIUC's Office of Community College Research and Leadership (2010) conducted a two-year evaluation of a partnership between Illinois high schools and community colleges. They found that Conley's framework illuminated the complexities of addressing college readiness and considerations for designing and implementing initiatives geared towards college-level preparation. These changes and subsequent outcomes are too early to determine the utility of such efforts. This study offers a purview of the difficulties of dealing with inadequately prepared students in postsecondary contexts (Perna & Jones, 2013).

With the gradual shift to amend secondary school standards to meet college expectations, higher education administrators still have to respond to the growing number of students with a myriad of skills and abilities that may or may not deem them college ready. Consequently, many colleges and universities offer summer bridge programs and first-year seminars, many of which focus on aspects of Conley's (2010) framework. Yet, relatively little is known about the practice and efficacy of such initiatives (Sablan, 2014). Sablan (2014) also noted the abundance of quantitative studies that fail to provide evidence of the cultural and social experiences of students

in the summer bridge programs. Consequently, St. John and colleagues (2014) applied a mixed-method, action research methodological approach to a summer bridge program at Midwest University. Researchers found that, in addition to the supplemental math instruction, the program provided coaching, mentoring, peer help and collaboration, and other support services.

The matters reviewed in this section explored aspects of the college readiness conundrum. The extant literature underscores that students lack many of the requisite skills and experiences necessary for a successful transition to college. K-12 educational leaders and policymakers are working to improve conditions in secondary contexts to bolster college readiness, yet until those goals are realized higher education leaders employ strategies such as summer bridge programs to facilitate academic achievement and retention. The challenges surrounding college readiness also necessitate research that informs decision-makers about what works in ensuring that students are adequately prepared (Reynolds & DesJardins, 2009). The final section covers a variety of factors that influence student retention in postsecondary institutions.

Factors that Influence Student Retention

There are a number of factors that influence student retention. Some of these elements are discussed here to illuminate potential impediments and facilitators to student retention especially among underserved students of color. Moreover, these factors play an instrumental role in shaping the academic and social contexts of the college-going experience.

Institutional Type

Nearly 66% of full-time students pursuing bachelor's degrees at four year colleges and universities attend public universities (Bowen, Chingos, & McPherson, 2009). Yet, only 40% of students who start their degrees at a four-year institution finish in four to six years (Bowen et al., 2009). Numerous challenges impede students from completing their degrees. In research-

intensive, flagship universities, obstacles to student success may be exacerbated due to competing forces and pressures. Yet, many American students attend research universities due to their “institutional prestige and substantial resources” (Lattuca & Stark, 2009, p. 27).

Research-intensive, flagship universities have served a critical role in providing access to higher education for underrepresented students. In particular, for STEM students, these institutions connect students of color with faculty who are involved with scientific discovery and exploration. Students who are exposed to this kind of research in curricular or co-curricular settings may be more motivated to learn (NAS, 2010). Additionally, these institutions have greater offerings of scientific majors and programs. Yet, some scholars suggest that flagship universities have shifted away from their traditional missions of educating underrepresented and low-income citizens especially within their own state (Rincon et al., 2010). Due to reductions in state funding, these universities are recruiting and admitting more out-of-state and international students which may redirect student support and attention from academically and financially underserved students. These dynamics as well as other environmental factors experienced in these institutions threaten to impede the success of vulnerable student populations.

The literature cites several reasons for STEM attrition among students of color in research intensive universities including lack of minority faculty role models (NAS, 2010), competitive peer-to-peer interactions (Espinosa, 2011), emphasis on research and fostering graduate students (Griffith, 2010), lack of diversity (Fries-Britt et al., 2013), and unsupportive institutional culture and climate (Hurtado et al., 2009). Dealing with these environmental factors in addition to adjusting to the academic rigor, teaching practices, and expectations of research intensive universities can create less than ideal conditions for student success (Gasiewski, 2010). In other institutional contexts such as MSIs, students of color persist and graduate at much higher rates, because many of these environmental barriers may be minimized or absent altogether

(Giguette, Lopez, Schulte, 2006; Lent et al., 2005). For instance, only 14% of Black students attend Historically Black Colleges and Universities (HBCUs), but many of these institutions graduate more than 70% of their students (Journal of Black Higher Education, 2012). In contrast, more prestigious public universities such as University of California-Los Angeles confer degrees at a much lower rate (Bowen et al., 2009). Brazzell and Reisser (1999) surmised that students have better outcomes at MSIs because of four good practices exercised in these institutions: (1) student-centeredness, (2) opportunities to participate, (3) pride, (4) student-faculty relationships. More recent studies show research-intensive universities developing initiatives to address these areas for minority students, but progress has been gradual and in some cases nonexistent (Hurtado et al., 2010).

Ethic of Care

The Documenting Effective Education Practice Project (DEEP) was a two-year study of effective educational practices in postsecondary institutions (Kuh, Kinzie, Schuh, & Whitt, 2010). Based on National Survey for Student Engagement (NSSE) data, researchers identified institutions with high rates of engagement given their student populations and institutional characteristics (i.e., size, selectivity, location) (Kuh et al., 2010). One successful model that emerged from this study was the “student-centered ethic of care model” (Manning, Kinzie, and Schuh, 2006) (p. 98). Manning and colleagues posited that this model focused on “care and relationships” (p. 98). They cited Gilligan (1982) and Noddings (1984) as undergirding this form of practice in “response to student needs; services geared toward the goal of facilitating student success; integrated services, policies, and programs, and practice centered on an ethic of care” (p. 98-99).

Gilligan’s (1982) research on moral development advanced a caring perspective with attention to the value of relationships, connections, and interdependence in decision-making and

responsiveness. For instance, a care-oriented response to someone in need would consider the *caring thing to do* rather than the *right thing to do according to the rules*. Gilligan also contended that care is not an innately feminine quality, she revealed that:

The different voice I describe is characterized not by gender but theme. Its association with women is an empirical observation, and it is primarily through women's voices that I trace its development. But this association is not absolute, and the contrasts between male and female voices are presented...to highlight a distinction between two modes of thought and to focus a problem of interpretation rather than to represent a generalization about either sex (p. 7).

Thus, expressing care is not a gender-specific behavior. The ability to and interest in showing care centers on a certain mode of thinking given a set of circumstances. This way of thinking is not inherently feminine, but a human response or feeling of responsibility to act on the behalf of someone else.

Building on Gilligan's work, Noddings (1984) applied notions of care to educational environments suggesting that caring relationships can be instrumental in supporting student achievement (Noddings, 1984). According to Noddings (1984), a caring relationship requires that the caregiver (e.g., administrator) understands the cared for (e.g., student) from his or her perspective (Noddings, 1984). For instance, Noddings (1984) asserted that engrossment and motivational displacement are components of the caring relationship. Engrossment entails being sympathetic towards students' circumstances. Motivational displacement posits that "when I care...my motive energy flows toward the other and perhaps, although not necessarily, towards his ends...I allow my motive energy to be shared; I put it at the serve of the other" (1984, p. 33). As a result, the caregiver minimizes his or her needs to advance the needs of the student.

Furthermore, student affairs professionals who employ the ethic of care model recognize that some students have been historically underserved by the educational system. Thus, practitioners supply students with the academic and social skills necessary to succeed in college.

Institutions who apply this model to institute programs and services such as orientations programs, college success seminars, and specialized career services. Some of the strengths of this model are the availability of carefully crafted resources, time devoted to students, and belongingness experiences. Yet, notable weaknesses are the amount of time necessary to meet students' needs and concerns with seeming too paternal (Manning et al., 2006).

Student Engagement

Student engagement is the “quality of effort and involvement in productive learning activities” (Kuh, 2009, p. 6). In particular, engagement has been linked to first year retention. For instance, Kuh and colleagues (2008) used NSSE data to determine if engagement in the first year of college influences first-year grade point average and first to second year persistence. Results revealed that engagement in educationally purposeful activities led to better grades and higher rates of persistence. In another study, Berger and Milem (1999) examined first-year retention at a private, highly selective research university. They found that early involvement in the fall semester predicted spring semester involvement. Students who had these early involvement experiences were more academically and socially integration integrated and had higher rates of institutional commitment and persistence. The study also confirmed that early peer interactions contribute to stronger perceptions of institutional and social support. These studies suggest that early engagement in educationally purposeful activities contributes to a number of important factors that are critical for student retention. As a result, increasingly higher education institutions incorporate effective engagement practices into their colleges and universities. Specifically, Kuh (2010) identified 10 evidence-based practices that promote engagement and deep learning. These practices include the following: (1) First-Year Seminars and Experiences, (2) Common Intellectual Experiences, (3) Learning Communities, (4) Writing-Intensive Courses, (5) Collaborative Assignments and Projects, (6) Undergraduate Research, (7) Diversity/Global

Learning, (8) Service and Community-Based Learning, (9) Internships, and (10) Capstone Courses and Projects. He argued that these practices may be more beneficial for underserved students. Yet, NSSE data illuminated that these practices may be least accessible to this student population.

Academic Advising

There are three advising styles discussed in the literature: prescriptive, developmental, and proactive (Varney, 2012). Prescriptive advising entails a one-direction form of communication in which the advisor is perceived as all-knowing and the student is a passive receptacle (Fielstein, 1994). The onus of responsibility is on the advisor who informs the students how to proceed. Developmental advising applies a shared and collaborative approach in which students are both knowers and learners. The advising style is a culmination of supportive measures related to course selection, program planning, and career exploration (Crookston, 1972). Lastly, proactive advising (formerly intrusive) is defined as a “deliberate structured student intervention at the first indication of academic difficulty in order to motivate a student to seek help” (Earl, 1988, p. 28).

In the mid 1970s, Glennen (1975 as cited in Varnery) surmised that advising should be combined with counseling practices in order for advisors to develop relationships with students and provide resources for students prior to their solicitation. Consequently, a group of voluntary faculty advisors were trained to examine student files for potential barriers to their success (e.g., pre-college academic performance) (Glennen, 1975). According to Varney (2012) proactive advising involves: intentional interventions, deliberately learning about students and their interests, proactive advising to enhance the likelihood of student success, informing students of all their options, and reaching out to students before challenges arise. Moreover, the extant literature affirms that a more proactive form of advising is critical to the retention and success of

marginalized students (Varney, 2012; Varney 2007). More recent research shows that the number of advising meetings a student attends positively correlates with their likelihood of retention by 13% (Swecker, Fifolt, & Searby, 2013).

Developmental Education

Student demographics in American higher education have changed due to a greater participation of students of color, women, adult learners, first-generation college students, international students and students from low and working class backgrounds (Zusman, 2000). Similarly, they enter higher education less academically prepared and in greater need of remedial education and English as Second Language courses (ESL) (Pascarella & Terenzini, 2005). Academic preparedness stems from family circumstances and educational deficits that can be identified as early as kindergarten (Bahr, 2010). Even at this age, children enter school with a range of abilities, skills, and levels of exposure to education (Bahr, 2010). Unfortunately, efforts to remediate educational deficits may be too deeply rooted in years of academic shortcomings (Bowen et al., 2009).

In a quantitative study investigating the fall 1995 cohort of first-time college freshmen who enrolled in California's community colleges, Bahr (2010) discovered that Blacks and Hispanics were overly represented in remedial mathematics. Though college level remedial mathematics is intended to bridge gaps for marginalized students, Blacks and Hispanics experience mathematical remediation at lower rates than their White and Asian counterparts. More than 25% of Whites and 33% of Asians attain college math skill within six years compared to 20% of Hispanics and 11% of Blacks in the same time span. There are opportunities for intervention at the college level such as strategic targeting and programming for underserved students. Bahr (2010) also suggests examining the role of academic advising in these students'

academic careers as well. The present study is significant, because it provides insight on the success stories of remediation.

Some opponents of remediation in postsecondary contexts claim students who begin in remedial mathematics are highly unlikely to continue in STEM. On the contrary, studies show participation in developmental mathematics can help students strengthen their math skills and persist in STEM majors (Bahr, 2010; Crisp, Nora, & Taggart, 2009). When remediation is properly executed Black students have the opportunity to persist in a manner similar to their non-Black peers (Bahr, 2010). Similarly, Hispanic STEM majors who attend HSIs are not hindered by their start in developmental math courses; in most cases, they graduate with STEM degrees (Crisp, et al., 2009). One institution responded to the inequitable enrollment of students of color in remedial education by implementing the Equity Scorecard, a process and data tool (Bensimon & Malcom, 2012). This initiative that explored the state of remedial education for underrepresented students became known as the Math Project at Los Angeles City College (Bustillos & Rueda, 2012). The purpose of the Math Project was to investigate why African Americans and Latinos were underperforming in remedial mathematics courses compared to their White and Asian and counterparts. The team of faculty members and practitioners conducted individual interview with eleven students who had completed the Learning and Study Strategies Inventory (LASSI) survey and were enrolled in remedial mathematics courses. It was discovered that students who performed poorly in these courses “lacked clarity regarding educational goals and the value of school” (p. 125). The authors asserted that incongruent life and school goals hindered the students from engaging in good study habits and attention towards their academic responsibilities (Bustillos & Rueda, 2012). Based on the data collected, the team recommended that math tutorial services increase their staff and hours to accommodate student needs and that a mathematics developmental workshop be implemented. The latter

recommendation would require students to enroll in the workshop (that met twice a week for the semester) to a) improve their math study skills, b) work on related subject matters presented in lecture, c) collaborate with peers in an active learning environment, and d) complete practice exams to prepare for in-class examinations (Bustillos & Rueda, 2012).

Tutoring

Tutoring has been linked to academic and social benefits for underserved students. For instance, Laskey and Hetzel (2011) conducted a quantitative study of students admitted through a conditional admissions program. Results showed that students who regularly attended tutoring had higher GPAs and retention rates. In addition to the benefits of receiving academic support, the researchers concluded that the relationships developed with tutors aided in their success. To test this assumption, researchers combined tutoring and mentoring responsibilities in an intervention designed to raise the academic outcomes of underserved students (Khazanoy, 2011). 70% of students with regular attendance passed the course. Several mentees who were considered “very high risk”, according to an initial diagnostic test, earned tests scores within the top 15% of their class. Many of the students attributed their success to the mentors and the course instructor. One student commented that her mentor’s caring demeanor and ability to “push” resulted in a passing grade after two failed attempts (Khazanoy, 2011).

Research shows that some students of color may be less apt to take advantage of tutorial services (Ticknor, Shaw, & Howard, 2014). In a study assessing the usage of tutorial services, Ticknor and colleagues (2014) discovered that Black students were less likely to use drop-in tutorial services. To mitigate these circumstances, the researchers proposed that the tutorial center should focus on course-related learning, foster an anti-deficit approach to academic support, and create a sense of belonging for students (Ticknor, et al., 2014). Further, they

suggested that future studies should examine what prevents Black students from using tutorial services.

Self-Confidence

A search of the literature regarding underrepresented groups and self-confidence in the context of the STEM disciplines yielded an overwhelming number of studies on women (Heaverlo, Cooper, & Lannan, 2013; Inkelas, 2011; Litzler, Samuelson, & Lorah, 2014). These results indicate two plausible realities: (1) little research deals exclusively with self-confidence and students of color, or (2) women are more likely than men to report concerns with self-confidence (Litzler, et al., 2014). Relative to the latter, the extant literature shows that interventions designed to improve women's self-confidence have worthwhile outcomes. Stewart and Osborn (1998) found an experimental physics course to be effective in helping women achieve gains in self-confidence and attitudes toward science careers. In another study comparing women in a single-sex STEM living-learning program and non-participants, Inkelas (2011) uncovered that living-learning participants had higher confidence in their math or engineering courses. Non-participants were more likely to exhibit low-confidence behaviors "such as dropping a class, doing less well in a particular class than expected, and feeling overwhelmed by homework" (p. 32). These findings have implications for other underrepresented or marginalized groups in STEM such that program interventions might be helpful in raising their self-confidence.

Navigating Racial Climate

Institutional climate is a factor often difficult for students to articulate, yet; it differentially alters the experiences of underrepresented minorities at Predominantly White Institutions (PWIs) (Hurtado, Milem, Clayton-Pedersen, & Allen, 1998). Numerous studies have identified the unfortunate consequences of racism for students of color attending PWIs (Feagin,

Vera, & Imani, 1996; Hall & Rowan, 2001; Harper, 2009; Picca & Feagin, 2007; Smith, Allen, et al., 2007; Smith, Yosso, et al., 2007; Solórzano et al., 2001; Swim et al., 2003). For instance, Feagin et al. (1996) conducted a qualitative study utilizing student and parent focus groups to discern “context and meaning” for Black students at a PWI. The findings of the study indicated that campus culture including symbols, artifacts, and space provided a racialized context to the institution (Feagin et al., 1996). As a result, student participants felt like “outsiders” within the institution and yearned for physical space that would not be perceived as anti-White (Feagin et al., 1999). Additionally, the participants contended that the university implemented poor recruitment and retention strategies (Feagin et al., 1996). Alums of the institution attributed their success to personal determination and intentionally disregarded the institution’s involvement in their matriculation (Feagin et al., 1996). According to Feagin et al., (1996) the participants used language such as “perseverance,” “endurance,” “battle,” and “struggle,” to describe their “academic careers” (Feagin, et al., p. 143). Unfortunately, these sentiments are not exclusive to this study.

Swim et al.’s (2003) qualitative study employed a diary methodology to document the experiences of more than 50 students with “everyday racism.” Findings revealed that, for college students, “the frequency of racism ... [occurs] ...about once every other week in the form of incidents that are probably or definitely prejudiced and once a week if more ambiguous incidents are counted” (Swim, et al., 2003, p. 59). Student participants identified instances of verbal expressions of prejudice, staring behaviors, and challenges with intercultural interactions. Research suggests that the recognition and response to racism depends on one’s positionality, context, and/or stage of development (McGee & Martin, 2011; Ortiz & Santos, 2009). Other researchers contend that individuals are less likely to define a situation as racist if it is not an overt act (Picca & Feagin, 2007). Whether the racist experiences are overt or covert they can be

emotionally impactful contributing to feelings of anger, reductions in comfort levels, and heightened levels of fear or threats (Harper, 2009; Swim et al., 2003). Moreover, Swim, et al.'s (2003) study adds to the existing literature that demonstrates how racism operates in college settings and may distract students from their intended academic purposes (Ortiz & Santos, 2009).

In STEM contexts, students often feel the need to prove to White students, staff, and administrators “wrong” about their intellectual ability in the classroom. In a qualitative study using a grounded theory approach to develop a framework for understanding African American male engineering persistence, scholars constructed the “prove them wrong syndrome” to explain this phenomenon (Moore, Madison-Colmore, & Smith, 2003). Participants experienced lowered expectations from White engineering professors, complications forming study groups with White peers, and false accusations about contributions to group assignments. To counteract these experiences the participants sometimes engaged in maladaptive behaviors such as “pushing harder” or working to outperform their White peers. These behaviors can be harmful to the psychological and emotional well-being of students of color. For instance, the mental health community might refer to these practices as John Henryism. John Henryism “refers to the predisposition to engage in active high-effort coping with environmental stressors” (Lehto & Stein, 2013, p.). In STEM contexts where high achieving performance and competitiveness are prevalent, underrepresented students may become overwhelmed, burn out, and drop out of these programs. Moreover, poor racial climate serves as a barrier to the persistence of students of color in STEM. Although students may identify racism as a barrier if they do not have productive coping strategies, there likelihood of persistence significantly decreases (Moore, Madison-Colmore, & Smith, 2003).

Overall, African American male students encounter more racially-motivated adversity in educational settings than their female and non-Black counterparts (Dancey & Brown, 2008;

Harper, 2010; Kunjufu, 1986). In higher education, Black men are often the victim of racial profiling, hypersurveillance, Black misandry, and other forms of gendered racism (Smith, et al., 2007a; Smith, et al., 2007b). These encounters negatively shape the interactions Black male collegians have with faculty, staff, and students at PWIs. For instance, Harper (2009) employed the term “niggering” to describe the diminished expectations of African American male college students. Unfortunately, these lowered expectations shared by faculty, staff, and students position Black male collegians to be stigmatized as “dumb jocks, affirmative action beneficiaries who were undeserving of admission, unprepared, and at at-risk” (Harper, 2009, p.700; Smith et al., 2007a; Smith et al., 2007b; Solórzano et al., 2000; Dancy & Brown, 2008; Hall & Rowan, 2001).

Peer Support

The most common themes concerning peers in the STEM discipline were: (1) peer influence on academic and social outcomes, (2) the institutional role in helping students develop their peer groups, (3) the value of peer mentoring to student success. In this section, I discuss several studies that report the aforementioned findings.

In a study investigating the experiences of students of color pursuing STEM degrees at a PWI, Palmer and colleagues (2011) found that peer support served two purposes: (1) academic assistance and (2) positive social experience. Academic assistance entailed support for understanding academic concepts and reducing anxiety about exams. The students also valued taking similar courses with academically-focused peers. Many of these students maintained these same friend groups throughout college. They also emphasized that these peers helped them to develop a familial atmosphere (Palmer, Maramba, & Dancy, 2011). Students received encouragement and motivation from peers which were critical for self-efficacy and affirmation for their STEM major selection.

Chang and colleagues (2014) suggested that postsecondary institutions should be more intentional in helping students to establish peer groups. Using the Cooperative Institutional Research Program's 2004 The Freshman Survey (TFS) and 2008 College Senior Survey (CSS), they examined factors that contributed to the persistence of students of color in STEM. They found that students who were a part of clubs and organizations were significantly more likely to persist in STEM. Chang and colleagues (2014) conjectured that being a part of disciplinary-based clubs and organizations enabled students to "engage meaningfully with other students who share similar academic interests and trajectories, institutions also provide more opportunities for students to study together" (p. 569). These findings are consistent with Espinosa's (2011) study of 1,250 women of color in STEM. She uncovered that women of color who met with peers to review course content and participated in STEM-related groups were more likely to persist in STEM than women of color who did not engage in these same behaviors (Espinosa, 2011).

Larose and colleagues (2011) assessed the outcomes of students engaged in a peer-mentoring program designed to reduce attrition in math, science, and technology disciplines. Short-term impacts showed an increase in motivation, better understanding of career decisions, and greater social adjustment. Success and persistence rates were also greater than a comparison group. In another study investigating the influence of peer mentoring on self-efficacy, researchers saw gains in self-efficacy among women and students of color from lower-income backgrounds. Lastly, Tenenbaum and colleagues (2014) conducted a qualitative investigation of a near-peer mentoring program. Both near peers and student mentees experienced personal, educational, and professional benefits including greater interests in pursuing a STEM degree.

Faculty Interactions

Findings have been mixed regarding student engagement and relationship development among faculty and students of color in STEM (Ong et al., 2011). In general, students of color are

more likely to have positive experiences with faculty outside of the classroom (e.g., engaging in undergraduate research) than within the classroom (Hurtado et al., 2010; Ong, et al., 2011).

Outside of the classroom students are able to spend significant and worthwhile time with faculty members learning about and participating in their research endeavors whereas in the classroom the interactions are often disconnected, less engaging, and potentially hindered by stigmas and misconceptions of students of color (Harper, 2009; Ong et al., 2011).

NAS (2009) reported that in 2006 African Americans, Native Americans, and American Indians comprised approximately 28% of the U.S. population, and only 9% of STEM graduates and employees. In a 2010 Bayer Corporation survey addressing the underrepresentation of women and individuals of color in STEM, more than 75% of women and respondents of color asserted that girls and children of color are “not identified, encouraged, or nurtured to pursue STEM studies early on” (International Communications Research, 2010; p. 13). Additionally, college professors (44%) were most frequently cited for discouraging women and students of color in pursuing STEM degrees.

Cultural deficit thinking has an unfortunate influence on college faculty and administrators. Though their perspectives may appear to be racially neutral, students of color are disproportionately affected by these negative stereotypes, because they are largely the students who begin postsecondary education in remedial mathematics (Harper, 2009). Some scholars (McWhorter, 2001; Ogbu, 2003) suggest that Black youth try to appear less intelligent, because their peers may not accept their scholarly behavior. Many studies have counteracted this finding, yet dominant groups still use this perspective to affirm their interactions with underrepresented groups (Stinson, 2006). For instance, Treisman (1992) surveyed over 1000 STEM faculty to determine their perceptions about why students of color may leave STEM disciplines more than White students. The most cited response was a lack of motivation. In contrast, Seymour and

Hewitt (1997) discovered that students of color were more motivated than Whites to pursue STEM degrees, yet they were often underprepared to pursue their degree interest. The literature shows lack of preparation stems from poor pre-college academic experiences. Furthermore, cultural deficit thinking can be harmful to the success of underrepresented STEM students in need of academic support.

Undergraduate Research

There are a growing number of studies identifying the importance of undergraduate research involvement in strengthening science identities and commitment to and persistence within STEM disciplines for students of color (Carter, Mandell, & Maton, 2009; Jones et al., 2010). Undergraduate research participants of color indicate that research experience has the most significant impact in their preparation for the profession and graduate studies in STEM (Kendricks & Arment, 2011). Also, findings suggest that African American students perform better in research settings when there is a structured, “family-oriented” environment with supportive faculty and peers (Kendricks & Arnett, 2011).

Establishing a science identity, which can be accomplished through undergraduate research opportunities, may be more important for students of color than their White and Asian counterparts (Hurtado et al., 2010). In a study with urban youth who were instructed to draw images of scientists, their pictures often resembled “White, nerdy, male caricatures with white lab coats” (Shannon, 2010). Difficulties with seeing oneself as the professional identity that one aspires to may influence one’s decision to leave the major (McGee, 2009; Seymour & Hewitt, 1997). Likewise, many scholars assert that self-efficacy and confidence is a greater predictor of success than cognitive variables for non-traditional students (Sedlacek, 2004). Self-efficacy is another component of science identity.

STEM Enrichment Programs

Many postsecondary education institutions value diversity, and they willingly admit potentially academically at-risk students (Kuh et al., 2010). Though admitting these students is the first step to creating a more equitable, pluralistic society, institutions of higher learning must do more to support and retain these students (Renn & Reason, 2013). Transition and special support programs have a reputation of helping students succeed at research-intensive, flagship universities (Kuh et al., 2010). These programs should focus on supporting academic and social adjustments and personal development of their participants. These programs demonstrate that success in college is a collective process rather than an individualistic process (Kuh et al., 2010). Many non-traditional students come from communities where collectivism and family is valued (Carson, 2009). Reproducing these kinds of environments on college campuses is critical to improving the persistence of students of color in STEM.

As noted earlier, STEM enrichment programs provide access to critical resources and activities necessary for acclimation and matriculation in STEM. These programs are designed to ensure persistence, retention, and academic success of its students. Former participants contend that connection to STEM peers and support with graduate school aspirations are additional benefits of these programs (Stolle-McAllister, Santo Domingo, & Carillo, 2010). Students who take advantage of these services are more academically and socially integrated, and in many cases outperform and graduate at higher rates than their peers who do not use the services (Hrabowski, Marton, & Greif, 1998).

These programs allow students to establish peer groups with similar interests and abilities. Due to the disparate environment and circumstances where students of color attend primary and secondary school, they may be less likely to encounter such individuals before college. Many studies have shown that small numbers of high-achieving students of color are

tracked into similar courses; this experience can be isolating and alienating. In higher education, students of color in STEM may be more likely to interact with peers of the same ethnic group in different academic majors (Cole & Espinoza, 2008; Ong et al., 2011). Thus, when they encounter academic hardships it may be much easier to change their majors to a non-STEM discipline, because they can find more support from peer groups of similar racial backgrounds (Cole & Espinoza, 2008).

Furthermore, there are numerous enrichment and academic intervention programs; however, only a few programs have published empirical studies (Museus et al., 2011). Much of the information available about these programs appears in magazines (i.e., *Science*) and educational periodicals (i.e., *Chronicle of Higher Education*) not in top-tiered scholarly journals. Additionally, many of these articles are descriptive and lack generalizable data (Jones, Barlow, & Villarejo, 2010). In the absence of rigorous studies there is relatively little known about what contributes to the success of these programs and their students. In the following sections, I describe some of the well-known, successful programs.

Minority Engineering Program. The Minority Engineering Program (MEP) has been replicated at more than 100 universities and privately sponsored programs (May & Chubin, 2003). Students who participate in the MEP programs are retained in engineering at a higher rate than non-participants. Ray Landis (1988), the founder of the program, discovered that persistence rates of the underrepresented students who participated in the program were not only better than underrepresented non-participants but the overall engineering cohort. Some of the success of the program is that students feel a greater sense of connectedness to their peers and engineering community at-large. Still, some campuses with MEP programs have high attrition rates, suggesting that merely having a program does not render positive outcomes for students. The MEPs most successful at retaining students contain strong recruitment practices, summer

programs, study centers, tutors, and significant amount of institutional funding (May & Chubin, 2003; Tsui, 2007). Additional empirical studies explaining factors and practices that facilitate student retention may be helpful in improving the status of these programs and their ability to assist students in their STEM degree pursuits.

The Mathematics Workshop. While investigating group differences in first-year calculus students, Uri Treisman (1992) found that homework completion and test preparation was connected to group performance. Students who performed well in these areas worked in study groups where they shared academic and institutional information, reviewed assignments, and taught methods for completing difficult problems. Eventually, this concept was used to establish an honors program to counteract “debilitating patterns of isolation by emphasizing group learning and a community life focused on a shared interest in mathematics” (Treisman, 1992, p. 368). Along with the calculus course, an “intensive” workshop was implemented in which five to seven students collaborated twice a week for two to three hours on challenging, well-crafted problems. Participants of color in the program who received low standardized test scores prior to university admittance were outperforming White and Asian students with high test scores. Moreover, this program was the first of its kind, and it later became known as the Emerging Scholars Program after being replicated at many institutions across the United States (Aslanian, 2001).

In the foundational study of the Mathematics Workshop, researchers admitted that there was not much intentionality that went into the research design (Fullilove & Treisman, 1990). Their research efforts were motivated by a pragmatic need to show that the program was working. Thus, they collected quantitative and qualitative data. The former was collected for the purpose of descriptive statistics including grades and graduation rates. The latter was collected to triangulate the quantitative data and provide proof that students attributed their academic success

to the program (Fullilove & Treisman, 1990). Thus, there was no theoretical framework guiding the study, and there was no mention of a grounded theory approach. This study also differs from the proposed study in that the participants were students who placed into Calculus. Studies show that these students would be more likely to persist without a program given their higher math placement than the students in the proposed study (Fullilove & Treisman, 1990). Academic underpreparation is often cited as the most common reason that students of color do not persist in STEM programs (Babco, 2003).

Meyerhoff Scholars Program. The most comprehensive and well-regarded program to date is the Meyerhoff Scholars Program at the University of Maryland Baltimore-County (Meyerhoff Scholars Program, 2011). Moreover, the program has 15 features that it employs for the success of its students. These include: financial aid, recruitment, summer bridge program, study groups, program values, program community, personal advising and counseling, tutoring, summer research internships, research experience during the academic year, faculty involvement, administrative involvement, community service, and family involvement. Some of these features are facilitated in conjunction with university services while others are specific to the program offerings. Meyerhoff boasts 813 alumni with 90% students who continue on to graduate and professional schools. In a study that compared Meyerhoff students to non-participants, Hrabowski and Maton (1995) discovered that their program students had a higher GPA (3.5 vs. 2.8) and science GPA (3.4 vs. 2.4).

In addition to offering programming for underrepresented STEM students, the Meyerhoff Scholars program is also a part of a longitudinal, on-going study that has been used to show a myriad of positive outcomes for their program participants (Stolle-McAllister, Santo Domingo, & Carillo, 2010). It is difficult to discern from some of their studies if they use sequential or concurrent practices when collecting and analyzing their data (Hanson et al., 2005). Over time,

sequential explanatory designs have been used often. For instance, the researchers have used quantitative data to show the academic outcomes, graduation rates, and participation in graduate school of participants and non-participants. Then, they engaged in qualitative research methods such as observations, semi-structured interviews, and focus groups to show how and why the program is working for its participants. Program researchers attribute retention of their students to academic and social integration. In contrast, scholars argue that integration is not a reasonable objective for underrepresented students, since these students often rely on prior relationships for emotional and social support during the college experience. Additionally, stating academic and social integration as an espoused goal provides little information as to what constitutes as meeting these outcomes.

Summary

In sum the existing literature indicates that students of color at PWIs face unique challenges to earning STEM degrees which can exacerbated with multiple marginalized identities (i.e., gender, SES), students of color are more likely to come from K-12 settings that did not prepare them for the rigor of college, structured STEM enrichment programs can help students overcome some of the barriers present at these institutions, and academic support should be a feature of the program offerings. Several gaps in the literature, however, remain. First, there are limited studies explanatory case studies; many of the existing studies concerning STEM enrichment programs are descriptive. Second, there is a need for STEM enrichment program literature to use more culturally relevant frameworks to investigate the success of these programs and their students. Third, there is a dearth of scholarship that has considered STEM enrichment programs that admit and retain underserved students of color. The proposed study seeks to address the aforementioned gaps in the literature.

CHAPTER 3: METHODS

This chapter provides an overview of my research design and methodological approach. First, I discuss my choice in using a case study research design. Then, I include the research site including some aspects of the institutional context and program. I provide more detailed information about these entities in Chapter 4. Next, I discuss my role as the researcher, data collection process, and data analysis. I conclude the chapter with limitations of this study.

Research Design

I conducted an explanatory, holistic, single case study (Yin, 2003) that investigated the influence of a STEM enrichment program, the Comprehensive STEM Program (CSP), on the retention of students of color in the STEM disciplines at Jefferson State University (JSU). This study will add to existing literature by explaining how STEM enrichment programs like CSP aid in the retention of underserved students of color. As I noted in chapter 2, much of the previous literature has applied a descriptive case study approach. This research approach has been criticized by the scholarly community asserting that there is a need for rigorous empirical studies grounded in theory (Museus, et al, 2011). Likewise, this explanatory case study extends the field by using theory to address the how and why “how” and “why” STEM enrichment programs help students to succeed (Yin, 2003).

Case Studies

I employed a case study methodological approach in this study for the following reasons: (1) an emphasis on in-depth analysis, (2) context as central to the phenomenon being studied, and (3) usage of multiple sources of data. In case study research, “deep data” and the ability to produce more detailed information than what can be provided through statistical analyses alone is critical to a holistic case development (Merriam, 1985). According to Schramm (1971, p. 6), “the essence of case study, the central tendency among all types of case study, is that it tries to

illuminate a decision or set of decisions: why they were taken, how they were implemented, and with what result.” The aforementioned questions exemplify my interest in pursuing the proposed study. The purpose of this study is to understand how the strategies and practices employed in a STEM enrichment program facilitate college readiness and retention among underserved students of color. Through in-depth analyses, I uncovered information that is relevant for administrators and practitioners to investigate and improve their programs. Previous studies have focused heavily on quantitative and descriptive data, mostly in the forms of student GPAs and retention rates. However, this study sought to examine multiple sources of data in addition to account for the context in which the program is situated.

The context is a salient component of case study research. As Stake (2000) stated “the case to be studied is a complex entity located in a milieu or situation embedded in a number of contexts or backgrounds” (p. 449). Understanding the case requires that the researcher explores the complexities, contexts, and backgrounds of the unit of analysis. In this study, the unit of analysis is the program, but the stakeholders and participants who are connected to the program add to the complexities of how it is operated, perceived, and advanced. The phenomenon being examined is the successful outcomes of academically underserved students in a STEM enrichment program, and the context is the university where the program is situated. However, as Yin posits “phenomenon and context are not always distinguishable in real-life situations” (Yin, 2003, p. 13). For this reason, the process of data collection and data analysis strategies allows the researcher to reflect upon how the phenomenon and the context affect one another. For instance, there are social, historical, economic, and political forces that influence the context, which in turn, influences decisions of the program administrators and how they work with their student population. In case study research, these forces are explored to illuminate the various entities that play a role in the behaviors, attitudes, and perceptions of the participants and their interactions

with the program. As a result, the multiple sources of data ascertained throughout the study inform the researcher about the context and phenomenon on a more in-depth level than other research approaches.

In case study research, multiple sources of data are important to understand the case and to strengthen the reliability and trustworthiness of the findings (Stake, 2000). In this study, qualitative data will be utilized both to understand the STEM enrichment program and how it influences the outcomes of the students. Stake (2000) argued that a case study “gains credibility by thoroughly triangulating the descriptions and interpretations” (p. 443). In this study, focus groups, interviews, participant observations, and documents were utilized to investigate the STEM enrichment program. Some of these methods required me to rely heavily on experiential knowledge which is another valued component in case study research (Stake, 2000). Through the participants’ experiences and stories about the program and other contextual information, I uncovered the academic and context-specific knowledge students needed to know in order to prepare for and persist in the STEM disciplines. The participants also illuminated aspects of the program that created a sense of belonging and cultivated their STEM identities. I triangulated this information with observations and program documents. Moreover, learning about STEM enrichment programs helps to support the interests of many stakeholders including students, administrators, and policymakers.

Finally, Stake (2000) distinguished three types of case studies: intrinsic, instrumental, and collective. The intrinsic case study helps a research better understand a particular case. The instrumental case study refers to investigating a particular case to “provide insight into an issue or to redraw a generalization” (Stake, 2000, p. 437). The collective case study allows the researcher to examine many cases “to investigate a phenomenon, population, or general condition” (Stake, 2000, p. 437). In the current study, I utilized an intrinsic case study, because

the purpose is to become more informed about the STEM enrichment program and its support of underserved students of color in the STEM fields.

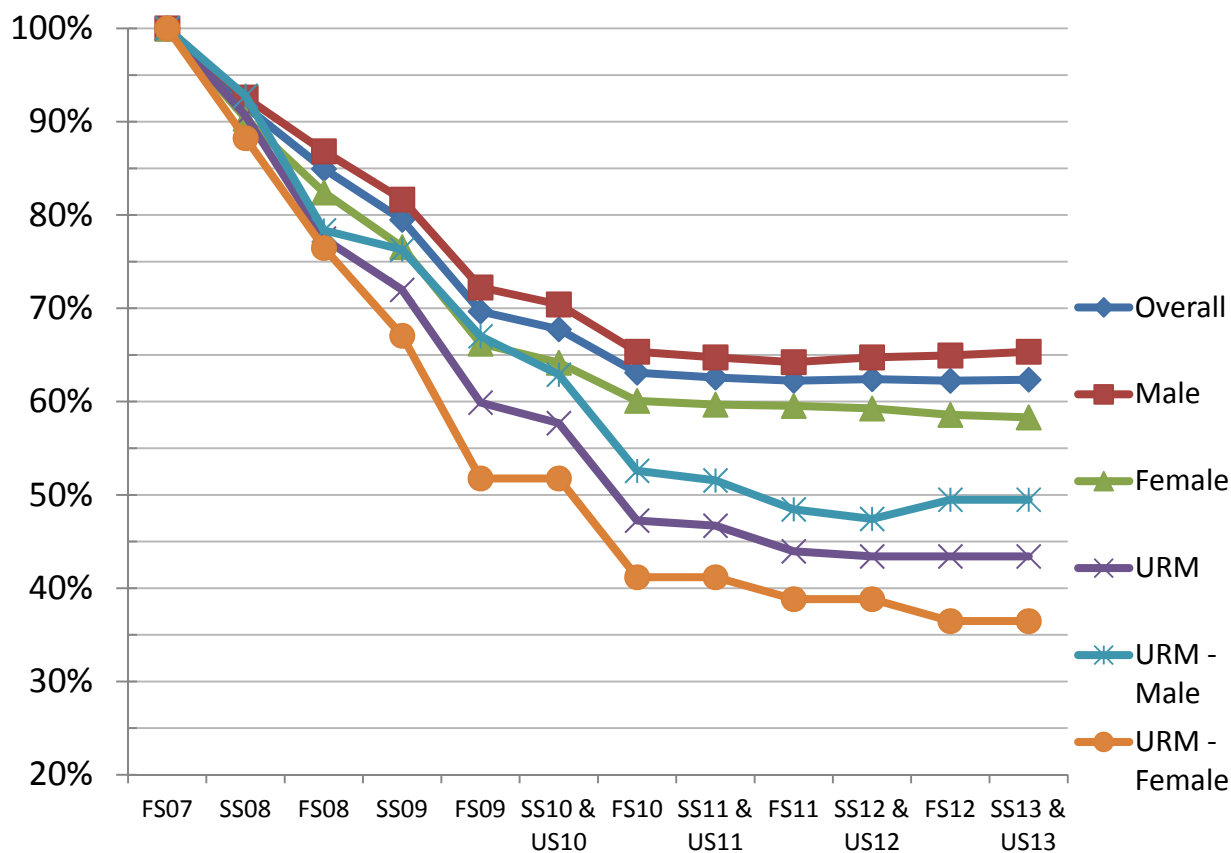
The Research Site: Jefferson State University

Jefferson State University (pseudonym) is a large, public, land-grant research university in the Midwest. The university has a commitment to increasing the number of URM students in STEM. Yet, the institution continues to apply for and obtain National Science Foundation (NSF) grants to increase the number of underrepresented groups in STEM (George, et al., 2001). Some scholars suggest acceptance of these grants necessitates that Jefferson State make a conscious effort to admit, retain, and graduate this student population (George et al, 2001).

Retention and Graduation Rates in the STEM Disciplines at Jefferson State University

Each year approximately 4,000 students out of 8,000 total matriculates declare a major in the STEM disciplines. Nine percent were students of color relative to the 16% at JSU. Beginning with the 2007 cohort, the difference between the retention rates of students of color and the overall STEM student population was relatively small from their first to second year at 77% and 85% respectively (see Figure 3.1). From second to third year, the overall population was 70% whereas students of color decreased by 10%. In 2010, there is a significant decrease in the number of students of color persisting in STEM at 47% compared to 63% of the overall STEM population. The retention rates steadily decreases over the next few years for students of color. Approximately 61% of all STEM students complete their degrees within six years compared to 43% of students of color. These statistics demonstrate the challenges in retaining STEM students from any background, but there is an even greater deficit among students of color.

Figure 3.1 Retention Rates in the STEM Disciplines at Jefferson State University



Comprehensive STEM Program

The Comprehensive STEM Program (CSP, pseudonym), a STEM enrichment program at Jefferson State University (JSU), was established in 2007 with the National Science Foundation, Louis Stokes Alliance for Minority Participation (LSAMP) grant to acclimate first-year students to the rigorous academic culture and college life in the STEM disciplines. The program also has a stated mission to retain students from academically and economically disadvantaged backgrounds in the STEM disciplines. CSP contains eight program components: summer bridge program, residential housing, tailored university math courses, weekly recitation sessions, peer

mentoring, academic advising, freshman seminar, and an undergraduate research experience. The program capacity is 50 students. The approximate cost per participant is \$6,000.

I purposefully selected CSP for several reasons. In the first year of implementation of this program, 95% of students were retained throughout the third semester (i.e., sophomore year). Also, students who attended recitation 80-90% of the time earned an average GPA of 3.45. In 2012, the program implemented a new policy in which students could take a second math placement exam at the conclusion of the summer bridge program. 88% scored higher on the second math placement exam. In the following year, 94% of the total cohort increased their math placement exam score. These scores are especially meaningful, because they allow students to matriculate to the next math course which affects retention, time-to-degree, and overall degree completion. According to institutional data, students who matriculate “more quickly” into their upper-division STEM courses are more likely to persist and attain degrees in STEM. In general, underserved students of color take three or more years to reach upper-division courses or junior status due in part to lower achievement and greater needs for academic preparation. Lastly, 70% of the first cohort attained a STEM degree which was 27% higher than non-participants from underrepresented backgrounds in STEM. 64% of the 2008 cohort earned a STEM degree.

Role of the Researcher

As a former undergraduate student in a STEM enrichment program, I encountered students who genuinely desired to be physicians, scientists, and engineers. Unfortunately, these students did not persist. Throughout this experience, I learned that there was a multitude of factors that affected their ability to produce strong academic results. Encounters with these students strengthened my desire to study the needs and solutions to addressing STEM student attrition. The research supports STEM enrichment programs as critical elements for supporting marginalized students in STEM disciplines. However, there is a lack of “plausible reasons why

things are happening as they are” in these programs (Miles & Huberman, 1994, p. 90). My past experiences as a STEM enrichment program participant, my identity (i.e., African American, female, first-generation college student), and background characteristics (i.e., urban, low-income) provided an insider’s perspective that other researchers may not possess. Despite my prior experiences as an undergraduate STEM student, I was open to the possibility that there are new and/or unique barriers to completing a STEM degree. Likewise, the knowledge and action necessary to overcome these barriers challenged my preconceived notions. For instance, going into the study I did not realize how much a sense of belonging and community would matter to the participants and their success. This factor motivated my desire to pursue this study and include a variety of voices (i.e., staff, students, alumni) to better understand the impact of this program. According to Glesne (2011, p.157), “entering into research with a mindset of openness, curiosity, and desire and willingness to interact in collaborative ways is likely to result in a different positionality than one in which the researcher maintains a mindset of entitlement, self-centeredness, and control.”

I am also a former administrator in the STEM Enrichment program of the proposed study. I had an insider’s intuition about the program which that assisted me in my data collection strategies. For instance, when I reviewed program documents I was able to analyze them more critically given my knowledge of the program and the literature. Moreover, my commitment to STEM students and enrichment programs may allow unintended biases. I will mitigate these circumstances with peer debriefing and aligning my findings with the literature.

Data Collection

This study is based on qualitative data collected from June 2013-April 2014 at Jefferson State University, which is in the Midwestern region of the United States. I used a case study methodological approach due to its emphasis on “deep data” and the ability to produce more

detailed information than what can be provided through statistical analyses alone (Merriam, 1985; Yin, 2003). As Padilla (2009) stated the college experience is a black box, and it is difficult to determine which factors contribute to student retention or attrition. The research methods for the study included document analysis, participant observations, focus groups, and semi-structured interviews. These data sources were used to explain how CSP engages students for successful outcomes and why these strategies and practices are used to do so.

Participant Recruitment and Selection

My goal was to study a STEM enrichment program that aided in the transition and retention of underserved students of color in STEM. I formally requested participation to the study the program through email communication. Once I received approval from the program director, I submitted an application for IRB approval. Following IRB approval (Appendix A), I recruited participants with assistance from the program director. The participants were made aware that they may be contacted to participate in a study about the program. Participation in the study was on a voluntary basis. I retrieved a list of program staff and instructors, program participants, and graduates from the program director. Then, I sent email correspondence (Appendix B) to program staff and instructors, program participants, and graduates informing them about the study. I included a link in the link where prospective participants could register for participation in the focus groups and/or individual interviews. To gather additional participants, I initiated contact prospective participants via text messaging or through direct contact at recitations or at the Multicultural Engineering Program (MEP) office. The criteria for participation in this study included the following:

1. Students must be a current, former, or recent alum (completed within 1-3 years) of the Comprehensive STEM Program at Jefferson State University
2. Student must be a declared major in one of the STEM disciplines

3. Student must identify as a person of color (i.e., Asian American, Black, Hispanic, Native American)
4. Students must be from an underserved background (e.g., woman of color, TRIO-Student Support Services participant (indicates low-income and first generation college student status), math placement below Calculus)

I purposefully sampled study participants to include a representative sample of CSP participants and underrepresented groups in the STEM disciplines. Miles and colleagues (2014) posit that researchers who utilize purposeful sampling should establish boundaries and a framework for the procedures and conceptual underpinnings (i.e., underserved CSP participants of color).

Document Analysis

I gathered documents that informed me about the goals and outcomes of the program including: LSAMP grant proposal, LSAMP evaluations, conference presentation, marketing materials and other forms of mail correspondence, and the program's website. I reviewed over 200 pages of printed documents and website links.

Participant Observations

Observations took place during the summer bridge program (June-August) and then September of 2013. I conducted 24 hours in observations and took observer memos (Glesne, 2013). I observed students and staff in the following domains: summer bridge program courses, recitation sessions, walking to classes or meals, meal times, residential floor meeting, and staff meetings; first-year seminar; advising sessions; and MEP study space. These observations allowed me to verify and enrich interpretations and my understanding of the data collected in accordance with my research questions. During some of these observations, I spoke with the participants to make meaning of what was happening in the environment.

Individual and Focus Group Interviews

Study participants completed a focus group interview and/or an individual, semi-structured interview (Hesse-Biber, 2010). I conducted five focus groups with 5-6 participants (totaling 29 participants) and 35 individual interviews. There were 50 participants in this study: 42 current and former program participants, 2 administrators, 2 instructors, and 4 recent baccalaureate recipients and former program participants.

The focus groups took place in November-December of fall 2013. An interview protocol can be found in Appendix C. I began with focus groups to gather data on the collective and individual experiences of CSP participants. These interviews also allowed me to identify students to invite for a future individual interview or additional participants to bolster my representative sample (Glesne, 2011). Glesne (2011) suggests that focus groups can be useful for studies similar to the current study. This form of data collection allows “participants to express multiple perspectives on a similar experience such as the implementation of a [program]” (p. 130). I also found these conversations to be informative regarding the language to use for certain questions. For instance, I had to clarify my questions about having a STEM identity. Instead of asking students to tell me about their STEM identities, I had to pose my questions in the following manner, “What makes you a STEM person?”

During the focus groups, I introduced myself and the other researcher, the purpose of the study, had students sign-in, and complete consent forms (see Appendix H). I informed the students that they had the right to discontinue to the interview at any time. I asked the participants if they were comfortable with being audio-recorded. Once I received their consent, I began the recording and the interview. I used my interview along with probing questions to clarify participant responses. The other researcher, an advanced graduate student, joined me

during these focus groups to take notes and document observations. We debriefed following each focus group to explore hunches, contradictions, and next steps.

I conducted individual interviews in February-April of spring 2014. The individual student and alum interviews lasted 30 to 80 minutes. These interviews focused on experiences within the university and program, elements that supported or hindered belongingness, and influential factors in their STEM identity development (see Appendix D & E). When scheduling the interviews I asked program participants and alum to bring an artifact that represented their experiences and/or interactions with the STEM enrichment program. According to Glesne (2011), artifacts...“provide both historical and contextual dimensions to [one’s] observations and interviews. They enrich what [one] see and hear by supporting, expanding, and challenging portrayals and perceptions” (p. 89). Thus, I was interested in how the artifacts might deepen my understanding of CSP and its impact on student outcomes. I followed a similar procedure with the individual interviews as I did with the focus group interviews. However, I gave \$10 gift cards to student and alum. Additionally, no other researcher joined me during these meetings.

Individual interviews with the program and assistant program director were used to learn more about the infrastructure of the program, effective strategies and practices, and corroborate findings from student interviews (see Appendix F). Instructor interviews entailed generating details about their teaching practices and behaviors in the classroom that aided in knowledge attainment, sense of belonging, and STEM identity development (see Appendix G). Administrator and instructor interviews were 60 minutes in duration. All of the administrators and instructors were Black or African American, and all of them were male except for one female instructor.

Demographic Information

Per IRB approval, I obtained demographic information through electronic student records. I gathered information on race, sex, first-year GPA, math placement scores, first-semester math course, first-semester math grades, TRIO-SSS status, majors, and class standing (see Table 3.1). The 46 student and alum participants comprised a variety of different majors. Table 3.1 lists participants' pseudonyms, class standing, sex, race, and major. Table 3.2 provides information on students' GPAs, initial math placement scores, and first semester math grades. The average first year GPA was 3.01, and the average GPA at the time of data collection was 2.82. The average initial math placement score was 13 (low value: 0, high value: 28), and the average first semester math grade was 2.90. Table 3.3 contains the first semester math course enrollment. Approximately 41% of the participants are women. Also, about half of the participants have TRIO-SSS status, which is a proxy for low-income and first-generation college student status.

Table 3.1 Student Participants (N=46)

Pseudonym	Class Standing	Sex	Race	STEM Major
Adam	Alum	Male	Black or African American	Civil Engineering
Alad	Alum	Male	Asian American	Civil Engineering
Alan	Senior	Male	Black or African American	Electrical Engineering
Alex	First-Year	Male	Black or African American	Predental
Amanda	First-Year	Female	Black or African American	Physiology
Anthony	Senior	Male	Black or African American	Information Technology
Autumn	First-Year	Female	Black or African American	Computer Science
Ben	Senior	Male	Black or African American	Mechanical Engineering
Brandi	First-Year	Female	Black or African American	Computer Science
Brent	First-Year	Male	Black or African American	Computer Science
Brittney	Senior	Female	Black or African American	Electrical Engineering
Carmen	Junior	Female	Black or African American	Construction Management
Chandra	First-Year	Female	Black or African American	Albert Einstein College
Chris	Junior	Male	Black or African American	Information Technology
Damon	First-Year	Male	Black or African American	Computer Engineering
Earl	Senior	Male	Black or African American	Electrical Engineering
Emily	First-Year	Female	Hispanic	Albert Einstein College
Frank	First-Year	Male	Black or African American	Computer Engineering
Gary	Senior	Male	Black or African American	Civil Engineering
Gregory	Sophomore	Male	Black or African American	Electrical Engineering
Jackie	Senior	Female	Black or African American	Electrical Engineering
Jackson	First-Year	Male	Black or African American	Mechanical Engineering
Jamal	Alum	Male	Black or African American	Mechanical Engineering
James	First-Year	Male	Black or African American	Chemical Engineering
Janine	Sophomore	Female	Black or African American	Computer Science
Jasmine	Sophomore	Female	Black or African American	Civil Engineering
Jayla	First-Year	Female	Black or African American	Environmental Engineering
Jim	First-Year	Male	Black or African American	Computer Science
Jon	Junior	Male	Black or African American	Computer Science
Joshua	Senior	Male	Black or African American	Civil Engineering
Kari	Senior	Male	Black or African American	Chemical Engineering
Kayla	First-Year	Female	Black or African American	Human Biology
Legacy	First-Year	Female	Black or African American	Actuarial Science
Monet	Alum	Female	Black or African American	Chemistry
Omari	Junior	Male	Black or African American	Mechanical Engineering
Oshay	Senior	Male	Black or African American	Chemical Engineering
Ralph	First-Year	Male	Black or African American	Mechanical Engineering
Roger	Senior	Male	Black or African American	Electrical Engineering
Rosie	First-Year	Female	Hispanic	Human Biology
Sandy	Sophomore	Female	Hispanic	Mechanical Engineering
Sarah	Sophomore	Female	Black or African American	Materials Science
Storm	Sophomore	Female	Hispanic	Chemical Engineering
Tim	First-Year	Male	Black or African American	Civil Engineering
Vanessa	Senior	Female	Black or African American	Applied Engineering Sciences
Vivek	Senior	Male	Asian American	Information Technology
William	Senior	Male	Black or African American	Electrical Engineering

Table 3.2 Aggregate GPAs, Math Placement Scores, and First Semester Math Grades

Category	Average
First-Year GPA	3.01
SS14 GPA	2.82
Initial Math Placement Score	13
First Semester Math Grade	2.90

Table 3.3 First Semester Math Courses

Math Courses	Enrollment
Intermediate Algebra	3
College Algebra	15
Pre-Calculus	10
Calculus or Higher*	13
Intermediate Algebra	3

*only one student placed above Calculus into Calculus III

Data Analysis

Focus group and individual interviews were transcribed verbatim by a professional transcriptionist and checked for accuracy. Once interviews had been transcribed, I de-identified them including names, places, programs, and any other identifiable information. At the time of interview, I gave participants permission to select a suitable pseudonym, and I assigned pseudonyms to participants who had not selected one.

After transcription, I printed and read through each transcript. During my reading of the transcripts, I jotted down notes that reflected participant comments and my thoughts in a journal and in the margins of the documents. I used this initial reading of the transcripts and the

participants' words and phrases to establish my code book. Decuir-Gunby, Marshall, and McCulloh (2011) describe a codebook as "a set of codes, definitions, and examples used as a guide to help analyze interview data" (p. 138). Codebooks help to formalize the coding process. During my second reading of the transcripts, I revised codes and definitions as I gained more insight and clarity concerning the data (Decuir-Gunby et al., 2011). The theories guiding this study and the research literature supported this phase of my analysis process. Whenever I was unclear about a participant's perception or experiential explanation, I reviewed the guiding theories and relevant literature to inform my thinking and reporting of the findings.

A systematic coding process of first and second cycle coding was utilized (Saldaña, 2013). As previously noted, I used these cycles to create and refine my codebook. The first cycle coding included In Vivo coding (Miles, Huberman, & Saldaña, 2014). Because I wanted to center the participants' voices, I used their words and "short phrases" to create codes (Miles et al., 2013, p. 74). The second cycle of coding entailed reviewing the "first cycle codes to assess their commonality and assess them a pattern code" (Saldana, 2013, p. 184). Descriptive content about the codes was developed from comparing the codes to the extant literature on STEM enrichment programs, students of color in STEM disciplines, and aspects of my conceptual framework (Yin, 2003).

In my final stages of analyses, I utilized concept mapping to ascertain how program components and outcomes worked together. In qualitative research, concept mapping can be used to generate, classify, and interpret relationships among critical elements (Morgan & Guevara, 2008). For instance, I began placing "lower level codes...into a set of more conceptual codes" (p. 110). It was through the concept maps, I was better able to understand the relationships between program components, student experiences, and the actualization of outcomes essential to college readiness and retention among this student population.

Trustworthiness

I used triangulation to strengthen the trustworthiness of the study's findings in the form of multiple sources of data, peer review, and member checking (Merriam, 2002). Focus groups and semi-structured interviews were used to compare and corroborate information revealed throughout the data collection process. Researcher memos from observations of program activities (i.e., summer bridge program, recitation, staff meetings), printed materials, and websites were used to understand the program and institutional contexts.

Miles and colleagues (2014) asserted that triangulation improves “corroboration and verification” of findings such that the researcher can draw stronger conclusions from the study (p. 267). In addition to triangulation, I used peer debriefing to ensure that my codes and themes are what they should be (Miles, et al., 2014). Findings were shared with three researchers to discern that the findings are consistent with the data collected. These individuals also challenged me to consider alternative ways of examining the data.

Lastly, I engaged in member checking through reviewing my findings with several participants and non-participants. I reached out to participants by phone or email to share my findings. Only a few agreed to meet and discuss the results of the study. One meeting was a one-on-one discussion which led to an opportunity to attend one of the National Society of Black Engineers (NSBE) meetings. The NSBE meeting contained study participants and non-participants. Both groups confirmed my findings and provided additional perspectives and potential implications for practice.

Limitations

The qualitative methodology limits the generalizability of this study. While this study closely aligns with literature regarding the experiences and perceptions of people of color in STEM, these findings will need to be confirmed through additional studies. This study took place

at one institutional site, and it excluded students who did not participate in CSP. Findings may not reflect the experiences of non-program participants. According to Padilla (2007), students who do not persist may also possess “expert” knowledge on what it takes to be successful. For the proposed study, students who did not persist in the STEM enrichment program and/or STEM major were not included.

Additionally, despite efforts to recruit a diverse representation of students and recent baccalaureate recipients of color in STEM, there were a relatively small number of Hispanic participants (4) and Southeast Asian students (2) and no Native Americans students in comparison to Black participants (40). The sample is also oversaturated with engineering students. Though students representing majors throughout the STEM disciplinary areas have always been welcomed within CSP, only within the last two years has the program had the resources and administrative support to more vigorously recruit non-engineering students.

CHAPTER 4: INSTITUTIONAL, STEM, AND PROGRAM CONTEXTS

This chapter expounds on the context of the research site, Jefferson State University, and the Comprehensive STEM Program (CSP). The data used to construct this chapter derives from several sources including observations, documents, and interview data. First, I elaborate on the context of Jefferson State University and the STEM colleges that represent the participants in this study. Second, I discuss the history and development of CSP with attention to its connection to the National Science Foundation (NSF) Louis Stokes Alliance for Minority Participation (LSAMP).

Overview of Jefferson State University

Jefferson State University (pseudonym) is a large, public, predominantly White research university in the Midwest. Many of the student participants of the current study commented about the significance of the size of this institution. They discussed its resources, diversity, and opportunities for academic and professional success. The institution has more than 40,000 students representing a diverse economic, racial and ethnic, and international population. It also has a multi-billion dollar endowment, 17 colleges, state of the art research laboratories and facilities, and a substantial externally funded research allotment. Many of its academic programs are nationally and internationally ranked for their academic quality, research production, and scholarly excellence.

As a land-grant research university, Jefferson State has a responsibility to use its resources to solve societal problems (Schuh, 1986). Currently, the institution is engaged in a multitude of new initiatives that address teaching and learning, access and inclusion, student success, and STEM retention for underrepresented groups. However, one area that the institution continues to struggle with is race relations among its students. This concern will be discussed later in the chapter.

Jefferson State is Our Name, and Student Success is Our Game

At Jefferson State University, there are several university-wide and college-specific endeavors that directly or indirectly affect students of color in the STEM fields. At the university level, there are new initiatives designed to support first-year, first-generation, and low-income students. At the college-level, advances are being made to improve STEM teaching and learning experiences including using competency-based learning to increase achievement in developmental education, studying and applying learning analytics to address student needs, creating living learning communities, and providing supplemental instruction. First, I will discuss efforts at the university-level. Second, I will discuss the three colleges at Jefferson State that comprise the majority of the STEM student population and their efforts and initiatives to support diversity and retention.

In order to address the academic and social outcomes of its first-year, undergraduate students, Jefferson State has been restructuring its academic and student affairs divisions to centralize services where students are most apt to use them on campus. Through the structure of this initiative, the university systematically monitors student persistence, institutional retention, and academic success of all of its first-year students with attention to its most vulnerable populations (e.g., first-generation and low-income students, international students) and creates special programs to support these students. The staff hired to oversee this initiative work within a framework that encompasses academic support, diversity and inclusion, campus living, and health and wellness. One of the many programs taking place, under this initiative, was created to support first-generation and low-income students and reduce the number of students on academic probation at the end of their first year. The program used a case management approach informed by data analytics and an integration of academic and student support services. Some of the efforts of this program include frequent engagement from academic advisors and peer mentors. It

is still relatively early to see the impacts of these institutional changes, but through data analytics and proactive student support Jefferson State appears to be moving in a positive direction.

Among many other similar institutions, Jefferson State has seemingly low graduation rates among students of color (See Table 4.1). This gap has warranted the attention of national policy researchers and advocates suggesting that institutional policies and practices should identify strategies for closing the gap. The university hopes streamlining its retention efforts to better serve undergraduate students may also address these opportunity gaps.

Table 4.1 White-Black and White-Hispanic Graduation Rate at Big Ten Universities

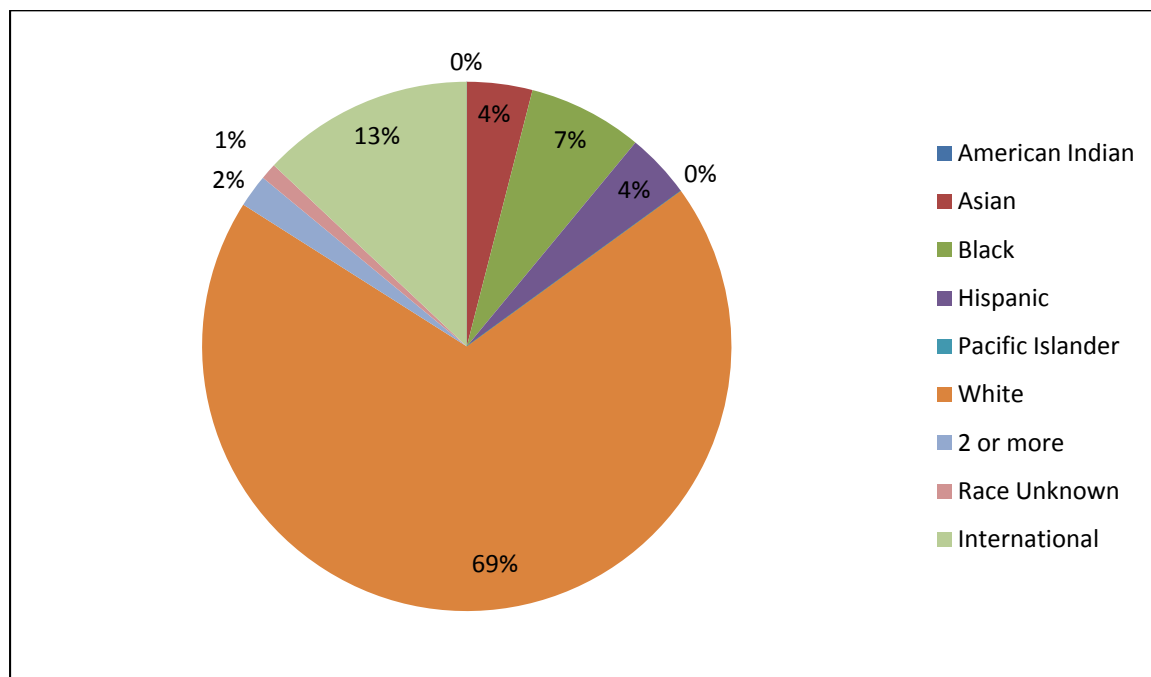
Institution	White 6-Year Grad Rate	Black 6-Year Grad Rate	White- Black	Hispanic 6-Year Grad Rate	White- Hispanic
Illinois	87%	71%	16%	76%	11%
Indiana	79%	59%	20%	73%	6%
Iowa	70%	61%	9%	67%	3%
Maryland	86%	78%	8%	78%	8%
Michigan	91%	78%	13%	85%	6%
Michigan State	81%	57%	24%	66%	15%
Minnesota	78%	57%	21%	71%	7%
Nebraska	68%	53%	15%	61%	7%
Northwestern	93%	94%	-1%	94%	-1%
Ohio State	85%	73%	12%	78%	7%
Penn State	87%	67%	20%	75%	12%
Purdue	72%	53%	19%	64%	8%
Rutgers	81%	73%	8%	74%	7%
Wisconsin	85%	68%	17%	77%	8%

Source: IPEDS 2015

Race Relations and Racial Experiences at Jefferson State University

In the present study, many students alluded to the race relations and their cross-racial experiences at Jefferson State. Several students commented about racial incidents that happened within the university at-large and interactions with White peers within and outside of the classroom. Other students discussed noticeably being the only person of color or woman of color in their classroom settings. In the following sections, I provide two examples that speak to some of the racial realities and campus climate at Jefferson State. The undergraduate racial and ethnic makeup of JSU is displayed in Figure 3.1.

Figure 4.1 Undergraduate Race and Ethnicity at Jefferson State University



Source: IPEDS 2015

Several of the study's participants mentioned the emergence of racial incidents targeted at students of color, primarily African American students, attending JSU a few years ago. In residence halls, the N-word and derogatory epithets were written on the dry erase boards on the outsides of students' room doors. According to participants in the present study, there were students who no longer felt comfortable attending class or considered transferring to other

institutions due to these incidents. These actions caused uproar on campus leading students to form cross-racial and sexual minority coalitions and demanding that the administration to change policies and practices that affected the academic and psychological well-being of students of color. Some of these demands included restoration of defunct summer bridge programs to facilitate college readiness, support services and faculty instruction for developmental math courses, and more faculty of color and multicultural student staff in the residence halls. These incidents and subsequent student actions garnered the attention of local, state, and national news outlets. As a result, administrators scheduled several meetings to listen to students and address their concerns. Some changes were made including increasing the number of multicultural student staff in the residence halls and reconstituting the summer bridge program.

During the data collection period, students used social media as a tool to inform university administrators and other stakeholders about the concerns of many Black students across the nation at PWIs (Preston, 2014). Twitter posts (or tweets) containing the hash tag Being Black Jefferson State University (i.e., #BBJSU) revealed the myriad of unique problems Black students face at PWIs. At Jefferson State, students lamented about being stopped without just cause by the police, having to prove their academic major status if they are in a major that lacks diverse representation (e.g., STEM, Business), and being the only person of color in a classroom. Senior administrators at the institution submitted their own tweet to inform students that they were listening to their concerns.

STEM Academic and Social Spaces at Jefferson State University

Students who aspire to earn a degree in STEM at Jefferson State University are most apt to declare a major in one of three colleges: College of Life and Physical Sciences, College of Engineering and Computer Science, and Albert Einstein College. I will discuss some of the

diversity efforts, resources, services, and prospective impediments to student success for students of color pursuing degrees in these colleges.

College of Life and Physical Sciences

In the College of Life and Physical Sciences, the Division of Student Affairs provides academic advising, relevant workshops, and an annual summer weekend program to acclimate first-year students to the college. The advising staff is relatively diverse and equipped to serve underserved students. Over the years, much attention has been given to struggling students through data analytics, special courses, and programs. There is also a long-standing program, described below, and some recent endeavors to enhance teaching and learning practices.

The Garret A. Morgan Program. According to website content, the Garrett A. Morgan (pseudonym; known as Morgan) program is a part of the College of Life and Physical Sciences. It was established in the 1970s to support students of color pursuing degrees in the college. The Morgan program is comprised of five staff including a director, associate director, academic advisor, career advisor, and tutoring coordinator. Currently, the program serves any student irrespective of race or ethnicity. Program admission requires students to have a high school GPA of 3.0 or better, an ACT composite score greater than 20, and an ACT math score greater than 20. Program offerings include free tutoring in gateway science and math courses (e.g., calculus, chemistry), a first-year seminar, academic and career counseling, and a residential component. A previous study of the program showed that students of color in the Morgan program outperformed non-participating students of color and Whites in gateway science and math course grades.

Modifications in teaching and learning. Consistent with national trends, there have been a variety of changes and exploratory initiatives to improve the teaching and learning experiences in this college. In recent years, the intermediate algebra (i.e., developmental

mathematics) course moved completely online with the exception of a few hybrid courses. The course uses competency-based learning software that relies on artificial intelligence to assess a student's knowledge, identify deficiencies, and employ adaptive technology to facilitate mastery of math concepts. The college is also involved in a national study investigating learning analytics and other endeavors to improve assessment practices in science courses. Some faculty members have used survey data to show students how their attitudes and behaviors affect their academic outcomes.

College of Engineering and Computer Science

Staff and student participants reported that the College of Engineering and Computer Science has instituted several initiatives to increase student persistence and retention. First, they established a living learning community. The living learning community is comprised of several key features: academic advisors, an introductory engineering course, residential peer mentors, and special workshops and programs. Though the living learning community has afforded some conveniences to the engineering student population at-large, only a few of its services draw students of color (e.g., academic advising).

Second, the college conducted a pilot program connecting a select number of faculty members to students enrolled in introductory engineering courses. The program was designed to provide opportunities for faculty to develop mentoring relationship with first year students. This program did increase engagement among students and faculty, but some of the students in the current study felt it was disingenuous and did not follow through.

Third, they hired upper division students to facilitate supplemental instruction in gateway courses. Though the supplemental instruction did not have a significant impact on student outcomes, student instructors did achieve gains in their conceptual understanding of the material as noted in a study conducted on the program. Some students, in the present study, were unaware

that supplemental instruction was available even though it was advertised in various courses and displayed on computer monitors in the college. Moreover, the efforts put forth by the college are evidence-based and commendable, but they will take time and planning to increase student participation.

Multicultural Engineering Program. The Multicultural Engineering Program (MEP) provides a number of programs and services to support underrepresented students in the College of Engineering and Computer Science. Program and service offerings include a learning center, academic advising, a peer mentoring program, and scholarship support. The general staff include a director, assistant director, academic coordinator who coordinate the daily operations of the office and CSP. There are additional staff members that focus on special areas of interest in the college: Women in Engineering director and the Study Abroad coordinator.

Segregation in academic spaces. Within the engineering and computer science building, students tend to segregate themselves among study spaces. Many students of color study in a Learning Center connected to the MEP during the day and evening hours. The White students use the MEP Learning Center during the day for the tutorial services, but in the evening, many White students study in another space the college built approximately five years ago. This study space differs remarkably from the MEP Learning Center. It is very colorful in its décor and furniture design. It also contains new computer hardware and software and several televisions. Overall, it is an appealing and inviting environment in which to study.

Diversity course. The college's elective diversity course has a relatively high enrollment among students of color. The MEP staff typically teaches the course and encourages students of color to enroll. Within this course, students are taught the strategies to help them navigate the engineering and computer science curriculum and the college environment and orient them to the profession. During the interviews, some students lamented over the "boot camp" style of the

course curriculum that demanded students to wear professional attire, be prepared at a moment's notice to recite their name and major without stuttering, and attend campus events for networking and getting connected to campus constituents. Though students complained about the challenges endured in the course—more mental than physical—many went on to become engineers and computer scientists thankful that they had experienced such refining. Currently, the course is taken by CSP students as a first-year seminar. The curriculum has changed to align with the needs of contemporary students and professionals, but the refining process still remains.

Differential treatment for academic outcomes. During data collection, I was informed that whenever students of color perform below university academic standards or are in danger of failing a course, a senior administrator in the college “walks” them down to the MEP office to “get them back on track.” The students did not like this approach very much. In fact, they found it to be quite odd that such an approach was in place. Some students suggested that this process of physically walking students of color down to the MEP office reified their status as underrepresented groups in engineering.

Albert Einstein College

Albert Einstein College (pseudonym, AEC) is a residential science college. It offers a variety of programs and services to promote diversity and support underserved students. In the 2010s, website content reveals that three faculty members received a Diversity Award due to their successful grant receipt and enrichment program to support students with lower math placement scores. Participants in the program were provided with academic support, a peer cohort, intentionally designed classes (i.e., math, science, and writing), and transitional support into the traditional AEC curriculum. The program coordinators (one White male, one White female, and one African American female), who are also college faculty, emphasized the importance of helping students to build skills and confidence necessary for success in STEM.

Recently, AEC received an NSF grant that allowed them to provide over 20 scholarships to students with financial need. Award recipients were also provided with access to science seminars, mentoring, and internship opportunities. At the time of this study, the college was actively seeking another NSF grant to provide financial support and assistance to a second cohort of students.

Other efforts in the college include faculty meetings on diversity, a website dedicated to showing supportive efforts toward women in STEM, a faculty-sponsored course on diversity in STEM, and undergraduate research opportunities, in partnership with other colleges, designed for students of color. Most recently, administrators developed new language to acknowledge that “working with diverse student populations” is essential to the college’s mission. The university’s Equity and Inclusion Office also used as a model to other colleges and academic units. These new initiatives demonstrate that AEC is working towards creating a more inclusive and equitable environment.

The information provided here is just a subset of the multitude of moving parts at Jefferson State—programs, initiatives, research, and development—but what is less known is how these entities work together to support the retention of students of color in the STEM fields. Unlike some of the programs and initiatives presented here, CSP is a coordinated and integrated model which uniquely positions it to address the myriad of needs for students of color in STEM.

Louis Stokes Alliance for Minority Participation

This section provides a brief overview of the National Science Foundation (NSF) Louis Stokes Alliance for Minority Participation (LSAMP). The Comprehensive STEM program is partially funded through the LSAMP program. LSAMP is a national program organized through state-wide alliances or consortiums. The LSAMP program was established in 1991 at NSF based on a Congressional mandate. LSAMP began with six Alliances, and currently boasts more than

40 Alliances representing over 600 institutions with more than 400,000 LSAMP participants who have earned BA/BS degrees in STEM disciplines (Barrena & Veden, 2013). As of 2014, 5,547 LSAMP participants have received doctoral degrees in STEM (A. J. Hicks, personal communication, August 15, 2014). Hicks (2013) indicated:

The goals of LSAMP are to significantly increase the quality and quantity of minorities who successfully complete baccalaureate degrees in science, technology, engineering, and mathematics (STEM), and to increase the number of minority students who continue to graduate studies in these fields. (Barrena & Veden, 2013, 3:57 mins.).

The LSAMP program emphasizes “innovative recruitment and retention strategies and experiences in support of groups that are historically underrepresented in STEM disciplines: African Americans, Alaskan Natives, American Indians, Hispanic Americans, Native Hawaiians, and Native Pacific Islanders” (Barrena & Veden, 2013, 40 seconds).

The LSAMP program “supports sustained and comprehensive approaches to broadening participation at the baccalaureate level” (Alliances for Success, 2011, p.1). The program utilizes “Alliances” to advance its goals city-wide (e.g., New York City), statewide (e.g., California), multi-state (e.g., Florida-Georgia), or U.S. territory (e.g., Puerto Rico) (Alliances for Success, 2011). The Alliances include various types of two and four-year colleges and universities, and some partnerships include “partners from industry, national research laboratories, and State and Federal Agencies” (Alliances for Success, 2011, p.1). According to Dr. Joseph Bordogna (2002), former Deputy Director and Chief Operating Officer of the National Science Foundation, “LSAMP students account for 70 percent of all minority baccalaureates in science and engineering” (paragraph 20).

In a 2000 Westat Report, authors identified six essential factors that contribute to the success of LSAMP including summer bridge programs, drop-in centers, mentoring, caring staff, research experience, and alliance structure. Additionally, the report found that alliance members

were highly cooperative while maintaining autonomy in each institutional program's offerings and operations. A 2006 Urban Institute report concluded that, "at the institutional level, a supportive environment that includes adequate provision of resources and support of faculty and [senior] level administrators" were critical to the outcomes and achievements of the program goals (p. v). CSP attempts to meet these goals through an array of services and activities.

The current synergistic efforts taking place at Jefferson State University are instrumental to the success of the students of color involved with the CSP program. Furthermore, CSP's integrative approach leverages the large, public, research university's resources and access to funding sources with its structure. I will define this approach in chapters 5 and 6.

Comprehensive STEM Program

The Comprehensive STEM Program at Jefferson State University began in 2007 to acclimate first-year students to the academic, psychosocial, and environmental aspects of postsecondary education. The program was designed to ensure the success of students pursuing a rigorous, STEM-focused curriculum. Specifically, the program sought to support students until they were admissible into their given college. With the exception of the Albert Einstein College, there is a dual admissions process such that students are first admitted to JSU, and by junior status (or 56 credits) they must meet specific criteria to be admissible to their particular college. For instance, in the College of Engineering and Computer Science, students are required to complete core courses (e.g., mathematics, physical and biological sciences, and introductory engineering courses) and attain a specific GPA. There is a slight variation in core course and GPA requirements contingent upon one's discipline. The remaining STEM-affiliated colleges require that a student make adequate progress towards a degree indicated with a 2.0 GPA or greater. Due to these admission policies and CSP's goals, most students engage in the program

for two years, but there are some students who stay connected until they graduate from the university.

CSP's Recruitment Process and Program Components

Admitted students declaring a major in a STEM degree granting program at Jefferson State receive CSP recruitment materials in three ways: (1) students admitted to the university through a special admissions process geared towards first-generation and low-income students, (2) students declaring a major in STEM with a math placement below calculus, (3) students declaring a major in STEM who express interest, in writing, to the program coordinators. A month prior to the start of the summer bridge program, staff invite applicants and their families to a one-day recruitment event. At the recruitment day, program staff meet with applicants and families, provide more information about the program, and conduct interviews with the applicants. The applicants also complete a non-cognitive questionnaire (NCV, Sedlacek, 2009). Approximately two weeks later, staff invite the selected applicants to participate in CSP.

All program components are mandatory; students are not allowed to opt out of any of the program components, or they will be dismissed from the entire program. Students who successfully complete the first year of the program receive a \$1000 scholarship during their sophomore year. There is no cost to the student for participation in the program. Moreover, I generated the following program information from interviews, observations, and program documents:

- **Summer Bridge Program:** The summer bridge program is a six-week academically intensive and socially engaging experience that introduces students to the academic culture and campus life at Jefferson State. Students live in the residence halls, attend classes (i.e., mathematics, Chemistry or Biology, Writing) and workshops (i.e., academic

and professional development), and participate in social activities and community service.

- **Biweekly Advising:** Students meet with a CSP administrator twice a month for at least 30 minutes. During these advising sessions, students complete a survey to document their academic performance and identify any non-academic concerns they are experiencing. They must also report their attendance, grades on exams, assignments, actual grade, desired grade, and actions that should be taken to improve their grade.
- **Recitation Sessions:** Recitation sessions are held in an academic building Monday-Thursday from 7:00pm-9:30pm. Paid academic assistants, who are upper-division undergraduate students, assist program participants with their Chemistry and Mathematics courses and assignments in one-on-one or group configurations. Additionally, many of the program participants support one another with learning and understanding course content and scientific concepts.
- **Selected STEM sections of Math and Science courses:** Based on math placement and availability, some program participants enroll in sections with smaller class sizes to promote networking and a shared experience amongst the participants. With permission from the participants, program administrators collaborate with faculty to monitor their academic performance on assignments and exams and follow-up with students during their academic advising sessions.
- **First Year Seminar:** This course serves as continuation to the academic, personal, and professional development that begins in the summer bridge program. Course topics and assignments include transitional problems, communication skills, conducting presentations, career assessments, writing assignments, developing a product or service

that addresses a STEM problem, and a term paper about achieving academic and professional goals.

- **Residential Assignment:** Program participants live in the same residence hall during their first year. CSP coordinate with residential staff to assign program participants as roommates, to the same floor, and/or the same side of the residence hall.
- **Peer mentoring:** Upperclassmen serve as peer mentors. Not all mentors are former CSP participants. If a qualified student expresses interest, they can become a mentor.

Mentoring promotes peer accountability and serves as an additional campus resource.

Mentor and protégé matching occurs through responses to a short survey about majors, academic and non-academic interests, and professional goals. Peer mentors and program participants make regular contact through formal and informal gatherings.

- **Undergraduate research opportunity:** Staff select students who successfully complete the first year of the program to participate in a summer residential research assistant position. CSP staff coordinate student placement in collaboration with the College of Life and Physical Sciences, NSF-funded undergraduate mathematics research program and the graduate school's Summer Research Opportunity Program (SROP). Students receive a \$1,100-\$3,500 stipend, conduct research with a faculty member for 4 to 8 weeks, present an oral and poster presentation, and complete a written report.

The History and Evolution of the Comprehensive STEM Program

The current structure of CSP is the product of several years of development supported by research, assessment, evaluation, planning, and implementation. Table 4.2 contains an overview of the program's development and modifications. CSP receives external and internal funding to support its program goals. Funding sources come from NSF-LSAMP, corporate sponsors, and

university resources. Assessment and evaluation take place through college-based researchers and other researchers involved in the LSAMP consortium.

- **2006: LSAMP Program Announced**

LSAMP granted funding to the alliance of state-flagship universities in Spring 2006. Since there was not an existing infrastructure and program at Jefferson State, the program director invited students to participate in the summer bridge programs at the remaining three alliance institutions in the state. Over the next year, the program director developed the program and recruitment strategy to implement the program in 2007.

- **2007: Summer Bridge Program Implemented**

Comprehensive STEM Program began at Jefferson State University in the summer of 2007 with only a summer bridge program component. Twenty students participated in the program. Program participants lived in the residence halls for an eight week academic-intensive residential program from mid-June to mid-August. The staff consisted of the program director, course instructors, resident mentors, and a graduate student. Five courses were offered including MatLab, writing, chemistry, two mathematics courses, and an academic and professional development seminar.

Instructors and staff determined math course placement based on the participants' performance on a program-designed diagnostic test. The program instructors felt the program's instrument was a better predictor of students' actual math abilities or where they might need improvement than the university's math placement exam. For instance, there were participants who had placed in higher math courses according to the university's placement exam, but placed lower on the program's exam. Though some participants were concerned about the program's math placement, they held on to the mantra "Trust the Process" and found ways to maintain their ego in the midst of taking courses they felt were beneath them. Math Course A's curriculum

includes intermediate and college algebra. Math Course B's curriculum contains advanced college algebra and trigonometry. Using interview and observational data, I will discuss this process and student perspectives in chapter 5.

Instructors and staff designed the chemistry course to resemble the introductory inorganic chemistry course offered at the university. Students attend lecture three times per week with some hands-on laboratory assignments and activities. The MatLab course introduced students to the computing language software and prepared them for the course that would be a part of the engineering curriculum. Some of the participants in the study commented that this course was very beneficial, and they were unsure why the program staff decided to remove it the following year.

The writing course employs a syllabus similar to the university first-year writing course with many of the same assignments. The academic and professional development seminar covered concepts such as study skills, resume development, and professional etiquette. The course also had speakers to introduce participants to university resources and institutional agents. Finally, the participants engaged in local and out-of-state corporate tours, community service, and social activities for participants to forge bonds among the staff and other participants.

- **2008: Modifications to the Summer Bridge Program**

The program director made several modifications in 2008. First, the program director decided to eliminate the Matlab course so that students could focus on the academic subjects that prevented many students from excelling in the STEM disciplines: chemistry and mathematics. Writing was maintained in the summer bridge program's curriculum, due to its strong correlation with academic achievement at Jefferson State. According to the program director, institutional data supported that students placed on academic probation at the end of their first year often underperformed in their writing courses.

- **2009: Comprehensive STEM Program Realized**

Based on two years of evaluation data, the program director and his staff discovered that in order for the CSP students to succeed they needed additional support to sustain them throughout their first academic year in college. At the 2009 recruitment weekend, CSP staff informed Jefferson State admitted students and their parents that the program would begin in the summer and extend throughout the first academic year. Successful program participants would also be granted the opportunity to engage in undergraduate research the summer following their first year in college. Lastly, successful participants would receive a \$1000 scholarship, \$500 to be disseminated in the fall, and \$500 to be disseminated in the Spring of the sophomore year. This year, the summer bridge program entailed chemistry, mathematics, writing, and an engineering design course. In the engineering design course, students used engineering concepts and skills to build structures. The final project for the course was to build bottle rockets that would be launched on the tennis courts of the campus.

During the academic year, program participants engaged in the following activities: biweekly advising, nightly recitation sessions, first-year seminar, peer mentoring assignment, residence hall assignment, and math course clustering.

Another program component that was added to the 2009 modifications included an undergraduate research experience. The program director established partnerships within the university to identify opportunities for students to engage in research. Specifically, the math department received funding from the National Science Foundation and sought students for a new undergraduate research opportunity. CSP staff worked with the math department to identify students that would be a good fit for this program. The remaining program participants were invited to participate in the graduate school's Summer Research Opportunities Program (SROP). Program participants engaged in four to eight weeks of laboratory work across the various

STEM-related colleges, created posters to display their research findings, and presented at summer research conferences.

- **2012: Second University Math Placement Exam Implemented**

Each summer, the bridge program component of CSP offers intensive mathematics courses to help students overcome gaps and deficiencies in their conceptual and operational knowledge. Yet, students were unable to capitalize on these cognitive improvements. If they did not make arrangements with the math department to take a second math placement exam prior to the first week of classes of the new semester, they had to enroll in the math course associated with their initial math placement exam.

Program administrators worked with the mathematics department to allow students to take a second math placement exam following the summer bridge intervention. At the end of the program, 88% of the participants increased their math placement scores. Many of the students were able to bypass one to three math courses. Another key feature of this program adjustment is that the staff identified a barrier that was affecting student persistence and took appropriate action. Students also reported being grateful that the mathematics department administrators and CSP developed this policy change.

- **2013: Program Expansion**

In 2012, there were very minimal changes made to the program. Yet, the program directors were working with university administrators to identify ways to scale up the program to support more students experiencing transitional issues and lacking academic readiness in their STEM courses. Once again, the program administrators sought opportunities through relationship-building to improve the program and maximize student outcomes. As a result, CSP administrators forged a collaborative effort with AEC administrators. CSP and AEC presented their goals to the Provost of the university. After several meetings and negotiations, the provost

decided to provide funding to increase the program capacity from 25 to 50 students. With this additional funding allotted to the program, CSP hired another staff person. AEC hired a new academic advisor to work with the additional students who would be CSP participants. There were also additional residential staff hired for the summer bridge program.

At the time of this study, the Jefferson State provost expressed interest in increasing the number of students in the program in the future. Based on the 2013 expansion, the program director was considering how to maintain the supportive group dynamics with larger numbers. He was considering moving toward creating pods of 25 students per group to make the larger group smaller and more manageable.

Table 4.2 CSP Program Development

Year	Program Development/Modification
2006	<ul style="list-style-type: none">• LSAMP grants funding to the alliance of state-flagship universities.• JSU students attend summer bridge program at other institutions.• Program director begins planning CSP.
2007	<ul style="list-style-type: none">• Program director implements an 8-week summer bridge program with 20 students.• Program components entail coursework, corporate tours, community service, and social activities.• Summer courses include math, chemistry, writing, and MatLab.• Diagnostic exams dictate math course placement in lieu of JSU's math placement exam.
2008	<ul style="list-style-type: none">• Program director discontinues MatLab course due to institutional data suggesting that writing is a predictor of academic probation status.
2009	<ul style="list-style-type: none">• Program director expands CSP to include academic year programming.• Program director informs participants they will receive \$1000 scholarships in their sophomore year.• Program staff collaborate with the math department and the graduate school's Summer Research Opportunity Program (SROP) to place students in undergraduate research experiences.
2010	<ul style="list-style-type: none">• There are no changes to the program during this year.
2011	<ul style="list-style-type: none">• There are no changes to the program during this year.
2012	<ul style="list-style-type: none">• Program administrators coordinate with math department to allow participants to take a second math placement exam following the summer program.• Increased scores make some students eligible to "move up" to the next math course
2013	<ul style="list-style-type: none">• With financial support from the provost, program administrators collaborate with the Albert Einstein College (AEC) to increase the number of students who can participate in CSP.• Program capacity increases from 25 to 50 students.

Comprehensive STEM Program Evaluation Outcomes

CSP receives assessment and evaluation support through a college-based research center.

Retention and graduation data, and more recent scores from retaking the university mathematics placement exam provided evidence of the success of the program. Table 4.3 provides retention

and graduation data from cohorts 2007-2013. Table 4.4 shows 2012 and 2013 data regarding changes in math placement exam scores and shifts in math course placement. Students who achieve scores that are consistent with a higher math placement will have the opportunity to enroll for that course. This change in course enrollment has implications for retention and time to degree. This data also informs program administrators and students about gains in math competencies after participating in the program.

Table 4.3 Retention and Graduation Data of Program Participants

	2007	2008	2009	2010	2011	2012	2013
Participants	20	14	23	18	18	21	41
STEM Retention	70%	64%	70%	72%	67%	81%	71%
Persisting	--	--	78%	77%	78%	95%	83%
Degrees Earned from MSU	90%	79%	--	--	--	--	--

Note. Based on data collection period of Summer 2013-Spring 2014

Table 4.4 Math Placement Increases and Course Movements

Cohort	N	Increased math placement score*	Placed into a higher math course	Intermediate algebra to Algebra	College algebra to Pre-calculus	Pre-calculus to calculus
2012	21	88%	59%	60%	100%	50%
2013	41	94%	70%	79%	100%	42%

Note: Not all those who increased the math placement score moved to the next course.

Summary

In this chapter, I discussed the context of Jefferson State University and its STEM colleges and the Comprehensive STEM Program as a member of the Louis Stokes Alliance for Minority Participation. I focused the university context on the multitude of programs and initiatives designed to address student persistence, retention, access, and inclusion. I also discussed race relations and racial experiences at Jefferson State to illustrate how psychosocial factors may also influence persistence, retention, and sense of belonging. This idea will be discussed further in chapter 5 from the perspectives of the study's participants.

I provided an overview of the LSAMP program to show the espoused values and goals of the program and to provide some of their findings regarding best practices. Next, I discussed CSP. I elaborated on the programs goals, recruiting and admittance process, program components, the history and evolution of the program, and evaluation outcomes. This information conveys the values and goals of the program that facilitate academic readiness and adjustment to college life at Jefferson State. It also illustrates the various program modifications and incremental process to developing a comprehensive program at support students pursuing degrees in the STEM disciplines. Developing a successful program takes time, intentionality, and attention to detail. The information presented here is the most significant program changes that are relevant to this study, by no means, are they the only program changes. The program director and his staff have made a variety of minor and major adjustments to the program, and they continue to learn new ways to improve the program to support the ever-changing needs of students. However, the foundational structure of academic and social support remains intact.

CHAPTER 5: FINDINGS: HOLISTIC SUPPORT

In this chapter, I discuss the first component, *holistic support*, of the emergent model for programmatic influences on college readiness and retention among underserved students of color in STEM. I draw upon the myriad of ways the Comprehensive STEM Program (CSP) incorporated holistic support. In Chapter 6, I describe the other three themes: community building, STEM identity development catalysts, and the proactive caring.

As discussed in Chapter 1, the Expertise Model of Student Success (EMSS) suggests that successful students undergo a process of determining what barriers exist and what knowledge they must acquire to overcome those barriers in order to pursue purposeful actions (Padilla, 2009). The knowledge students need to be successful in college encompasses both academic and heuristic or context-specific knowledge (Padilla, 2009). College is a new domain for many underserved students, and the absence of the appropriate knowledge can negatively affect their first year in college and markedly influence the trajectory of their overall college experience. Thus, the CSP staff use their knowledge of the barriers that underserved students face to identify appropriate strategies and practices to bolster their achievement. Phil Smith, the program director, shared some of these factors during his interview:

You know, some of these students are first generation. They've had, they haven't had family members that they can look, look to as mentors or ask questions of to help them navigate this process. Some of it has to do with the fact that they are hailing from school districts that are economically challenged, that simply don't have the resources to prepare them for post-secondary education experience. Some of it has to do with their attitudes. I think, you know, this generation of students is so used to things being on demand, movies, entertainment, information. This idea that they would have to sit down and crank in a textbook for eight hours a day on their own is just not, it's foreign to them.

Phil identifies a myriad of concerns regarding the pre-college experiences and characteristics of underserved students of color. Given this prior knowledge, beginning in 2007, Phil reached out

to college administrators within the STEM colleges at JSU and devised a plan to address the academic needs of this student population:

It was all about we want to find a way to increase the numbers of those students that are underrepresented or academically underprepared. Increase the retention of those students in engineering. So we looked at what does it take to get them into the College of Engineering and Computer Science. What GPA do you need? What courses do you need to take? We spent time with the math department and asked them, what does a student need to have to be successful on a math placement exam? What does a student need to have to be successful in a math class at [Jefferson State University]? We... talked to people over in the writing department. What does a student need to do to be a successful writer in a [first year writing] course at JSU? We talked to different faculty members in the [College of Life and Physical Sciences] and in [the Albert Einstein College] to get an idea of what it takes to be successful in science courses. And then we took that information and tried to create a bridge program that [addressed] most of those things.

In some ways, Phil's process of having conversations with college administrators then designing a program to meet those needs reduces the anxiety that first year students may endure in order to obtain the same kinds of information. Throughout this chapter, students discuss how they were underprepared for college expectations, unaware of how to study for college-level STEM courses, and unfamiliar with how to create course schedules that allowed them to incrementally increase their course load as they strengthened their competence and confidence. As one student asserted in one of the focus group meetings, "the program hone[s] what students need to do to be successful." Moreover, the various types of support that CSP provides emerged as a central theme throughout this study. In this section, I discuss the holistic support that the program provides in five areas: (1) academic, (2) transitional, (3) psychosocial, (4) practical, and (5) professional.

Academic

CSP addresses academic support through the following activities: (1) summer instruction, (2) recitation, (3) academic advising, (4) help-seeking behaviors, (5) study skills and habits, (6) habits of mind. Many of the students expressed that these resources and information were

important to their success in the STEM disciplines. In particular, they appreciated that sources of support could be accessed in the same office.

Summer Instruction

The summer bridge program is a six-week academic intensive program to acclimate the participants to the academic and social aspects of college life. The program focuses on academic subjects in math, science (e.g., chemistry, biology), and writing. Students cited the math course as the most beneficial academic learning experience. In this section, I explore some of the advantages of the summer instruction and the application of mastery learning processes.

On the first day of classes, students are given a math assessment to determine their placement for the summer math course. Autumn, a first year Black female computer science student, explained this process:

The way they broke our math classes up [in the summer bridge program], we took like a pretest and then they broke the classes up based on whether or not you needed help in trigonometry and whether or not you needed help in algebra...It may seem like everyone was struggling but that's only because they put you in the class for what you needed help with and not for the one that you knew the most about.

According to Autumn, the assessment score determined their math placement and not “what they knew most about.” Based on years of research and advice from administrators overseeing similar programs, the program staff decided to use their math assessment instead of the university’s math placement exam score to determine course placement. In some cases, there were students who had calculus on their fall schedule, but they were assigned to the intermediate or college algebra during the summer program. These students may have had advanced skills in some areas, but they were also lacking certain kinds of conceptual information. The lower math placement allowed the students to address hidden math gaps or deficiencies. Some students became frustrated with this math placement, but by the end of the program they came to appreciate the strengthening of their math skills.

Summer math instruction entails daily lessons and small classes with 20 or less students. Students work individually or in small groups to solve the myriad of practice problems introduced during the lesson. Sometimes students are invited to the blackboard to solve a math problem with the instructor. At the end of each week, students complete a math assessment to determine progress or areas for improvement. This course design applies a mastery learning approach employing both formative assessment and on-going, individualized feedback enabling students to identify and rectify gaps in their academic knowledge. As a result, this course design and weekly assessments allow students to “make mistakes” that might be otherwise detrimental during the academic year in terms of formal course grades (Nicol & Macfarlan-Dick, 2006).

Tim, a first year Black male civil engineering student, discussed how the mastery learning and formative assessment empowered him to become a self-regulated learner:

... [the summer program] gave me a safe place to make all the mistakes I can't afford to make in the real semester. Cuz just like you said, that math class, I was getting those teens and low 20s, too, but as I was failing that class, I was actually learning so when I got into the school year, a lot of the material that I had from the summer, I know. I know how to study. I know how to be productive because in high school, I did nothing, would still get an A so now I know I actually have to try so yeah, being in CSP, it let me do everything that normal freshmen might've made a mistake to do in the actual school year. It let me do that and not penalize me in the long run.

According to Tim, the summer program provided a safe place in which to endure correction and academic enrichment. For instance, Tim pointed out that receiving those low scores on his math assessments—though potentially painful— contributed to his learning and development. He even discovered that he could not employ the same tactics he used in high school to his academic life in college. Thus, the summer program was beneficial to Tim's long term success concerning how to study and apply math concepts.

Recitation

Recitation takes place four days a week for two and a half hours. Academic coaches or assistants facilitate the recitation sessions. Academic coaches assume multiple roles in CSP as peer mentors and role models to the program participants. These students are upperclassmen in the STEM disciplines, many of which have substantial accolades as student leaders and high-achievers. Some of them were also former participants in CSP.

During recitation, students review math and chemistry concepts. They receive assistance from the coaches and their peers in one-on-one or group formats. There are typically three classrooms in an academic building designated for recitation sessions. In conversations with the participants, they highlighted the importance of the timing of recitation, the physical space, opportunities to review concepts and focus on their most challenging subjects (e.g., math, chemistry), and access to mentors and academic assistants. For instance, Autumn noted several advantages to recitation:

Our mentors really help out a lot and then the fact that majority of the people in the program may have some of the same classes and we can all just work and help each other in a controlled space. And it's not like we have to make time [or] someone can't make it. It's a designated time. You know where it's at. It's always gonna happen that way. The recitations help out a lot. If I wouldn't have had that, I probably would've been behind on a lot of my homework and studying. So that has helped out a lot.

The usefulness of the academic coaches (i.e., mentors) emerged as a major finding in this study. In particular, William, a former CSP participant, elaborated on the significance of their individualized instruction to his knowledge attainment and comprehension of the material when he stated, “the academic assistants...gave me that individual attention. So I was able to not only review concepts but thoroughly understand.” William emphasized an ability to “thoroughly understand” concepts which might suggest higher order thinking skills such as application and analysis (Anderson et al., 2001). Program participants often cited these intellectual gains as being

instrumental to their academic achievement (useful/important outcomes of the program). As a result, a significant number of students contended that recitation was a worthwhile program component.

Autumn also mentioned the fact that many of the participants are co-enrolled in the same STEM courses during the semester; this strategy contributes to the cohesiveness of the program in creating a common first-year experience and promoting a community of scholars (Kuh, 2008). Such environments are essential to creating collaborative learning environments in which participants can rely on peers and mentors for academic and social support.

Autumn concludes her statement with an acknowledgement that without the program she may have been significantly “behind” on her “homework and studying.” As noted above recitation contains a number of attributes that enrich the academic outcomes of the students. For instance, Autumn pointed out the benefits of having designated space and time to study. Omari concurred stating, “...it gives me a set time every day where I can do homework cuz if I was on my own schedule, I’d probably be a bit behind.”

Alad, an Asian American Civil Engineering baccalaureate recipient, discussed the advice his mentor provided him in recitation:

...attending those recitations, instilled really good habits in me as far as regular studying... I remember my mentor in the [CSP] program always said you’re a student first, no matter what. And you know, that’s the kind of focus the recitations provided. And as far as hard work goes, well, that kinda followed the focus. Definitely, those recitations helped, yeah.

Transitioning from high school to college, many of the students expressed that they had not been exposed to the structure and level of organization necessary to perform well in postsecondary education. Having mandatory recitation sessions in their first year of college helped them to develop that “focus” Alad discussed in his interview. Thus, recitation provides

designated time, space, and resources (e.g., academic coaches, peers) so that students can maximize their study time.

Academic Advising

Many of the students expressed concerns about the university or major advisors within their respective colleges. Advising is provided in two ways at JSU. There are general advisors who advise students from any major including no-preference students. There are also college advisors assigned to the students based on their major. According to the participants, many of the university or major advisors apply a prescriptive advising approach such that there is a focus on a course selection, registration, and degree audit with little attention given to relationship-building or holistic development. Though the students appreciated advisor's attention to detail, they wanted more from their advising experiences. They desired the individualized and caring approach of the CSP staff. For instance, Anthony, a Black male graduating senior in Information Technology, commented on his experiences with university advising:

I think advising is a big issue I feel like when it comes to the advising to be an engineer I don't think those advisors know you as a student. Know where you came from and your strengths and weaknesses. So they give you the same course load as students who come from top schools in the state. I just don't think that's good. And it's not really beneficial in the long term.

Course scheduling is particularly important to the persistence and academic success of underserved students (Varney, 2007; 2012). Assigning students the appropriate course loads and combination of courses ensures that they are able to handle the academically rigorous STEM curriculum. Anthony elaborated on some of the challenges with course schedules especially during the orientation program prior to his matriculation into college:

I know that when I signed up to come here and my schedule was made I had 16 credits and electrical engineering courses that I would not have been ready for but luckily CSP program I was able to change my schedule in ways that would help me stay successful. And I think some of the students who aren't exposed to the summer bridge programs

come in wanting to be engineering, and they get thrown into these 16, 17 credit hour schedules.

As Anthony highlighted, CSP assists students with developing their academic schedule. It is their general practice to encourage students to enroll in no more than 12-14 credits per semester for their first year in college. Some administrators at JSU believe that this approach does not position students to earn their college degrees within four years. However, the CSP administrators believe that a student's course credits should be gradually increased as they show proficiency and success through their performance in the earlier years of their academic program.

One of the goals of CSP is to facilitate retention and degree attainment within the STEM disciplines. Students switch out of the STEM disciplines for a variety of reasons; many of these reasons are never disclosed to administrators. Using annual reports of disaggregated retention and graduation data, administrators are able to predict student populations who are more likely to leave STEM and/or JSU altogether. In the following quote, Phil discusses how they use academic advising to help students remain in the STEM disciplines:

We look at, are they staying in STEM? Are they staying in their original STEM major? Because our data show that underrepresented females would leave engineering but stay at Jefferson State. Underrepresented males would leave engineering and leave Jefferson State. So we're just trying [to determine if] people choose to leave or are [they] forced to leave, [and are there ways they] can they stay [in a STEM major]. For example, we have students who wanta major in chemical engineering and wanta work for [a Fortune 500 Company] and they don't have the GPA to get into chemical engineering but you can still get a degree in chemistry and still work for [a Fortune 500 Company]. So we're trying to identify what are their goals? [And] are we keeping them in STEM? Can they still accomplish what they want to accomplish when they got here through another route?

This strategy requires that the practitioner know the student. One can make a recommendation that a student change majors or consider an alternative career path, but a student may be reluctant to heed this advice. The approach and the genuine, caring attitude through which this information is delivered dictates how students will respond and move forward. For instance, Storm, a Latina sophomore in chemical engineering, discussed how the

CSP advising approach was especially helpful to her being an out-of-state student and avid planner:

...[the program helped with] knowing people ahead of time, too, because I'm out of state, I didn't know anyone and so that never really worried me. The planning and the meetings we had with Phil and Collin that definitely helped out. I was able to just like talk to them, like about my courses. They asked me how are you doing? Well, you should do this, go to tutoring. Make sure you go to recitation, talk to your professors. You know, and so that kind of reinforced everything. I actually knew them, [and] they know me. Instead of just talking to an advisor who doesn't know me which I have not gone to. I've met my advisor for chemical engineering. She seems really cool and stuff but she doesn't really know me and my strengths...I usually just go to Phil or Collin if I have questions. Like when I was responding to an email from [my internship site] about my offer, I asked Collin, is this a good email?...I don't think I would've gone to my ChemE advisor. She's nice but I don't know her like that, you know.

The advising meetings allowed the program staff to reiterate useful resources and strategies for persisting in the STEM disciplines. Storm, like Anthony, discussed that having advisors who knew her strengths and goals were necessary for her advising experience. For instance, she felt comfortable asking Collin about her internship offer, because of his expertise and continual support of her goals. In contrast, she was less likely to interact with her college advisor, because they did not have an existing relationship. She acknowledged that her college advisor was “nice,” but she did not think it was necessary to meet with her college advisor and CSP advisors. This perspective may suggest that having too many advisors—university, college, and special programs—may be counterproductive for students. Too many sources of advice may confuse students and prove to be time-consuming when one considers the process of meeting multiple people and establishing multiple relationships primarily for the singular goal of degree completion. The student may prefer to have a trusting, genuine relationship with one advisor in which they can render various kinds of support in one space. For instance, Jasmine, a Black female sophomore in computer science, asserted that the CSP advisors aid students in “every aspect of [their lives],” she shared the following perspectives on the CSP advising:

...after the program ended in the summer, they didn't just release us out to JSU. They brought us back biweekly to see how we were doing, both emotionally and academically. You know, helping with schedule changing and stuff. So they basically became, our advisors in every aspect of our life if we needed it. And [they gave] support for future things.

Because students had existing relationships with the staff, it appeared that the students would have attended academic advising even if it was not a mandatory program component. They perceived these advisors as caring, knowledgeable about their strengths and weaknesses, open to discussing all aspects of their intellectual and personal lives, resourceful, and trustworthy. These attributes made the staff seem reliable and worth seeking out their support.

Help-seeking Behaviors

Some students reported struggling with seeking out academic assistance. For these students, college was the first time they encountered academic difficulties. Thus, they perceived receiving support from others communicated that they were incapable of succeeding in college. Others feared their peers may perceive them as less intelligent, while other students identified pride as a factor that affected their ability to receive support. For instance, Gary, a Black male junior in electrical engineering, explained his initial trepidation with seeking out help from his peers:

Gary: When I started to open up and talk to more people, I felt like I got more help with the things that I needed. People knew that I needed help. For chemistry, for example, I failed it the first time. It's not because I wasn't smart enough or I didn't know how to do the work. I just never asked for help with things I needed help with...opening up and talking to different people and getting help when you needed help was super important.

Interviewer: So, what motivated you to start getting the help you needed?

Gary: My [first semester] GPA my freshman year was a 2.3, not all that great. But from there, I realized some things had to change and some of my friends from CSP that I didn't listen to, their suggestions, I guess, that first semester, I started to take them into consideration and people, a lot of people just said that I just need to ask for help. It's not that I couldn't do it. It's just I refused to do it. It's almost like I took it as a sign of weakness because [I had been] doing stuff by myself for so long, even at home school, I probably built that habit up because it was just me.

Interviewer: Why did you take it as a sign of weakness?

Gary: I really thought it was just me more so than anything, me not wanting to ask for help because I thought people would think that I was stupider than them. And I thought I was a really smart person so why would I ask for help from somebody?

For Gary, being homeschooled prior to attending college and working mostly independently prevented him from seeking academic assistance. He also perceived help-seeking behaviors as a “weakness.” Similar to Gary, Janine acknowledged that she waited “too late” to begin seeking help:

Janine: I go to [tutoring] so just getting the help I need, not being too ashamed to go get help anymore. It’s, yeah, I see that growth for sure. Started to go to the [tutoring] because the resources are there. I just waited too late. So by the time I did go and seek the help, I was like, oh, wow, this would’ve really helped if I would’ve came earlier in the semester, so I ended the semester strong, [but it was too late to improve my grade].

Interviewer: What prevented you from seeking help?

Janine: My pride. So on top of me being nervous about coming out and talking to people, it was a pride thing. It was like, hm, I think I can get it. Maybe if I just sit here and try to figure it out on my own. That pride thing, I guess that comes from being a black woman. But I just really thought that I could figure it out on my own. And then it took me a minute to just be like, okay, you know what? You can’t figure this out. You need some help.

Janine identified several factors that impeded her from seeking help including pride, cultural differences, and a belief that she could eventually understand the material without external support. Gary’s and Janine’s accounts about why they failed to seek out academic support provide useful insight about how programs can use messaging to mitigate students’ feeling as if they cannot ask for help. CSP staff work to normalize the culture of receiving academic assistance through the structure of the summer bridge program, recitation, the first-year seminar, and academic advising. Peers also play a significant role in encouraging one another to be open to providing and receiving support. I observed on several occasions CSP participants gathering in the MEP Learning Center to provide practical and social support concerning their

academics. As Gary stated he became more open to receiving help due to the encouragement of one of his peers.

Study Skills and Habits

Nearly all of participants attended urban, under-resourced high schools that did not prepare them well for the rigorous scholastic environment in college. Many participants underscored that in high school they were able to study for course exams the night before, complete homework assignments without reading their texts, ascertain main ideas without taking notes or completing homework assignments, and earn passing grades with little to no effort. Thus, developing study skills and habits were pivotal to the success of the program participants. CSP emphasizes teaching strategies for studying and forming better study habits. For instance, Liz discussed the difficulty with creating her formula sheet for one of her STEM courses in the absence of good study skills and habits:

They let us have [formula] sheets but if you have a [formula] sheet and if it isn't worth anything, then you're not gonna pass the exam and you only got two hours to figure out these 15 questions. You gotta do calculations with every single one of them...so you better get it done. So [I had to] really learn to sit down and study for the first time in my life. Cuz I never did that in high school, [and] I was [in the] top 5% of my class...

In STEM courses, it is a common practice to allow students to use a formula sheet during their examination period. However, students still need to exercise a certain level of skill to develop a sheet that will be useful for a course exam. If one has not read the material, taken good notes, or completed their homework the help sheet will not support him or her during the examination period. Through academic coaching and peer relationships with CSP participants many students acquired tips for developing quality formula sheets.

Other students noted that completing homework the night before its due date or failing to take notes in class became increasingly difficult as they advanced in their upper-division courses. For instance, Carmen relied heavily on her “intuition,” but these abilities became less reliable:

I did learn that I cannot depend on my intuition for things anymore. I have a pretty strong intuition on learning things. Like if I didn't go to a class and we have homework, I can pretty much figure out what's going on in [the] homework. Okay, this number equals this number, like I'll create formulas in my head to figure out what's going on in the homework. But getting into my 300, 400 level classes like I am this year, I learned that through CSP, you can't just use your intuition to do things. You gotta actually write this thing down. You can't do this the night before.

I observed in the first-year seminar that the program staff taught lessons on study skills, mnemonics, and methods for analyzing and synthesizing course material. Some of what Carmen shared was a part of these presentations. The staff informed the students that the material becomes increasingly difficult and establishing strong study skills in their first-year courses will help them in their upper-division courses.

Students also indicated that the recitation sessions provided opportunities to learn about study habits as exemplified by one of the focus group participants: "We met tutors who were like really smart. They showed us different study habits we might need to use or change." Other students pointed out that developing strong study skills in their first year of college allowed them to set a strong foundation for their educational trajectory. This point is especially critical given that many of the participants matriculated from pre-college environments in which they did not require these kinds of skills to be successful. One focus group participant elaborated:

I agree with that studying thing. Like I used to study, 15 minutes before my test [in high school]. I wouldn't get 100% but, I'd do like pretty good. Now I find myself studying for my orgo exam a week and a half before the actual test, I would never do that in high school. Like not at all.

Having strong study skills is essential for success in the STEM disciplines. Attending a large, public, research university does not lend itself to much interaction with the instructor or teaching that is conducive to a variety of learning styles (Landis, 2013). In this institutional setting more attention may be placed on content coverage rather than student understanding. If students are unable to engage in some self-teaching they may be more apt to underperform in

their courses. College administrators cannot assume that students will have these skills entering college (Conley, 2010). Thus, CSP's concerted efforts aid students in developing their study skills. This support strengthens their capacity to capitalize on academic gains garnered through the summer program.

Another area the program staff stresses is the amount of time students should invest in studying for their STEM subjects. Amanda highlighted her strategy for preparing for her Chemistry course:

So [JSU] has chemistry help rooms, and I've started to go there more. I've started to go to my teacher's assistant's office hours. And just like reading the book more and like starting to like actually apply what I'm reading. Because before, I didn't, I wasn't doing that at all. So I just started to, cuz like chemistry's pretty much another math class. You have to know a lot of equations and do practice problems. I guess invest, I guess ultimately just invest more time into chemistry.

The program suggests, on average, that students spend three to four hours per credit hour studying for their STEM courses. This approach strengthens the students' foundations for future learning and acquisition and integration of new material. Moreover, using resources, taking advantage of academic assistance and tutors, applying metacognitive strategies, and establishing appropriate study habits are all addressed in CSP. Because much of this information had not been conveyed to them in their pre-college educational experiences, many of the program participants contended that they would have struggled more in their first year of college.

Habits of Mind

A number of students discussed the "mindset" or "approach" to STEM coursework that was quite different from what they had experienced in their pre-college educational experiences. Some students felt beyond mastering math and science skills and concepts, they also needed to think differently about how they approached their STEM coursework. The college readiness literature suggests that acquiring the habits of mind, abilities, and dispositions for college-level

work is a critical component to student success (Venezia & Jaeger, 2013). The added layer of earning a STEM degree required advanced analytical and critical thinking skills. For example, Legacy contended that the way she learned high school math was different than how she was taught to approach math in college:

If it weren't for CSP, I think I probably would've been on academic probation or something because I came to CSP approaching college math like I was gonna approach high school math. And it put me in my place and from there...[CSP] taught me I can't approach it the same way because even though they're like, oh, it's still just reviewing what you knew [from high school, my college professors] still come about it [in a] different way than [my] teachers did in high school.

What Legacy describes is a shift in the metacognitive processes necessary to perform in a variety of academic settings. Though these behaviors or processes can be taught and cultivated (Arthur & Kellick, 2008), students may be unaware that they lack this ability until they encounter an environment in which this proclivity is ignited. In teaching students about writing, Delpit (2006) argued that students must be taught in a skills-oriented and process-oriented manner. A similar line of thinking could be applied to the STEM disciplines. Students must be taught both the skills and the process to acquiring and understanding knowledge. Brittney, a Black female senior in electrical engineering, explained this notion as “having the right mindset”:

[Because of CSP] I was prepared for the mindset...if you have the right mindset, you can do anything. [Due to] the mindset and also the rigorous [nature] of the courses I was prepared, I knew how to approach the problem...how to handle this and that... how to figure it out.

The bridge program taught Brittney how to approach her math and science problems. As some of participants discussed, one has to be taught the underlying concepts in order solve different kinds of academic problems, but they also must possess the ability to methodically think through a problem. Exposure through the bridge program was helping students to do both. Lastly, William discussed this new way of thinking as open-mindedness and guidance:

Because I feel like that one project kind of opens your mind up to a lot of different things. It doesn't have to be a lot of projects just one project will have you thinking in that mindset. That's what I've noticed. That kind of happened to me in my internships. I mean CSP did that too though. For one project that put us in groups. [We weren't] just looking at something [to] use it...you kind of look at it and want to know...what's causing it to function? So that definitely put you in that mindset [and] kind of like guide you in that direction to think with an open mind and think about how you can use some stuff.

The year William participated in the bridge program there was an engineering design course. He and his peers created bottle rockets with plastic pop bottles and launched them at the campus tennis courts. Another project entailed an "egg drop" competition to investigate gravity and other physics concepts. These enjoyable, problem-based activities help students to develop and practice metacognitive strategies. The process of planning strategies, evaluating, and decision-making to solve problems provide the exposure students need to tackle theoretical problems in the classroom environment (Costa & Kallick, 2008).

Transitional

College readiness entails having a level of preparation to perform well in first-year academic courses and the habits of mind to navigate the academic climate (Conley, 2010; Perna, 2012). For instance, CSP administrators agreed that underserved students have the tenacity and resiliency to navigate the tumultuous terrain in the collegiate environment, but without the appropriate support the process to earn a college degree in STEM can be particularly challenging. Phil best articulated this contention when he argued:

These kids were in high school three months [ago]...by the time they get here in September...And what magically, mythically, majestically happens in those three months that changes a student where now they're mature and they're focused and they're disciplined, I can figure it out on my own. Nothing. Nothing happens. I mean, there has to be some level of preparation for that. There is that belief that you're at Jefferson State University, [so] you should be able to figure this out on your own and unfortunately, our students are not equipped. They simply are not, they have not been prepared to be independent learners. And until that happens, they're not going to do well unless there's something systemic, something intrusive in terms of structure that forces them to learn to be independent learners.

For CSP participants, the program is the “structure” that supports them in their transition to college. To better understand the kinds of transitional support garnered from CSP, a part of my interview protocol asked students to discuss how CSP helped them make a smooth transition from high school to college. Students provided a myriad of responses to this question. The most common responses were related to college literacy, time management, and notions about the summer program being a bridge between high school and college.

College Literacy

Many of the program participants are first-generation college students and, in some cases, the first people in their families to attend college. Some of the students indicated that the first time they had visited a college campus was when they moved into the residence halls for the summer bridge program. Unlike some continuing generation students, they could not easily rely on parents and other family members to tell them about college life or how to successfully navigate it. Thus, the program administrators used the summer bridge program, first-year seminar, and recitation sessions to communicate information about institutional policies, practices, values, and norms. For instance, CSP staff encouraged the participants to build relationships with faculty and attend office hours. In my interview with Monet, a Black female JSU alum with a chemistry degree, she discussed lessons learned about getting to know your professor:

Making sure we're going to the teachers' office hours, those little tips, I think everybody should [know]. You go to your teachers' office hours, make sure they know who you are, know your name, this, that and the other. Because when you're on that borderline between a 2.5 and a 3.0, they know who you are so they [may be] likely [to] give you that 3.0. So it was just stuff like that.

Alad concurred with Monet's recollection of conversations about attending office hours. He stated:

...professor's office hours...that's another thing that the [CSP] stressed [because] so many benefits could come from it. They give you advice on what to study for [in preparation for] the next exam. They can help you, obviously help you with your homework. Help you with your class if you're struggling... [Also,] professors... notice things [such as] who's always in the front. Who's paying attention? Who's not sleeping? Who's always sleeping? They notice these things and they'll gravitate toward the attentive people. Maybe they'll ask a question and they automatically single you out just cuz you're always there.

CSP teaches students how to master the academic environment. A critical component to student success is faculty interactions and relationships (Tinto, 2012). Being instructed to attend office hours, seek out opportunities to make connections with faculty, and sitting up front and be attentive in class are habits and behaviors that the program ingrains into the students. These messages may seem basic or obvious, but for first-generation college student these "tips" are necessary for socialization to the college environment.

Other students valued the context-specific knowledge obtained from the program. Information such as course scheduling and how to find relevant resources on campus supported their smooth transition into college. For example, Earl identified the importance of knowing about pre-requisite courses and balancing course loads:

I would say CSP kinda gave me the knowledge to know my requirements before coming in so I knew exactly what prereqs I had to take, the six prereqs and knew when to take them. So I probably would've came in confused and just took classes that I thought I needed and not being sure of the necessary classes I needed. And the way that my schedule was set up by Phil and Collin, you know, kinda led me into the right path of doing it and not having an overloaded schedule. So that's probably one of the main things.

In addition to scheduling support, Ben appreciated having an understanding of the inner workings of the college environment:

CSP just really made it like, I don't wanta say narrow but like it kinda narrowed down like what you have to do. Coming to a big college like this, you could get lost. Like you don't understand who to go to or where to find help. You know, and even that communication is key because sometimes you might want help but you don't know who to ask, or you want to ask but you just don't because you're lacking the communication. I feel like CSP just helps you communicate better and also it's a help center.

CSP aids students in streamlining the process of accessing resources and knowing what is needed throughout the college-going process. Students noted that being a part of the program helped them to simplify the large, decentralized college environment inherent within a large, public, research university. Students benefitted from the abundance of resources at JSU, but they also felt overwhelmed. CSP helped students determine what services they needed and where and how to access them. More importantly, CSP was a one-stop shop for services and referrals. As Collin stated, “another immediate impact is them getting comfortable with campus and where the resources are should they need help in various types of situations.”

Time Management

Time management is operationalized in several ways within the program. The summer bridge program is highly-structured with classes, recitation, social activities, community service, and free time from 7:30 a.m. to 11:00 p.m. Monday thru Friday. Saturday and Sundays are a little more flexible with a few planned activities, but students are still provided with recommendations for their free time (e.g., sports, laundry, study, worship or religious expression). Some students maintain this scheduling format to organize their time during the academic year. Academic advising sessions are another venue where students discussed how they used their time. CSP staff equip students with scheduling grids, time charts, and recommendations for being more efficient with their time. Discussions about time management strategies and practices also take place in the first year seminar. Storm explained how the summer bridge program helped her to develop a regimen for her academic and social needs:

In terms of like the amount of studying that has to be done...recitation during the summer really helped, especially cuz we had actual math and science courses. [During the academic year]...we had recitation Monday through Thursday, again the same time...I actually did go to every single one of those and so that made me think like, okay, this is how I'm going to do my work. This is the amount of time I'm going to spend for each class and not just spending a large amount of time on studying but also being able to

work smart, like Mark said at one point. So yeah, that definitely trained me, when to study and...when to have fun during the weekends.

As previously stated, many students were unaware of how much time they should devote to academic and social aspects of college life. The staff used the structure of the summer program and candid advice to teach these college success skills. For example, the staff designed the summer bridge program course schedule and content to resemble an actual college semester at JSU. Some classes met three times a week for 50 minutes, while other class schedules were two days a week for 110 minutes. This structure allowed students to get a sense of how to manage and prioritize time in order to prepare for their courses. The students also began to understand how much time they needed to allocate to different kinds of assignments or tasks (e.g., weekly assessment versus final exam). Some courses required more or less study time depending on the subject-matter, course difficulty, and the student's skill level and ability (Landis, 2013). Thus, "working smart" entailed having greater self-awareness and managing time according to preparedness and course demands.

Some students agreed that they spent too much time socializing or not enough with friends and loved ones. The staff wanted to ensure that students created a healthy balance in their lives. For this reason, they incorporated social activities in the summer program schedule. There was free time in the evenings during week, and planned social events on the weekends. As noted in Storm's comments concerning "fun during the weekends," the staff recommended to students that social activities should be pursued once they addressed their academic tasks. Moreover, the staff often used the summer bridge program schedule as an example of how to organize one's time when advising students during the academic year.

The staff also passed out planners and schedule grids to teach the students time management skills. Some students mentioned that staff members reviewed their planners during

advising sessions to ascertain if they were using their time effectively. For example, Autumn described the tools and approaches that Phil used with her:

Like I have bad time management skills and so when I went in for my biweekly meeting, Phil got me a planner and he printed out sheets that are like you have a week and then 8:00 a.m. through whatever time, to fill in all of the days to make sure all my time is accounted for. So they just really help you out. (Autumn, Black female, computer science, first year)

Because the students were not accustomed to managing their own time and schedule, they needed a significant amount of support in this area. Research shows that modern students transition into college from highly-structured pre-college lives overseen by their parents and other adults (Kimmel, 2008). Some participants revealed that they tended to over indulge in social activities due to this new found freedom. Consequently, program staff worked with students to help them prioritize their responsibilities and exert more discipline in how they utilized their time.

Furthermore, the summer bridge program provided initial exposure of how students might organize their time. Additionally, recitation was a consistent staple in their daily schedule ensuring a designated study time. Students also discussed that principles and tools shared during advising sessions helped individual students better organize their time.

Summer Program as a “Bridge” between High School and College

Many of the students described the summer bridge program as a good transition from high school to college. Participating in the bridge program allowed them to develop a core set of friends and have a solid foundation for their college experience. Because CSP participants had to be away from their friends and family their last summer before college, some participants described the program as “tough.” However, overwhelmingly, they felt the summer bridge program was a worthwhile experience. Phil discussed why the bridge program is a meaningful experience for underserved students:

It's tough being a college student, period...you're not used to this community. You're not used to this campus. You're not used to dealing with certain types of people...there's a lot in that transition. It is especially difficult for a student majoring in STEM. Their curriculum is extremely challenging. The math that they have to go through is tough. And so if you start off in intermediate algebra, and you're an engineering student, you've got to go [Intermediate Algebra, College Algebra, Trigonometry, Calculus I-IV]. That's seven math classes. That doesn't even begin to address the math you'll have in your engineering courses. So it is tough and we are trying to determine, do you have what it takes? They're gonna have days where they second guess, did they pick the right major? So we do make [the summer bridge program] challenging...there's a boot camp element to this program. But just like in boot camp in the military, it's designed to prepare you for real life conditions when it gets tough...When you have a faculty member who won't take your excuses, demands you're in class on time every time, and you can't come in and tell them about how you had to help your parents move. They don't wanta hear any of that. They wanta know, did you study? Did you read? Are you prepared? Can you pass this exam? That's what we're trying to prepare them for.

The program staff use their knowledge of the college student experience to identify potential pitfalls that may prevent students from performing well in their STEM courses. In particular, they use the summer bridge program to identify areas that individual students might need additional support so that they are successful throughout the academic year. Phil and his staff work to address both academic and non-cognitive factors that may stifle a student's transition into college and advancement in the STEM disciplines. Consequently, the students had a number of positive things to say about the bridge program. Ben, a Black male junior in mechanical engineering, conveyed how the program established a strong foundation for him:

[It was] a good support group. Like CSP really helped...with my beginning years, definitely freshman, sophomore year. It laid down like a good foundation for me to, you know, get started in college cuz sometimes that start in college can be rough and I feel like without CSP, I would've had a rough start.

Ben states, he would have endured a "rough" start without the support of CSP and its people. Feelings of isolation and loneliness can lead to student departure. Thus, having friends is important to the academic and social adjustment to college life. Amanda and Autumn also illuminated the academic and social benefits of participating in the summer program:

I wouldn't know as many people as I know now and just also from being in this program, my transition from high school to college would be completely different. I probably wouldn't [have] made as many friends. I don't think it would've been as smooth [of a transition] and probably academic wise, I don't think I probably would've been as disciplined and as I am now (Amanda)

Because it really just showed you how college would be. It gave you a good transition rather than going from high school straight into college and being like shocked. It's really different. (Autumn)

Amanda asserted that the program allowed her to make friends and develop a level of discipline necessary to her academic success, and Autumn contended that the program reduced feelings of "being shocked" about postsecondary education. Both Amanda and Autumn revealed in their interviews that they experienced initial challenges with staying focused and managing their time, but CSP staff aided them in overcoming these difficulties.

Jackie, a Black female junior in computer engineering, emphasized the benefits of being connected to a network of scholars who shared her interests and zeal for the STEM disciplines:

It's very, very helpful. It's a good transitional program. You meet kids who have similar interests. So I would say that's one thing that you just, it's like a networking opportunity. It also helps you with like math and chemistry. It helps you get acclimated to the campus...it gives you more confidence in yourself because [of what] you have to do after the program and you have to talk to people, presenting your accomplishments and things like that. So I think it's just a good program to do. Especially if you're gonna be an engineer.

Jackie graduated valedictorian from an urban high school that did not have a strong STEM curriculum or presence. Prior to coming to JSU, she had been unable to cultivate relationships with peers who were equally interested in STEM. She also mentioned in her interview that participating in the program allowed her to build confidence and develop her communication skills.

Other students expressed that the summer program facilitated an introduction or "jumpstart" into college:

I guess the best way to sum it up was it gave me a jumpstart on college. So like many kids are coming into college trying to figure out what they really wanted to do, trying to figure out the campus, figure out friends, figure out all this other stuff. I had already figured it out six weeks before classes even started. So I basically was able to start classes focused on classes, not focused on everything else because the foundation was already built (Jon, Black male, computer science junior).

I don't know where I would've been without CSP. Seriously. I guess it really did prepare me. I wasn't ready for college at all. I had no idea what to expect so CSP was like a little taste of college. It was just those three classes and, but it prepared me. (Janine, Black female, computer science sophomore)

Jon noted that dealing with transitional concerns during the summer months rather than the first weeks of classes allowed him to focus on coursework. This element is especially significant for underserved students. There a number of environmental factors that tend to distract first year students from the academic aspects of college life. Having time and space to consider and negotiate those potential distractions prior to college matriculation supports a seamless academic transition. Thus, due to Jon's focused determination and the program's transitional support he earned a 3.75 in his first semester of college. As Janine mentioned, she was unprepared for college, and the bridge program allowed her to obtain a "taste of college."

Finally, many students expressed the summer bridge program better acclimated them to the culture and expectations of college life than the university orientation program. For instance, Alad underscored a number of distinctions between the bridge program and the university orientation:

It helped me first of all to get comfortable with Jefferson State. And I had a network of students and mentors to talk to. Because I couldn't imagine. It was hard for me my first week here. I'm moving on my floor, and I only know two people cuz they went to same or similar high schools. I don't know who my roommate is. I'm all scared about what's gonna happen. I'm scared about my first day of classes. How do I buy my books and everything. I still had a lot of that mentality, but a lot of it was taken care of with CSP. [The university orientation program], two days is not enough. That helps but it doesn't get you acclimated in two days. You need something like that and that's what CSP gave me. Especially not being lax over the summer and working on academics. The group projects [and] learning how to work with people that are different from [you] no matter what high school you came from or what educational background you have that helps.

Getting used to the dorm lifestyle all that stuff. And yeah the network was huge as well because knowing people in your class that you're already comfortable with...then finding a study buddy that you know you can trust.

The summer bridge program plays a significant role in the transition of underserved students from high school to college. Many of program participants felt underprepared for the expectations and rigor of college. They also lacked readiness for the environmental and social changes. Fortunately, the summer bridge program allowed the students to transition into college with fewer barriers than the typical college matriculation experience.

Psychosocial

Scholars argue that the psychological climate and social environment on college campuses can be difficult for students of color at predominantly White Institutions (PWI) (Harper, 2009; Hurtado et al., 1998; Steele, 1997). In this section, I present three realities disclosed during my data collection concerning how students experience and manage biases in STEM environments: 1) being the only one, 2) dealing with bias in the classroom, and 3) intersections of racial and gender bias. I conclude this section with how CSP staff prepare students for and respond to biased incidents.

Being the “Only” One

Many of study's participants indicated challenges with being the only person from their racial background in STEM classroom settings. Some participants described feeling weird or odd when they first noticed they were the only person of color. Jamal, a Black male JSU mechanical engineering alum, noted that over time, he realized there were less Blacks in his upper division courses:

So you know, as I started out like early in my curriculum, there were a few black people, black males, black females but as I progressed, started to look around and like, man, it's just me. Maybe there's somebody else but they're in a different section. So you know, I kinda didn't wanta think about it too much. After I looked at it and realized, that I'm like the only black or yellow speck in the room. Kinda just brushed it off a little bit, just

because there was no reason to reap on it, just be aware of it and... But then I guess at the end of the day, puts a lot of pressure on you, too, right? Because you don't wanta be known as oh, yeah, well, he's like dumb or something. Then they kinda put this stigma on the rest of you so it's, it does put some pressure on you at the same time, that you wanta kinda prove that Black people, Black males are smart and are just as capable as their White counterparts.

Like Jamal, many participants discussed hardships with dealing with racial bias in the classroom. They wanted to be valued and validated in the classroom environment, but many experienced discontent and exclusion. These encounters became taxing on their identities and their goals to achieve success in STEM. Fortunately, Jamal was able to manage emotions under these conditions. He never discussed lashing out or acting overtly aggressive in order to "prove" his intelligence. In fact, none of the participants mentioned outwardly confronting incidents of bias. However, many students internalized these episodes, and some retreated such that they disengaged and discontinued efforts to form study groups with majority students.

Women of color reported mixed views and responses about their racial and gender bias and underrepresentation in the classroom environment. None of the Hispanic women in the study indicated concerns about their relatively low or non-existent presence in classroom settings. They noticed it, but they did not question why these gender differentials might exist. In fact, Emily, a first-year Hispanic Albert Einstein College student, contended that she was "proud" to be among the few women of color in her mathematics courses. She saw this environment as a sign of her academic accomplishments. Participants such as Monet, a Black female JSU chemistry alum, appeared to be deeply affected by the lack of critical mass among students of color in STEM courses. Thus, Monet elucidated the challenges of being the only Black female in her STEM classes:

I was actually the only black female in a couple of my chemical engineering classes at [JSU] and it was just like, this is really discouraging because if you ask a question or you ask for help, oh, they'll give you that side eye, like do you really know what you're talking about. Come to find out you guys were having the same problems I was having,

also had the same questions but were too scared to ask, voice your opinion or voice your concerns in the class...I think I had to prove myself. Yes, I have some sort of valuable knowledge. I can bring something to the table and...it was good and bad. One, it was good because the professor always knew who I was and he always made sure that I understood the problems and the different situations that were going on in class, make sure that I comprehended it all. But it also was like why you gotta pinpoint me out? That's how you feel, like why you gotta ask me? Why don't you ask the other people? So it was just like being a black female, being black and a female in STEM is really hard, flat out because I just feel like you always have to make sure like you're on top of your game and always ahead of the curve...always ahead of everything because if you fall behind, I feel like you won't have the support to bring you back.

Though Monet believed that her classroom peers were afraid to ask or respond to questions raised in the classroom, her actions were deemed unacceptable or proof that she did not belong in this space. She also perceived that her professors asked her to respond to questions more than other students, because she was a noticeable minority among her majority peers. Consequently, Monet concluded that being “Black and female in STEM was really hard” suggesting that Black women received little to no support if they failed to maintain a high level of performance.

Emily and Monet's perspectives reveal that how one perceives the underrepresentation of women and students of color in STEM is not a monolithic feeling or experience. Both of their perceptions present different insights and potential strategies for helping students deal with the racial and gender realities in STEM. For students like Emily, administrators should create space in which women of color feel comfortable disclosing biased incidents, should they arise. However, they should be careful not to assume that all students have had such experiences or sees the world through a racialized lens. In Monet's case, administrators could help students to unpack what may be happening in the classroom environment and identify productive ways to deal with these circumstances. For instance, some STEM students of color have found peer mentoring to be a useful outlet and a means for preparing other students for classroom environments (McGee & Martin, 2013). Other practices may include facilitating opportunities

for women of color to build relationships with male and majority faculty and peers. Moreover, college administrators must be prepared to respond to the multifaceted realities of women of color in STEM. CSP's strategies will be shared later in this chapter.

Dealing with Bias in the Classroom Environment

In addition to dealing with the isolation and alienation of little to no racial diversity in STEM courses, the program participants discussed experiences with bias in the classroom. Most students in the study agreed that the biased incidents did not result from interactions with faculty members. Any discord in the classroom across racial differences stemmed from interactions with majority peers. For instance, Janine conveyed that she heard stories about faculty members, but most of her personal accounts with discrimination were with her peers. She hypothesized about these differences:

I guess with the professors, this is more so their job so they have to be more professional about it. But I have heard bad stories about professors but professors I run into aren't as bad, but students, it's just like, no holds barred. I could just say whatever, look however I want a look.

Janine's perceptions corroborated with Sarah's story about a student moving to another seat to avoid sitting next to her. Sarah, a Black female materials science sophomore, was surprised to have had such an experience given how hard she worked to get to college. Her comments began with speculations that college life may have been easier if she had attended a Historically Black College or University (HBCU):

Sarah: I believe the [college] experience would've been better going to an HBCU, just because I'm kinda with my people and [though] everybody isn't from the same background we've known the same struggles. Coming [to JSU], every student doesn't know what I've struggled [through] or how I've gotten here. My freshman year, I took [Pre-Calculus] and, of course, I'm in this class full of White students, that was my first math class versus all of my friends starting off in [Intermediate Algebra]. And them thinking that's the higher math and just because the number's higher doesn't mean that you're at the same level that we are. And with that being said, a student got up from the seat next to me when I sat down because I was Black...I tested to get in this class just as you did. So it should never be like that and they don't see stuff like that.

Interviewer: What suggested to you that it was because you were Black? Do you think it could've been something else? Perhaps, he saw his friend coming into class?

Sarah: No, cuz he was already seated, so like he was seated and once I sat down, cuz I asked him, is anyone sitting here and he was real hesitant so just like, oh, okay, and then he ended up moving his seat.

Interviewer: I see. How often do those kinds of things happen to you in the classroom?

Sarah: That was my freshman year. I really haven't experienced too much of anything like that. Of course, you do get those little stares, whatever, from other students, the higher you go in some of your courses or whatever, seeing that those do continue or whatever. So... I try not to let it bother me. I've experienced a lot of racist things in my life and I think you really don't expect anyone saying that, of my age, seeing that it is 21st century, stuff like that shouldn't happen but it happens every day.

Previous studies have cited the everyday racism college students of color encounter within the classroom environment (Ong, 2005). According to these studies, Sarah's interactions with the student she described are not uncommon. In fact, the scholarship refers to them as microaggressions. "Microaggressions are subtle insults (verbal, nonverbal, and/or visual) directed toward people of color, often automatically or unconsciously (Solórzano, 2001, p. 60). This nonverbal microaggression communicated to Sarah this male student did not feel comfortable sitting next to her. This incident was disappointing such that it motivated Sarah's comment that she deserved to her given her test scores. In the current study, a number of students talked about these small but psychologically and emotionally taxing incidents of discrimination and bias. For instance, Gregory, a Black male electrical engineering sophomore, pointed out barriers to forming study groups with White students:

Interviewer: What were some of the challenges that you've faced while trying to earn your engineering degree?

Gregory: Well, just always kinda being only the minority in your class. It's kinda hard to form study groups. You know, people don't really wanta study with you but it's all about making friends with different people in your class and just letting them know that you're really serious about the material. You also are smart and you belong there, especially in the upper level classes.

Interviewer: Did you find that approach to be stressful to try to get into those groups and prove to people that you were smart?

Gregory: It wasn't stressful to me. I felt like I belonged there and I know I did so it wasn't really that stressful.

Interviewer: So what did you do to gain access to those study groups?

Gregory: I just [be]came friendly to those people, introduced myself to them, let them know that I needed help with some of the material and it'd be great if we all just formed a little study group. That way, we'd all benefit from it.

Interviewer: Were you ever unsuccessful with that approach?

Gregory: A few times.

Interviewer: And how did that make you feel?

Gregory: I just went to other resources as far as pursuing, like maybe getting a tutor through the MEP Learning Center or things like that.

Gregory's experiences with forming study groups with majority peers was concerning, but hopeful in that he was able eventually form groups with some of his majority peers. On the other hand, his interactions with his majority peers resembled what other participants conveyed throughout their interviews. Being a person of color or a woman of color necessitated proving one's intelligence in order to be accepted or valued in the STEM disciplines.

Intersections of Racial and Gender Bias

In this last section concerning students' experiences with bias, I bring attention to the accounts of several women of color who underscored the hardships of discrimination when one is both a person of color and a woman. In this first quote, Monet disclosed that people tend to forget the aspect of being a woman in confronting biased treatment:

...It's just because of the color of their skin and also being a woman because some people fail to realize being a woman, like people don't think we're smart. And it's just like, are you serious? Are you not gonna value my opinion at all? It's kinda messed up at the end of the day...it's discouraging that at times because as a black person, I feel like we, we have the right to be in college.

Monet concludes her statement with “we have the right to be in college.” The fact that she illuminates such an obvious statement suggests that she has seriously contemplated this idea. The psychological stress and strain of navigating a biased environment can pose a threat to one’s academic success. The literature defines this phenomenon as stereotype threat (Steele, 1999). It compounds the existing hardships of pursuing a difficult subject matter and potentially compromises the academic experience. Brittney, a senior in Electrical Engineering, affirms Monet’s sentiments. She, too, perceived that majority students do not believe she is intelligent enough for the STEM disciplines. She provides two examples to elucidate her perceptions:

Brittney: They just think that we don’t know anything. Like we don’t know what’s going on in the class or it’s just automatically like do not form a conversation or form a group with them, *the Black people*, because they don’t know what’s going on or they just here... especially with girls. They don’t want you to, I’m not saying they don’t want you to succeed but they don’t want to see you like doing better. Before, I went on spring break, we had exams Thursday and Friday. I had one Thursday and Friday. I had five exams last week actually. And the people [including] some of my black friends, it was like the guys, [asked] what’d you get on our exam? They’d be like oh, no, you didn’t, no, you didn’t. Or they might know something that’s like a [formula] sheet equation that you can put on a [formula] sheet or something. They won’t tell you. They just wanta see you struggle a little bit. But it’s cool.

Interviewer: Why do you think they want to see women struggle?

Brittney: Because I think people don’t wanta see women succeed in life, just period. And somebody said a smart comment to me...in one of my 400 level classes, it’s a design class and we had to like write about where we plan to work after graduation. I had to give mine, I was supposed to graduate this semester but two classes, I gotta take two classes next semester. We got our little review sheets back and people said the only reason you working at [that Fortune 500 company] cuz they got a woman CEO now. Like dang, that happened before this. You know what I’m saying?

Brittney provides a variety of observations that make the classroom environment seem hostile. She did not feel valued, respected, or supported in this context. She also underscored that this was not only a problem with majority students, but also men of color. Experiences such as what Brittney describes can affect sense of belonging in STEM (Strayhorn, 2012). They not

only make students feel alone, but they can make it difficult to find and attach to a community (Ong et al., 2011). In chapter 6, I report that having the CSP community was one of the most important entities to the participants' success in STEM. However, the communal feeling provided by CSP cannot permeate the isolation of classroom environments that lack racial and gender representation. In those instances, students have to garner different strategies to cope with the circumstances of those class settings (McGee & Martin, 2011).

Finally, Janine, expressed discontent with working on group projects with her White, male peers. Like Monet, these interactions in the classroom were overwhelming, but she developed a strategy to deal with these challenging situations:

It's overwhelming going into [my introductory engineering design course]. Having to deal with those group projects and things like that. And it's just a bunch of White males in the group and then they don't wanta really listen to your input and things like that. So you just kind of have to be assertive. So that's when I started making changes. Like okay, I need to be heard because I'm here just like you all are here. I got here how you guys got here so I'm not about to go, you know. Unheard. We had to work with a disabled woman. She was losing like movement in her limbs and we had to make a tablet for her. So they didn't really wanta hear my input. They just wanted to build everything. They wanted to do everything. But it's like, you know, hey, I can [provide] input as well. And then I know before that, we had to make that robot and program it and the guy was a computer science student and at that time, that's when I was thinking about switching over to computer science and I'm like, well, you know, I can kind of give my input as well. So let me help you. It's discouraging. It'll mess with your mind. If you don't go in there like this is what I have to do, I know I need to get this done, like it can discourage you. You really need to stay focused up here.

Janine's encounters with her White male peers affected not only her ability to contribute, but her psychological well-being in the classroom environment. She surmised that if she does not engage in self-talk prior to entering the classroom environment, her "mind" will be in disarray. Consequently, she counteracted these experiences and feelings of discouragement with staying "focused."

Having Difficult Conversations

Program staff prepared students for the classroom environment through having difficult conversations about being a student of color and handling bias. These conversations often took place during residential floor meetings during the summer bridge program. Mostly, they encouraged students to use their performance and competence to mitigate the chilly or uneasy climate in their classroom settings. Vanessa, a Black female applied engineering sciences senior, shared what she remembered about these conversations:

Yeah. I definitely would say that they have, especially Phil, he talked about a lot, you know, how you will be, you know, many of the few black engineers and it will be kinda tough to get used to but to not make it an obstacle...but use it as kind of motivation to prove yourself and things like that. We had a lot of talks, especially in some of the courses that we took in CSP, they would always tell us, you know you gotta work a little bit harder than everyone else. So we were prepared a lot. It wasn't something that I didn't expect.

According to Vanessa, Phil informed the CSP participants about the potential racial realities within the STEM disciplines. In particular, he underscored some of what was revealed earlier in this section emphasizing that the students would be a visible minority in their classroom settings. His advice for dealing with bias was to use hard work and determination to mitigate these challenging circumstances. Consequently, many participants including Vanessa disclosed feeling prepared for what they might encounter in the classroom environment.

A subset of students was initially critical of these conversations, because they did not see the point of them. These students had attended more racially mixed or predominantly White high schools. They did not see the need to be prepared for such environments. However, once they realized their peers did not transition from similar environments, they better understand the nature of these conversations. As previously noted, administrators must realize that not all students are matriculating into college from the same pre-college settings. Administrators should find ways to be both flexible and cognizant of their messaging and the backgrounds of their

students. Though CSP were having important conversations, the way this information is conveyed should reflect the audience of diverse students.

Focus on Performance and Building Competencies

CSP facilitates opportunities for students to build their competences in STEM subject areas such that students perform better. Thus, when I asked Phil what recommendations they provided students for dealing with bias in the classroom he provided the following response:

...the way to eliminate that is performance. My experience has been once faculty, staff and other students see you perform those other things don't happen...for the most part. Yes, they still do happen but those people aren't gonna change their minds, [or] their opinion of...others anyway...But...I think, as a student's reputation grows and they are known for performance, then you don't have that issue. We have the biggest impact [in] how we stress the importance of competence and how we...show students how to become [successful] in our programs and how we help them in those areas where they need help...So those are the areas...we can help the student overcome those things. (Phil Smith)

According to Phil, the most effective way to combat bias and discrimination is to focus on building competencies and performing in the classroom environment. While Phil acknowledged that there still may be instances in which students face discrimination due to their race or gender regardless of their academic prowess, he surmised that it was more important for students to focus less on those circumstances and more on intellectual development. Furthermore, he felt CSP played a role in this area through the provision of academic services and advising.

In the STEM disciplines, environmental factors and individual behaviors that promote competition and notions of survival of the fittest constitute as the culture of science (Fries-Britt et al., 2013). However, in these spaces students of color often feel what they experience goes beyond a competitive culture and is indicative of implicit or blatant bias (Fries-Britt et al., 2013). These students want to succeed and perform well, but peer perceptions of inferiority may limit their engagement in classroom environments (Steele, 1999). Also, the belief that performance

will minimize racism and sexism contradicts some of the aforementioned experiences from students of color in this study. CSP participants achieved gains in their academic abilities which equipped them for subsequent tasks; however, these forms of support did little to aid them in addressing the racial and gender climate in STEM.

Reinforce Students' Belongingness and Contribution to STEM

Another strategy the staff used to counteract biases was to reassure students that they belonged in the STEM disciplines and that their achievement in these areas would position them to make a lasting impact within this field. For instance, Mr. Drew, the summer program chemistry instructor explained:

...one of my biggest motivations for teaching the chemistry class was to encourage the students to understand that even though they may be in the minority by a population in the chemistry class or engineering classes, that their skills, their talents, and what they're getting now in the program is preparing them to be a member of that classroom or a member of the science society...and play their role by being in that class and prove it to themselves, not to anyone else, that they belong in engineering.

Mr. Drew indicated a strong interest in affirming students in their intellectual abilities and supporting them through his work in the summer program. As discussed in his interview, having been a student of color in the STEM disciplines at JSU he had an understanding of what the students might face. He believed his role was to prepare them to be a "member" of the classroom environment and society at-large, because they had something to offer (i.e., skills and talents). Finally, Mr. Drew insisted that students "prove to themselves and not to anyone else" that they belonged in the STEM disciplines. Proving one's self is a recurring theme among women and communities of color in STEM (Moore et al., 2003). While some participants expressed feeling empowered to "prove" people wrong about their cognitive abilities, other students reported feeling overwhelmed by this positionality.

Practical

Practical support entails some of the basic needs that students have while pursuing a college degree that can be more difficult for underserved students of color to obtain without institutional support. Some of the practical support CSP provides is assisting students in finding campus jobs, employing students in their office, and providing book scholarships or helping students get scholarships from other sources. In my conversation with the program's assistant director, Collin Davis, he emphasized the importance of practical support:

Some students are coming up, they're in a position where financially, it's challenging for them to do some of the things that they need to do to be successful as students, so we can give them pointers on how to secure a job, how to make sure that their financial aid packages are in order, things of that nature.

Collin's statement is another example of how CSP operates as a *one-stop shop*. Though Collin is not a financial aid advisor or career counselor he is prepared for when his students visit him with a range of questions. Administrators in these environments have to be prepared to address a variety of student needs. Their knowledge and capacity to educate students about their various concerns reduces the number of offices and/or administrators that students must visit to have their needs address. It also reinforces that the CSP staff is trusted source of information to be sought out as needed.

Another area of support CSP provided was aiding students in providing and identifying alternative forms of student aid. Unlike some national STEM retention programs, CSP is unable to offer full-ride scholarship packages. The financial circumstances of the participants juxtaposed with the funding limitations of program causes CSP staff to use their creativity and ingenuity to find other ways to support the financial needs of their students. For instance, Roger, a Black male junior in Electrical Engineering, discussed how the CSP's book scholarship helped him to buy books that he could not afford:

I actually needed [that book scholarship]. It was [my Intermediate Algebra] math book that I needed and I didn't have the money to buy one. And so the conditions, of course, for the scholarship was that you do whatever the program requirements were so that's what I did to get it.

CSP provides \$1000 book scholarships to actively engaged program participants.

Students receive \$500 for the Fall and Spring semesters. Research shows \$1000 in grant aid can increase persistence in college by 5% (Hossler, Gross, & Ziskin, 2006). In addition to the book scholarships, CSP maintains a loan system for common STEM texts and laptops that can be accessed on a temporary basis. Jasmine underscored the importance of these resources to her college success:

...I know people like [Oshay Jackson] definitely pass on their materials and stuff, just to sort of lessen the financial burden for [students of color]. The MEP also, with the computers that they have, I know I've had to use it like several times when mine breaks down and you have to send it in. You can't really do much as a college student without a computer.

Other students mentioned that CSP was instrumental in them receiving scholarships from other sources such as the JSU STEM colleges or Fortune 500 companies. These relatively small sources of financial support are critical to minimizing the overwhelming feeling of being disadvantaged. An inability to deal with these relatively small but significant set-backs can disproportionately affect the academic and psychological well-being of underserved students of color (Sedlacek, 2009).

Professional

CSP aided the students in their professional development through helping them construct their resumes, strengthening their business acumen, and engaging them in undergraduate research. Many participants underscored the latter as instrumental for establishing content for their resumes. Collin Davis further elaborated:

The students that go through [this] program are also well positioned to succeed professionally. We stress the importance of landing internships and co-op opportunities.

Doing undergraduate research and building relationships with faculty members because many students don't really understand that you're gonna need to build relationships with faculty because you're going to need letters of recommendation. Faculty can give you leads on jobs and things of that nature. So that's a piece of the program that students don't think about immediately but later on down the line they see as a great benefit.

Students echoed Collin's advice throughout their interviews. Participating in internships, co-ops, and undergraduate research experiences reinforced their commitment to and benefits of earning a STEM degree. Additionally, building relationships with professionals in the field including professors afforded opportunities for academic and professional advancement.

Most students also attributed their resumes to the assistance rendered to them through the program. Some participants indicated that their strong resumes heightened their visibility and desirability for employment at career fairs and conferences. For instance, Gregory contended that having a quality resume was especially helpful for impromptu visits from corporate representatives at National Society of Black Engineers (NSBE) meetings:

They helped us prepare for career fairs. They were always on us about updating our resume. Cuz for the NSBE programs, we had companies...come by and give presentations and also offer an internship or a job opportunity. So you always had to have your resume prepared for the opportunity.

The students also expressed the extent to which they valued honing their professional behaviors and dispositions. Many participants commented on learning how to dress for interviews, strengthening interpersonal skills, applying business acumen. Students also emphasized how CSP helped them talk to and get connected to recruiters. Other students pointed that the program prepared them for dealing with various personalities from living with and executing projects with different students during the summer program. For instance, Alad explained:

...knowing how to talk to people and sort of gauge people's personalities and try to make sure you can work with a group of different personalities...that's like the core of engineering. You're you're never gonna work alone. You're always gonna be calling clients, working with your coworkers on different projects and there's definitely gonna be

people you don't like but you have to be like professional and so that was a big part of CSP.

Lastly, several students revealed that engaging in undergraduate research aided in their career preparation. For some students, the undergraduate research experience was the first time they had paid work experience which enabled them to develop foundational skills for other employment opportunities:

I did undergraduate research after my freshman year [in] the study of earthquake engineering. It was definitely a good experience. It kind of built the platform for me to actually gain an internship...the next year. (Earl)

...the undergraduate research after my freshman year... was a catalyst for me to get my two other internships after SROP, both being in the industry. And so CSP was really like a catalyst for me to see the corporate life and what computer science could really bring. (Jon)

Many of the participants reported that CSP services and activities offered opportunities to develop their resumes, professional skills, and build their networks. These experiences afforded access to forms of cultural and social capital that they may not have had otherwise (Ovink & Veazey, 2010). For instance, research participants gained knowledge and employed behaviors that were important to their understanding of and future contribution to the field. Though earlier sections of this chapter focused on how CSP supports academic preparation, these other outcomes are essential to holistic student success. Not only did the staff want students to achieve academically, but they also emphasized establishing careers and becoming productive citizens.

Moreover, the advice and support that the CSP staff imparted into their students regarding professional development contributed to their overall success and socialization to the STEM profession. Engaging in undergraduate research, internships, and co-ops help students to address immediate financial needs and motivates them to persist in the STEM disciplines.

This section detailed five different forms of support the program provides as identified in my interviews, observations, and document analyses. I suggest holistic support influences the students' knowledge attainment, overall readiness, and retention in STEM.

Summary

The chapter outlined five strategies and practices that the program incorporates to aid students in their academic, professional, and psychosocial development known as holistic support. Four areas (i.e., academic, transitional, psychosocial, professional, and practical) were pragmatic in nature attending to their educational and vocational needs, but psychosocial support dealt with the nuanced racial realities of students of color in the STEM disciplines at a predominantly White institution. In the next chapter, I discuss the remaining components of the emergent model: community building, STEM identity development catalysts, and proactive caring.

CHAPTER 6: FINDINGS: PROACTIVE CARING, COMMUNITY BUILDING, STEM IDENTITY DEVELOPMENT CATALYSTS, AND EMERGENT MODEL

In this chapter, I present the findings from this study on underserved students of color in the Comprehensive STEM Program (CSP) at Jefferson State University (JSU). I used an integrated conceptual framework including Expertise Model of Student Success (EMSS), sense of belonging, and science identity development as a conceptual lens to investigate how a STEM enrichment program facilitates college readiness and retention for this student population. I also sought to identify the strategies and practices that contributed to these intended outcomes.

Four overarching themes emerged from the interview, focus group, and observational data: 1) holistic support (Chapter 5), 2) community building, 3) science identity development catalysts, and 4) the caring ethos. I provide a conceptual model for understanding the strategies and practices that influence college readiness and retention among underserved students of color in the STEM disciplines (Figure 6.1). I organize this chapter into four sections. At the beginning of this chapter, I explore how CSP addresses community building. I focus on the familial atmosphere and relationships between peers, staff, and mentors. Next, I describe the practices that serve as STEM identity development catalysts. Then, I discuss the elements that comprise proactive caring. Finally, I provide an overview of the model that emerged from this study.

Community Building

Having a sense of belonging entails membership in a community, feeling valued and cared about, acceptance, and encouragement (Strayhorn, 2012). Research shows sense of belonging influences student achievement and persistence (Strayhorn, 2012). Central to the present study, community building emerged as a major finding and an important element to the belonging experiences of CSP participants. CSP staff developed the community of scholars through an infrastructure of coordinated services and activities designed to support underserved

students of color in STEM. This community of scholars emerged, in part, because of their interests and connectedness to the STEM disciplines leading to the eventual support of one another. Findings revealed that CSP staff further cultivated this community through a multitude of programmatic features such as recitation, advising, and social outings. CSP also used the peer mentoring program component to provide participants with role models and the support of experienced students. What emerged from this multi-level communal infrastructure is a familial atmosphere that permeates throughout the program and strengthens the relationships between staff, students, and peer mentors. In this section, I discuss the familial atmosphere, peer relationships, relationships with staff, and peer mentoring relationships that foster the CSP community.

Familial Atmosphere

The participants continuously cited the familial atmosphere as an important component of CSP. Several students even referred to their peers as brothers and sisters and the program staff as fathers, uncles, and big brothers. They valued being a member of a group that promoted both academic excellence and community. For instance, when I asked the program director, Phil Smith, what most students identified as the most beneficial component of the program, he stated:

The familial atmosphere. The students that I've talked to and asked them, they say, they say things like I wouldn't've been able to do it without [CSP]. And when I ask them to elaborate on that, you know, they talk about, I have someplace to go. When I needed help, I had someplace to go to work with other students. I had someplace to go for mentorship and advising. And in all those things, I knew I was gonna get accurate information. I knew I was gonna get the help I needed. I knew I was gonna be able to exhale. So it's that familial environment whether they're working with us, the staff or their peers. A place, a home away from home. A place they can go to whenever they have a need or want. And they don't always get what they want but they know they can go there and ask for it. That, I think, is the single thing.

Autumn, a first-year Black female biology student, concurred with Phil's perspectives:

Well, it's just, they pretty much gave me a family to start out with. And then a place to just relax and be able to study and work and then the encouragement and then just the structure and the help we get, like from biweekly meetings. They really keep on top of everything we need to do and get a wakeup call if you need one.

Many of the participants agreed with Autumn about the breadth and depth of services and activities within CSP. The participants noted that CSP and the program's physical campus location met a variety of their needs as students. Much of what was described also resembles the families and communities that students left to matriculate into postsecondary education. As indicated by the participants, this environment makes them feel encouraged and supported similar to an actual family that has been recreated in a campus context.

Collin Davis, elaborated on how this familial atmosphere is developed beginning with the summer bridge program:

The sense of belonging is critical. We know for students who, even if they are strong academically, if they feel like they don't belong, the chances that they are going to persist are lower. And so all throughout the summer, there's a great emphasis on just building that sense of family. We start off when we're making sure that we're doing all the activities together, as a family...to bring the cohort together. You're not able to opt out of the program activities even if you wanted to...we eat together, we study together, we, we go to activities together. We meet with the students during their first academic year on a bi-weekly basis so that they know that staff members are there, that we care for them. That they belong to a community. Even if it's not academic but just doing something fun. Whether it's a game night, going to an aquatic center event, we [also] emphasize looking out for your fellow student. We emphasize traveling in the buddy system...and looking out for others...because we don't want anybody to feel alienated...One of the questions that we ask in the bi-weekly meetings is how are you doing socially. Do you feel like you have a group of students that you can hang with, that you're comfortable with? Do you feel like you know some staff members on campus that you feel comfortable talking to? We meet with them...to know whether there's any changes in those kinds of circumstances.

As Collin indicates, CSP staff are intentional about developing a family bond among the students. Beginning with the summer bridge program, students are required to engage in academic and social activities together; no one is allowed to "opt out." The goal is to help students get accustomed to "doing things as a family." Thus, they travel in a "buddy system,"

have meals, and study together. During my observations of the summer program, I noticed the initial frustration of students with the buddy system and the notion of walking to class or the cafeteria as a group. For instance, the participants must walk as an entire group to class and meals throughout the first three weeks of the program. During the next two weeks, students have to travel with at least one person within the program. Eventually, CSP staff allow the participants to travel alone. As Collin stated, the goal of this program component is to ensure that students do not feel alienated during the bridge program and throughout the academic year. Thus, in advising sessions, CSP staff even inquire about the socio-emotional well-being concerning their friendships and comfort in CSP. They use this information to connect students to other program participants or peer mentors. Because they value the communal nature of the program, they use the community of scholars to advance its goals.

Finally, Kari, Alex, and Tim underscored how their connection to CSP made them feel like they had a family and home at JSU:

I feel like the program kinda, gave me like a family, or like a base group of people that I can reach out to cuz instead of coming here, not knowing anybody...I come here and I know people that I'm actually cool with...(Kari)

... the people that I met [in CSP] are more of a family to me. I can be on a different level with the people [in CSP] because it's like a family. I spent six weeks with these people. I know them on levels that most people don't know them. And so that's when I feel like I belong. (Alex)

Being at recitation or either just seeing them outside, when I see them, oh, there go my brother walking by, going to his class or I walk in [my College Algebra] class and I see Alex, hey, Alex! It's like, that's my family here with me just seeing these faces...Hey. I have people I talk to, go watch TV in your room...I belong at Jefferson State. This is my home. (Tim)

The program staff and participants recognized that the special element to CSP was the familial atmosphere. Similar to an actual family, there is a place where everyone can call "home." The

student and staff perspectives illuminated not only the importance of people, but also physical space that gives the group an identity and foundation.

Peer Relationships

All of the students discussed with great pleasure the peer relationships they established through CSP. CSP follows a cohort model which allows the students to coalesce over shared experiences and memories. Throughout my conversations with the students, many lamented about the hardships of the six-week summer bridge program underscoring their issues with the heat, rules, absence from family and friends, and the numerous math assessments. In spite of these hardships, many expressed they would not change much about the summer program, because they had each other.

When I asked participants to provide artifacts that represented their experiences in CSP, many of them shared Instagram and Facebook pictures. These photographs featured many tales of their shared experiences providing images of laughter, spring break trips, and group dinners. The bonds illustrated in these pictures were first solidified in the summer bridge program and sustained throughout the students' academic careers. For instance, Chris explained,

[We were] just like a group of students coming from inner cities that was there for each other. From the first day at [the summer program], we all kinda grew a bond to each other. Like everybody were friends with everyone.

Chris brings attention to the identity he shares with his peers as collegians from the inner city forging friendships and being “there for each other.” Gay (2002) contended that “many students of color grow up in cultural environments where the welfare of the group takes precedence over the individual and where individuals are taught to pool their resources to solve their problems” (p. 110). This idea is reinforced in CSP in the way student services and activities are constructed. The peer relationships grow as a result of continuous interaction, and program staff use this natural evolution to facilitate student success. Collin Davis, explained:

Looking at it more long term, these students are building relationships with other students that are in their cohort. They're going to go through pretty much all of their classes together, or many of their upper level classes together so they'll be a built in support system for each other. I think that's probably the most important thing that we can give them is each other and I think the relationships that are built in that type of a program go on for many years and they really do motivate each other to be successful.

Amanda echoed Collin's perspectives when I inquired about advice she would give to future CSP participants: "just make sure to really make good relationships." Cuz those are the people that are gonna get you through it." Getting through encompasses late nights studying together, passing on old class notes and books, and having people who "have your back." Omari, shared what this camaraderie meant for them personally:

[CSP] helped give me a connection with people at JSU already. From that, just kinda helped me smoothly transition into school. So like I take the same classes as some of the students. We try to set up our schedule [in a] similar [way], you know, live in the same area. We stay together and help each other out...we tend to study like our math and sciences together. Go through the college experience together.

Omari identifies several strategies that other students in the program utilize to capitalize on the academic and social support from the program. Taking courses together and living in the same campus residence hall strengthens this community of scholars such that they feel less alone in the college-going experience. Throughout the interviews, friends and their support in the college experience emerged as an important aspect to student success. For many CSP participants, college was a significant adjustment. Leaving their family and friends from their previous communities to embark on this new journey of adulthood, self-exploration, and academic and professional development was a foreign concept to some of the students.

As discussed in chapter 5, some students had no idea what college would be like. Their fear of the unknown combined with a strong desire to better their lives through STEM degree attainment was scary but hopeful. Additionally, all of this change and transformation was taking place in a relatively large campus setting. Knowing 20 to 40 other students who were

experiencing some of same things was important for structural purposes in the form of critical mass and the psychological security of having a communal safety net to “have your back.”

Study participants also stressed how having friends at a large, public university made the size of the institution manageable. Kari commented:

...the relationships you develop in [CSP] were big, especially coming to a big school, you really don't know anybody, it can be intimidating. So when you come in with friends and stuff like that, you can be more comfortable trying to focus on school and not be so concerned with like people's perception of you.

Many participants discussed how attending an institution so large made them feel more like a “number” than a valued member at JSU. Thus, the friendships they established within the program contributed to greater connectedness within the university. For instance, Gary, an out-of-state student, noted that the program provided him with people he could rely on:

First and foremost, it gave me my primary circle, social circle that I hang with here at Jefferson State. And they're not just a social group, they're a support group, like a group I can go to when I'm in need and at the same time, like I'm involved with a lot of organizations with these same people and a lot of the same classes with these same people. So it gave me my basis for me to feel comfortable here at Jefferson State. Had people to rely on. Definitely wanta say that.

Trust as a cultural value is significantly important to communities of color (Gay, 2002). Lacking the social support of friends and trustworthy others can make the experience of earning a STEM degree isolating and alienating. Gary also mentioned his organizational involvement with the CSP participants. Many of the upperclassmen participate in the National Society of Black Engineers (NSBE) and Greek-lettered organizations. These other affiliations also play a role in sustaining the relationships among the current and former CSP participants. Similarly, Phil Smith described how students stay connected throughout the duration of their college career:

I think the immediate impact is them being able to look to their right and left and see people who look like them, who come from where they come from, who are still pursuing that degree. I am pleasantly surprised by the, the living-learning cohorts that have been created from this program. There's a badge of honor for having gone through it and they typically stay together. So the '09 kids are still together. I just sat with seven of them this

morning that were in the MEP Learning Center studying and we just kinda talked for ten minutes. They're still studying together. The '10 cohort is together, the '11 cohort. And then there's some, there's some mingling through the cohorts, so some '09 kids and 2010 kids and 2011 kids and 20... so I was talking to those seven, there were two 2012 students sitting there studying. They know each other. They've mentored, the older kids mentored the younger students. But they're still connecting with them when they need assistance.

Moreover, the cohort model embedded within the CSP structure increases the likelihood students will make friends and gain the social support they need to be successful in their endeavors. Throughout my conversations with the program participants, students underscored how much they valued the relationships that emerged as a result of the program; these relationships sustained them amid the hardships of earning a STEM degree

Relationships with Staff

As noted previously, relationships between staff and peers were a major finding in this study. So often, the students expressed delight with the program staff and the influential role they played in their success. Mostly, they appreciated the genuine care and concern shown to them by the staff. Many students even indicated a greater commitment to the STEM disciplines and their academic achievement, because they did not want to disappoint staff who had invested immensely in their future. Consequently, Phil Smith credited the success of the program to the staff and the relationships they cultivate with the students:

The secret is the relationships we create and maintain starting with the bridge program. From those relationships...we can text them. We can go knock on their door. We can tell them...they should go to this...[or] do this. For the most part, they follow that coaching. The key piece to relationships are people. You have to have people who are passionate and genuinely interested in these students. They have to believe that we are genuinely invested in their success. If they don't believe that, they aren't gonna do anything you ask [of] them. [These students] don't care how much you know until they know how much you care. And if you're not genuine... [and] authentic...you're not gonna get any airplay with them. The students, they come with whatever, but on the staff side, you have to have really good people who are...passionate about student success, student support, student engagement.

Phil underscores that relationships between the students and staff motivate students to comply with CSP's policies and requirements. He notes that genuine care, interest in the student success, support, and engagement are integral to the program outcomes. Due to these strong relationships, initiated in the summer bridge program, CSP staff can be honest with students about their shortcomings and areas to improve, and students will be more open to their feedback and responsive. For instance, Janine spoke about Phil being the first person she called once she completed her Calculus final. Initially, she considered not retaking the course, but her trust of Phil prompted her to follow his recommendations. She explained:

Janine: I just took my math final yesterday and I called Phil as soon as I got out of my final and I just broke down in tears. I was like, Phil, I did it. It was the best feeling, knowing that I knew everything on that final. Cuz I've been so discouraged, trying to play catch up and things like that so knowing that I could do it was a really good feeling

Interviewer: Why did you call Phil?

Janine: Because I feel like he's the one that helped prepare me the most. He's...like my dad away from home. So if I just need someone to talk to, I can always go to him. [Once I finished] my math final, and I got off the phone with my mom I immediately called Phil and [said] thank you so much.

Janine received a D in her Calculus course the first time she took it. After completion of the second Calculus course, she received a B allowing her to replace the previous grade. Prior to enrolling in the calculus course for the second time, Janine considered changing her major. Phil suggested that she retake the course prior to making a decision about changing her major. Once she knew the results of her grade, he would support her in any way he could regarding her next steps.

Having a trusted administrator suggest retaking a course prior to transitioning out of the major communicated to the participants that one failing grade was not a detriment to their academic careers. In the study, women were more likely than men to report thoughts about leaving the STEM disciplines; many did not believe these majors were a good fit for them. Some

of these concerns were brought on by their classroom experiences, and some of their challenges were due to less than ideal grades. To circumvent notions of leaving/switching out, the staff used their knowledge of institutional policy and academic resources coupled with their existing relationships with students to make suggestions. As mentioned in chapter 5, many students were reluctant to seek help because of their attitudes concerning academic support. Moreover, these relationships were critical to making students reconsider leaving the major.

Sarah also reflected on the characteristics of Collin and Phil that made her comfortable with their leadership and advisement:

... building those relationships with people like Collin and Phil is just like, they can actually help you get to the next level and I see those two in like a father figure like because they can be stern but they can be nice and, you know, goofy along with you but knowing that you need to get this done.

Sarah valued the relationships she had with Collin and Phil. She appreciated their professional and personable mannerisms. These attributes appealed to Sarah like many of the students in the program. Students also reported that the staff's personalities eased tensions about discussing academic needs and personal matters.

Also, the time staff invested with students was a reflection of their commitment to making the program work and facilitating successful student outcomes. The relationships between students and staff emerged as a result of the foundational activities and services provided during the summer. As Earl noted,

...I know that I came in through [a special admissions program] so I had [those] advisors, but I feel like I had a more one on one relationship with Phil and Collin, because I spent the summer with them. So you know, I feel closer to them, more approachable to talk to.

As noted in chapter four there are a variety of programs geared towards student success and some specific to students within the STEM disciplines. As Earl notes, he belonged to one of those other programs, but he did not feel that same level connectedness to the staff within that

program. Spending six weeks doing some of the activities Collin described, earlier in this chapter, strengthens the relationships between the students and staff. For example, Phil and Collin interacted with the students on a daily basis, and on some occasions they included their families. These actions made them seem like trustworthy, well-rounded people who the students could see themselves regularly engaging with. Furthermore, these investments in time with students during the summer resulted in students seeking out staff for important academic and retention-related matters during the academic year.

Peer Mentoring Relationships

A number of students expressed their satisfaction with the CSP peer mentors. Peer mentors are upperclassmen in STEM disciplines, many of which are former CSP participants. CSP staff assign a mentor to every new program participant. Depending on the available peer mentors, they are matched with students based on major, sex, and race if desired by the protégé. Peer mentors encourage program participants to get more involved with campus life, and they serve as a resources for navigating the STEM disciplines and JSU. Alad and William elaborated on the benefits of being assigned a mentor:

... [CSP] set you up with those mentors. So you know, from the get go, you're given the resource of the mentors to ask about really anything. It could be academic, could be personal. Just something to get you through the program or prepare you for college....
(Alad)

[Peer mentors] get you involved with certain things you weren't even thinking about, like maybe campus events. I know my mentor convinced me to go to my first tailgating, during the [rival sports team] game. And that was fun. (William)

Peer mentors taking out the time to inform their protégés of various facets of college life also made students feel valued and respected. These are other elements of the sense of belonging framework. Participants often spoke with enthusiasm about how their mentors took them places, gave advice, and encouraged them to get involved on campus. The previous quotes shed light on

the value of peer mentoring relationships in the first year of college. For instance, Alad discussed the various roles mentors can play in the lives of students (e.g., academic, personal). In the present study, peer mentoring supplemented the work that staff may have been unable to facilitate due to time constraints or the lack of presence during times in which students were more likely to prefer engaging with one another. For example, William highlighted how his mentor invited him to his first tailgate. Sports are a significant part of the JSU culture. Being engaged in a tailgating experience is one of the many ways students begin to develop a connectedness to the university, which is important for student persistence.

The confidence of Storm's mentors in her abilities fortified her own self-efficacy. During her interview, she discussed their support and belief in her:

At this point, I feel both my mentors who are in chemical engineering, they really helped me and they really believe in me, that I'm going to [earn my degree] and so does everyone in CSP. They already like oh, she's a chemical engineer. And they're always telling me, like you're the best chemical engineer I know. And so that really just, that really reinforces it because I just know I'm gonna get it, Tonisha.

Throughout Storm's interview, she stressed how much her mentors believed in her. They empowered her with information, advice, and positive reinforcement. Storm appreciated and applied all that her mentors invested into her. Consequently, she participated in undergraduate research, served as a board member in NSBE and a leader in the residence hall, and maintained over a 3.4 GPA. Finally, when I asked her about her science identity, she revealed, "I am an engineer, because my mentors told me to say I'm an engineer, and I believe it." Storm was truly something special in her own right, and the addition of the CSP mentoring support reinforced what she already had within her.

Monet spoke a great deal about her mentor and the impact she had on her experiences in STEM. Monet's mentor, Brielle, was a substantial source of support for Monet. She stated:

Well, one of my mentors was Brielle. She was an electrical engineering major and she was in NSBE. She became my mentor my second semester, freshman year and she was already, had to be either third or fourth year. So, she was the main person who was always telling me like, yeah, you're gonna most likely be the only one in your class and make sure you just have to know, just know your stuff basically. So it was just her and then the older group of NSBE because all of them had different experience[s], all of them have already been through everything that we were about to go through and encounter through the [College of Engineering and Computer Science]... One thing that I was grateful to have also like the NSBE people, the older NSBE people because they, they had so much knowledge just being that they were older and they were well experienced, well-seasoned people. [Referring to course scheduling] This is a class you probably should take, this, that and the other, just little guidance like that and then having Brielle being 101 guide as a female, as an African American female, so it was just like okay, I have somebody. If I have any questions, just somebody to talk to so...

CSP participants greatly benefited from their peer mentors. Many commented about how valuable it was to have same-race and same-gender peers in the STEM disciplines. These mentors provided academic counsel and context-specific information about navigating the STEM system at JSU. For instance, in the previous quote, Brielle prepared Monet for the lack of racial ethnic representation in STEM courses, and she provided advice on the STEM curriculum. Such information has been likened to peer pedagogies that may influence learning and persistence among students of color (Harper, 2013). As students are more aware of the environments they inhabit they can employ effective strategies to deal with discrimination and bias (Harper, 2013; McGee & Martin, 2011).

Peer mentors also create bridges to other important resources such as NSBE. CSP serves as a conduit to NSBE. Many of the program's mentors were NSBE members. Thus, many program participants became interested and involved with NSBE due to the relationships with their mentors. These other affiliations expanded their network and enhanced their social experiences.

This section highlighted how CSP creates a sense of belonging for program participants through cultivating relationships among peers, participants and staff, and participants and peer

mentors. As a consequence of the program staff's efforts to build a communal and welcoming environment, many students also recognized an emergence of a familial atmosphere. This atmosphere, the people, and the relationships make the participants feel valued, appreciated, and confident that they can persist in STEM.

STEM Identity Development Catalysts

Carlone and Johnson (2007) found that competence, performance, and recognition were central to a salient science identity. Building on this research, many scholars have concluded that science identity salience contributes to student success (Chang, et al., 2014). This section describes the practices within CSP that serve as catalyzing agents in the STEM identity development of its participants. I focus this section on three areas: (1) competence and confidence-building practices, (2) undergraduate research, and (3) praise and celebration. I begin this section with Phil's perspectives on how CSP addresses STEM identity development.

When I asked Phil Smith to describe the ways he believes CSP helps students to develop their STEM identity, he offered the following:

We help, in the competency area...in terms of our academic support program, so the tutoring, the mentorship, the advising I think has a way of contributing to them gaining competency. [Then] they perform. We recognize them. Through that recognition, they feel more competent. Because they feel more competent, they perform better, they get more recognition. You know, so they all kinda feed off each other. I think we have the greatest impact on competency and recognition. But if those other two pieces are in place, they're better able to perform. So it feeds off each other. The three feed off each other.

Phil described the cyclical nature and interconnectedness of competency, performance, and recognition as exercised in CSP. Each area influences the other which was very apparent in how the students discussed their experiences in CSP. As they strengthened their competencies in math and science they felt more confident in their abilities and the possibility of earning a STEM degree. Praise and celebration garnered through formal and informal CSP activities made the participants feel intelligent and proficient in STEM. Also, opportunities to engage in

undergraduate research reinforced their competencies and interest in STEM and allowed the students to perform scientific practices.

Competence and Confidence-Building Practices

Engaging in educationally purposeful activities such as completing homework or earning a stellar grade on an exam allow students to demonstrate their competence and increase their confidence in content areas. Not only is competence and confidence important for persistence in college, but within the context of the STEM disciplines, it is essential for strengthening one's science identity. CSP was very intentional about enabling students to improve their math and science competencies so that the participants could achieve academically. In particular, CSP instructors enhanced the participants' content knowledge and cognitive strategies during the summer program, and academic coaches supported these advances during the academic year. For instance, Mr. Drew, the summer bridge program Chemistry instructor, explained how he used various strategies to help students build their confidence in the sciences:

Mostly what I would do with students, especially in my [chemistry] class, was a lot of inquiry based instruction with the students to raise the students' confidence that they could make [a] contribution and that their understanding of the world around them are valid. That their understanding is a valid understanding and they, too, can problem solve and come up with reasons for what they experience in their world or may experience in a chemistry lab. Based on their understanding of what they're studying, [I made connections] with their prior knowledge. They can actually use that, if they're affirmed they can do this, [it suggests they] do belong in the science society. (Mr. Drew)

His teaching style is an asset-based approach that helps the students realize they have the capacity to perform well in science and their prior knowledge is valuable. This approach may also be considered a culturally responsive or relevant pedagogy (Gay, 2002; Ladson-Billings, 2009). The combination of experiential learning, using prior knowledge, and theory to practice application makes learning about the sciences more intriguing. When students have a vested

interest in the material they are more likely to achieve mastery (i.e., learning) which influences their competence and increase their confidence.

Another area the program emphasized was developing suitable study skills and habits. This program goal was discussed in the previous chapter as a form of academic support; however, it also has utility for science identity development. Students gain competence through spending time with their course material, studying, reviewing concepts, reading, completing practice problems and homework assignments. These exercises enable students to catalyze cognitive process that aid in memorization, acquisition, critical thinking, and synthesis. Consequently, prior to participating in CSP, most students agreed that they did not have good study skills and habits. Their pre-college educational experiences did not require much investment in studying as a requisite skill for academic achievement. Thus, when I asked Gary how CSP helped him in college, he stressed improvements in his study skills and habits:

For the most part, I feel like I'm better at problem solving. From working in so many groups, I've learned my role in a group. I also think I'm just good at how to study. Studying was something that I didn't know how to do. Reading books, it's important [even though it] wasn't so important in high school.

Gary identified that problem-solving, understanding roles in group work, studying, and reading books were ideas that CSP shared with him. These relatively simple ideas are very meaningful to underserved students who may lack prior knowledge about these tasks. This information also equips students to confidently engage in the academic process.

Finally, CSP aids students in addressing confidence issues related to engaging in math tasks. The extant literature shows that even students who are competent in math struggle with self-efficacy and self-concept (Jameson & Fusco, 2014). Students who have less exposure to and lower self-confidence in advance math feel underprepared to perform at the college level (Hall & Ponton, 2005). These feelings of inadequacy can have an impact on persistence in the STEM

disciplines. Moreover, the cognitive prowess necessary for mathematics becomes increasingly difficult as students matriculate into their upper division courses. Thus, building competence and confidence in the first year of college is critical (Zakaria & Nordin, 2008). Chandra explained how the CSP summer bridge program strengthened her self-confidence in math:

Coming into the program or just like thinking previously about choosing my major and having it be engineering based, I was really concerned just because I know math is a major part of it and I think I'm good at math but just like in high school, like my math foundation, it was just taught really weird and I felt like I didn't obtain all the information that I could from it. So definitely coming in this summer and being able to retake all those classes essentially in six weeks, and gain that knowledge again definitely gave me a larger sense of confidence coming during this first semester. Now, it's like just going through that, I was like, okay, I can do it. It's not gonna be as hard as I thought it was going to be. And like you know how if you have that sense of confidence,...[it] will help you push through it.

Chandra recognizes that confidence and self-efficacy are additional factors that influence resiliency and success in the STEM disciplines. Her analysis reveals that math achievement is more than just skills (Larnell, 2011). Chandra also noted how the lack of college readiness transitioning from high school to college can affect self-confidence. Without programs such as CSP, potentially more students would perceive themselves as inadequate to pursue a STEM major and choose a field less intellectually demanding without considering that they have the capacity to develop the skills and competencies for the discipline.

Undergraduate Research Experiences

CSP works with the JSU graduate school to place students in undergraduate research experiences at the end of their first year in college. Most participants who engaged in undergraduate research made gains in all three areas identified in the science identity framework: competence, performance, and recognition. Students had opportunities to demonstrate their knowledge and understanding of STEM material, perform tasks in the laboratory using scientific tools, and garner recognition for their research. For some students, these experiences contributed

to their salient science identities. For instance, students underscored how these opportunities cultivated their science identity and enabled them to apply what they had learned in their academic courses. Gary explained:

Yes, most definitely. From doing so many tests and different trials to make sure you got different things right, it definitely made me feel like I had a science-y mind and I was doing things that would help improve his studies or improve myself. And I learned a lot. Turns out that they use the bell curve in a lot of different things [such as] optimization.

Gary posited that his undergraduate research experience advanced the faculty member's research and his own learning and development. Such experiences show students that they can not only be learners of science, but also contributors to scientific outcomes. Thus, Gary pointed out the formation of his "science-y mind." Many of the other participants who engaged in undergraduate research reported cognitive shifts in their understanding and application of scientific concepts and methods.

Similar to Gary's experience, the research process intrigued William such that he became more inquisitive about engineering mechanisms. He stated:

...when I did [undergraduate research], kinda became excited about engineering, because I never really cared about how stuff really functioned internally until I did that, then it kinda made me excited to know what goes on. So I would say that's something these programs provide though. In a sense, it kind of changed my perspective of engineering. Maybe it was probably due to my background, too. Cuz I didn't have anyone in my family who's an engineer.

Through this undergraduate research experience, William was able to access environments that increased his knowledge of engineering concepts and strengthened his commitment to STEM. He also discussed how engaging in undergraduate research leveled the playing field for him in comparison to many of his majority peers who came from families with engineers. William expounded on this perspective:

William: Yeah I'm below definitely. I mean cause something I've realized just coming here and talking to people. All the engineering majors here most of their parents are already engineers. So they're kind of accustomed to some of the things they're going to

see. Like they grew up around some of the stuff. They kind of got an understanding of some of the stuff that is going on. So because of that they kind of got one up so it's like they said they're kind of surprised you don't have an engineer already in your family. I mean I don't know that kind of pushes you more to want to do it.

Interviewer: Do you think that places you at a disadvantage not having parents or family members with an engineering background?

William: I mean compared to them, yes. Because at the end of the day it's still up to you and the effort you put towards classes. As far as actually having a technical knowledge though upon entering school yeah they have an advantage. Definitely I mean they're exposed to this stuff already.

Interviewer: Are there things that the college, university, or CSP could do to help students bridge those gaps or potential disadvantages from not having a parents or family members with STEM backgrounds?

William: I mean you kinda you got something there with the [undergraduate research program]. You got something going there with how students are able to investigate different fields and learn about the engineering field. That kind of gives you some exposure to what's going on. But I say [undergraduate research program] that's probably the closest thing that help bridge that gap to balance things.

Interviewer: And by you participating in [undergraduate research] did that make you feel more like an engineer or scientist?

William: I would say yeah working in the lab doing research it definitely opened up my mind and help you think different. And from a broader sense. Not just looking at something and use it. You kind of look at it and want to know. What's causing it to function? So that definitely kind of guide[s] you in that direction to think with an open mind and think about how you can just use some stuff. I would say CSP helped with that.

Moreover, William pointed out the cognitive development that occurred from engaging in undergraduate research. His mind was “open,” he thought “differently,” and he was engaged in the application of knowledge. These cognitive processes are critical to sustaining one's interest and socializing him or her into a given profession. CSP's involvement in helping students engage in undergraduate research early in their college career significantly encourages students to persist and gives them something to look forward to.

Because their research experiences piqued their interests in advancing STEM-related research, some students considered attending graduate school. For instance, Adam talked about

being more motivated to pursue graduate education due to the confidence he garnered through CSP:

Interviewer: How has CSP helped you to feel like you belong in engineering and at JSU?

Adam: It gave me a lot of confidence, because I guess it motivates me. It motivates me to like do more.

Interviewer: What kind of things does it motivate you to do?

Adam: Just motivates me to go deeper into the things that I've been doing, like research, I can go deeper in research or go deeper in my studies or whatever.

Interviewer: When you talk about going deeper in research, what kinds of things would you like to do?

Adam: Maybe like grad school research.

Interviewer: Can you see yourself going to graduate school one day?

Adam: Yes.

One the goals of the Louis Stokes Alliance for Minority Participation (LSAMP), through which CSP is partially funded, is to increase the number of students who pursue graduate degrees.

Adam's interests in conducting undergraduate level research through his endeavors in CSP indicate that the program can be influential with undergraduate success and a critical pathway to graduate education.

Finally, a few female students discussed being recognized for their contributions to their faculty member's research. For example, Jasmine's involvement in undergraduate research positioned her to be recognized by her faculty mentor and other undergraduate researchers:

...I was actually doing something, not just reading things from the book but actually getting engaged with something, having the responsibility of making sure that things came out well. Actually being important to a project. You know, they still use the data that I used from the summer to continue on in their research and for future summer interns. There was one girl in the [MEP Learning Center], and she was like, oh, are you Jasmine and I was like, yeah, and she was like, I was talking to [Dr. Bridges] and she was showing me some of your work from last summer cuz I may work for her. I was like, oh, she remembers me. I was actually important, you know.

Jasmine's begins her statement indicating that she was "engaged with something" that required "responsibility" and ensuring the successful outcomes of a product "not just reading things from a book." Jasmine values this research experience as more important than the typical tasks she may have engaged in within her lower-division STEM courses. Thus, when the student meets her in the MEP Learning Center to acknowledge her work, referencing that Dr. Bridges mentioned Jasmine, her identity as a STEM person and work is validated (Linares & Muñoz, 2011). Consequently, she concludes her statement with "I was actually important." Being seen as someone who makes a contribution to science is significant especially for female scientists of color (Carlone & Johnson, 2007). These kinds of experiences coupled with positive reinforcement contribute to science identity salience and provide an intrinsic rationale to persist in STEM.

Praise and Celebration

CSP staff incorporated a number of activities and initiatives into the program to praise the students and celebrate their accomplishments. During the summer bridge program, students are recognized for their academic performance in weekly meetings. Once the academic year is underway, the program director acknowledges students' accomplishments through posting their exams and other assignments—with permission—on an office bulletin board. Additionally, the program director nominates students and/or utilizes formal award ceremonies within the STEM colleges or NSBE to acknowledge student success and outcomes.

The study's findings illuminated that praise and celebration not only coincides with the recognition component of the science identity framework, but it also corresponds with enhancing a students' sense of belonging within their respective major. Having one's grades recognized validates their competence and intellectual capacity to succeed in the given discipline. Feeling

connected to and valued by a community of STEM scholars is critical to persisting in the major (Laursen, et al., 2010; Strayhorn, 2012). Furthermore, the following quotes explicate how praise and recognition operates in CSP:

...recognition is a very important thing. While the students are going through our program in the summer, we recognize students who are performing and excelling and exceeding the expectations of the program. We recognize students like that on a weekly basis in front of the group and so their peers can see that they're doing things that are going to lead to them being successful. (Collin Davis, program assistant director)

The recognition piece is, is very [important], it's not programmatic or systemic. It's genuine. So we'll have somebody come in and say, I got a 3.0 on my math exam. We celebrate that. I got admitted to the college. We celebrate that. I got this internship. We celebrate that. And by celebrate, I mean it's hugs, it's high fives, it's a lot of announcements. It's sharing that information with faculty, staff and other students. You know, we put a gold star on a test or we hang it up on the refrigerator for other people to see. (Phil Smith, program director)

Collin's comments demonstrate how CSP leverages the cohort model to set a standard for excellence during the summer bridge program. This practice is effective for the recipient and the other students to motivate them to reach the same standards. It also reinforces for the award recipient that he or she is developing competence and performing in a manner that is valued in the STEM disciplines. On the other hand, Phil draws attention to the practices instituted during the academic year. When Phil refers to the refrigerator, he speaks of a bulletin board in the MEP Learning Center as a symbol of a refrigerator in one's home that a parent may post his or her child's good work. He also accentuates other accolades that students may achieve (e.g., internships) and a variety of activities (e.g., hugs, high fives) to praise and celebrate the students. These expressions are very meaningful to students as evidenced in Emily's story:

... so it happened during CSP. It was like the first time...I got a [high score] on my AP calculus exam and I started telling everybody, and it was really exciting and Phil, he found out about it and he just said congratulations, you know what I mean. And that [w]as the first time, a faculty member ever acknowledged my success rather than like me. I knew it was good, but just to see that someone who's seen a lot of students go by cared about me I felt like they really, actually cared what I was doing. And I don't want a name any [universities] but when I went to some of the other [universities] for open house or

something, I didn't feel that connection. I didn't feel like they wanted me to be there or they cared if I was there.

Emily's example shows the importance of a relatively small gesture—congratulating someone for performing well on an advanced placement exam—as substantially meaningful to the individual student. Emily describes this caring moment as something different from what she had experienced in other university settings and as a first from academic staff. Additionally, Emily being praised as a woman of color for mathematics achievement counters the dominant narrative about women and people of color in STEM. It is especially critical for sustaining her science identity to have these early encounters that aligns competence with recognition. Unfortunately, such experiences may occur less throughout her educational trajectory (Carlone & Jonshon, 2007; Ong et al., 2011). Thus, having this experience early in her college career is potentially vital for her longevity in the field. Another woman of color in the program expressed great delight in being acknowledged for her high GPA. Janine explained:

...so, I thought about switching my major. Had no idea what I wanted to do. I just knew I wanted to switch my major. And I hadn't been going to NSBE meetings that often but I just decided to go to the Torch Banquet just to support and they were giving out awards for people with the highest GPAs and then they mentioned my name and I just, I was just like, what? [I] couldn't believe it. It's just that encouragement...small things like that. You need things like that...a little goes a long way.

Like Emily, Janine's accolade demonstrates a level of competence in the STEM disciplines; she would not have received the award if she was underperforming in her STEM courses. Even though she earned strong grades, she was considering leaving the STEM disciplines. Because of this award, Janine felt compelled to persist in her major. Later in her interview, she discussed how this experience affirmed her desire to become a computer scientist. Janine's account exemplifies the significance of recognition and its potential impact on persistence in STEM. Once again, Janine underscores that these seemingly small gestures “go a long way” in facilitating student retention.

In this section, I put forward some practices that CSP engages in to support STEM identity development. For instance, the program provides academic support and assists students to develop strong study skills and habits. Consequently, the students perform better, become more competent and confident in their abilities, and receive recognition from the program. Additionally, the undergraduate research component is supported by LSAMP's goals to increase the number underrepresented groups who pursue graduate education. In the undergraduate research settings, participants have an opportunity to demonstrate competence and perform scientific practices.

Proactive Caring

Proactive caring undergirds the approach and the work of the CSP staff. Proactive caring is an intensive advising strategy—before academic issues arise—that support underserved students in contrast to reactive approaches that lend support once students experience academic difficulty. Program staff use admissions data to identify prospective participants who may benefit from the program services and invite them to apply to the program. Once students begin the program, staff work to provide an environment that is “emotionally nurturing and academically rigorous” (Rivera-McCutchen, 2012, paragraph 3). The program staff are highly involved in the lives of students ensuring that their transition to college and success therein is predicated on continuous meaningful interactions, care, and support. Findings revealed that the proactive caring is a composite of six elements: (1) staff accessibility, (2) trust, (3) positive motivation, (4) reinforcement, (5) encouragement, and (6) student accountability.

Staff Accessibility

The first year of college requires a significant amount of transition, adjustment, and adaptation to the cultural norms and practices of the collegiate environment. Because many students are unfamiliar with this new environment they need support with making decisions

about coursework, roommate concerns, and a variety of other decisions that surface within the first weeks of entering college and beyond. Underserved students are especially at risk for experiencing challenges with navigating the collegiate environment. They may be more apt to miss important deadlines such as course drop/add periods or encounter difficulties with course management systems. Consequently, many of the CSP students expressed their satisfaction with having accessible CSP staff. The CSP staff made themselves available to students by telephone, walk-in visits, and text messaging. Students relied on the staff for their expertise and knowledge about the inner workings of the university to deal with various policies and procedures. Because these students were invested and motivated to succeed in their first year of college, they regularly contacted the staff to familiarize themselves with resources and other important information.

Sandy, a Latina sophomore in Mechanical Engineering, explained the importance of staff accessibility to her transition into college:

Being able to have people that I already knew coming into college and, you know, people of authority to confide in and ask about different things like scheduling or different conflicts. Just having someone on the phone that I can just without hesitation just dial and help me figure things out. I mean, like I said, I just think having that solid base, always being able to touch back like that, I can't even stress that enough. Having a phone number in my phone that any circumstance is like something is going wrong, something, like my roommate, I need a new roommate. How do I go about doing this?

Sandy indicated a number of transitional concerns that students face during their first year in college including scheduling concerns and roommate issues. She appreciated having access to "people of authority" whom she entrusted with her personal circumstances and expected to receive credible advice and support. Though there are academic advisors and residential staff who could help Sandy resolve the aforementioned issues having an existing relationship with the CSP staff made her more comfortable with seeking out their advice.

Regular student contact is integral to establishing relationships and trust between students and staff. Phil Smith, the CSP director, outlined his approach to regular contact with CSP participants:

[We are] engaged with students on an everyday basis, text messages at night, emails in the morning, advising sessions during the day. And then the other thing is because it is intrusive and it does require people on the ground connecting with these students on a daily basis, it costs. You can't do drop in if you feel like it. We need staff to be here to meet with these students every other week. We need staff to knock on doors, to find out where students are if they're not in class. We need people at recitation sessions. It requires high man hours.

Phil's perspectives illuminate the demanding nature of working with underserved students in their first year of college. One might suggest that the students benefit from a high touch, high impact environment. The staff's proactive approach allows them to stay abreast of the students' whereabouts and maintain high visibility in their lives. Because program participants have trusting relationships with the staff, they welcome their impromptu visits to the residence halls or study spaces.

Trust

The majority of students mentioned trusting the staff as integral to their compliance with program policies and expectations. Because they trusted the staff, they more apt to engage in program activities. For instance, Omari, a first year Black male in mechanical engineering, commented about trusting staff advice:

Interviewer: How do you know you will earn your mechanical engineering degree from JSU?

Omari: Mr. Smith always says trust the process so I'm trusting the process.

Interviewer: And what exactly does that mean to you, to trust the process?

Omari: Well, what that means is [Collin Davis] already went through school. Mr. Davis, he's already gotten his engineering degree in mechanical. They've already done CSP before and they've seen how the trends work. So I figured they know what they're doing. They're the experts so I'm just, I'm just along for the ride.

Omari indicated that the staff's academic and professional backgrounds played a role in his decision to trust staff advice. He points out that Mr. Collin Davis has a mechanical engineering degree and years of experience running the program. These factors contributed to his comfort level for going "along for the ride." Omari also mentioned that he follows Phil Smith's mantra to "Trust the Process." During the summer program's orientation, I observed Phil encouraging students and parents to "Trust the Process" throughout the program. He asserted that if the students were diligent and flexible with program policies and expectations they would be well-positioned to achieve their goals.

Vivek, an Asian American male graduating senior in Information Technology, added another rationale for trusting the program staff. As disclosed during his interview, Vivek experienced several years of academic difficulties. During these times he sought out advice about how to move forward. Sometimes he heeded Phil's recommendations for next steps, and sometimes he did not. Ultimately, he wholeheartedly committed to Phil's advice, changed his major to another STEM discipline, and dramatically improved his GPA such that he will be gainfully employed in a high-paying position at the end of this academic semester. Vivek reflected on why he was reluctant to seek out Phil's advice, but eventually valued Phil's insight:

Phil is [stern], so you're afraid to talk to him sometimes because of that but you will go to him because you trust him where he'll be hard on you but it's for a reason. And I think that needs to be stressed really well. You know, that it works. A lot of us kids coming from these schools, we haven't had that discipline [in an academic setting]. [Some students come to the program as if] they know everything and that's a big problem that [the program staff] teaches us. No, you don't know everything. But you're here to learn. And that's what this program really does for us.

Vivek indicated that his pre-college experience did not lend itself to the academic rigor and discipline necessary for success in the STEM disciplines. Vivek's eventual trust of Phil and his genuine intentions resulted in the achievement of his goals. As Vivek noted, many of the CSP

participants enter the program assuming they know what it takes to be successful in STEM, but the program teaches the students that the nuances and intricacies of college success may be different from their pre-college experiences. In my observations of advising sessions, some students were more challenging to convince that they needed the program's support or that they should attempt the strategies put forth by the staff. Stories like Vivek's experience served as a constant reminder for students to "trust the process," and in some cases, a persuasive tool encouraging students to apply the evidence-based approaches of CSP.

Positive Motivation

Many of the students discussed experiencing challenges with sustaining their motivation. Much of their lack of motivation stemmed from issues with academic competencies, expectations in the STEM disciplines, and diminished self-efficacy. Other students struggled with developing strong study skills and habits and being self-regulated learners. In response to these challenges, positive motivation emerged as a strategy to mitigate these circumstances. Positive motivation entailed both motivational messaging directed toward students and approaches that empowered students to regulate their own motivation through building their aptitude in STEM courses. The students emphasized how staff members used various tactics to encourage them to persist in the STEM disciplines. During one of the focus groups, participants reflected upon the motivational messages of CSP's graduate assistant, Mark:

William: ...now that I'm older, I remember Mark used to be talking to us. I never used to take it serious but I kinda see like, I understand why he did it and the point of it... and like that stuff actually does help you now as far as being motivated. Now that I'm older and stuff, nobody really pushing you but yourself. Self-discipline is big in college, especially when you're older. All that was initiated from CSP...

Interviewer: So what were some of the things Mark told you all that you think is helpful now?

William: What'd he say?

Kari: Who motivates...who motivates the motivator?

Interviewer: So what does that mean?

William: We were looking at him like what is he talking about? [laughs] But now like you get older, you're like, yourself.

Kari: Right, basically. Saying it is you who motivates you.

William: You get older and class get hard and you don't feel like doing your homework cuz you don't know how to do it so you're like, man, I gotta do it so...Just, they're just a feeling, pretty much. Like you don't, you don't wanta do homework if you don't know what's going on

Kari: But you gotta, you know you gotta do it. It's more of a feeling thing than anything else. That's what I thought he meant, who motivates the motivator? If you're not feeling too great, still gotta do the work.

Recounting these interactions with Mark helped the students to realize how important principles such as self-discipline, resilience, and perseverance are to their academic success. Program staff acknowledged that math, science, and engineering were challenging subjects, but students had the locus of control to create their success with the appropriate resources and guidance. Amanda, a first year Black female student in chemical engineering, discussed the program's motivational influence in another way:

I think the program like all around has made me a better person because I matured a lot. Before joining the program, I wasn't as motivated as I am now and I didn't have people to push me. I didn't really have people that would [be] on my back to do something. Without the program, I probably wouldn't have as much passion as I do because I know so many people [believe] that I can do it, and I [want] to make them proud.

Amanda's participation in the program catalyzed her maturation process and passion for earning a STEM degree. Upon entering the program, she felt she was not as motivated as compared to when she completed the summer bridge program. Many of the students enter the program with a curiosity about the STEM disciplines, because of their preconceived notions about the disciplinary expectations (e.g., "being good at math and science") and career prospects.

While in the summer bridge program, many students begin to doubt their ability to persist. The weekly assessments especially in mathematics make evident their lack of college readiness. Once they complete the program, the students feel more assured in their competencies and abilities. Then, their first year of college creates another set of barriers to overcome. The cyclical nature of successes and failures can be disconcerting to underserved students. Consequently, they may appear less motivated about persisting in the STEM disciplines at various stages in their college career. Yet, program administrators also might use these experiences to foster resilient attitudes and behaviors.

Participating in the summer bridge program allows students to work through these challenges in a relatively safe and supportive environment. They identify their strengths and weaknesses and utilize the program staff to identify strategies to overcome their shortcomings. Yet, motivating CSP participants is an on-going, continual process that goes beyond the summer bridge program and even the first academic year. Using strategies such as Mark's motivational messages in conjunction with academic support, feedback provided through math assessments in the summer bridge program, instruction on study skills and habits, self-evaluation in advising sessions, and rewards and praise for performance within the summer bridge program and throughout the academic year influence student motivation.

Reinforcement

Reinforcement is the tendency of the staff to emphasize or stress attitudes, behaviors, and values that elicits the pursuit of educationally purposeful activities. Program staff use advising sessions, program components (e.g., summer bridge program), and their relationships with the students to reinforce success-oriented behaviors. For instance, the program staff strives to help students become effective and independent learners. During the summer bridge program, participants are taught strategies for maximizing classroom learning, study skills, and time

management. However, throughout the academic year some students still struggle to maintain the skills taught to them during the summer program. The 2009 program expansion stemmed from the need to provide a programmatic mechanism in which ideas introduced during the summer months could be reinforced throughout the academic year. As Phil stated:

it's only six weeks so we don't get to [address every issue] in that time but we're trying to give them the initial exposure to what it takes [to succeed in college] and that's why [the] year long piece is so important, because we can't get it all done in the six week bridge program. We couldn't get it all done in a 10 week bridge program.

Phil's program change allowed the staff to stay connected to the students throughout their first academic year and continue the process of academic development that had been initiated in the summer program. For instance, program staff used biweekly advising meetings to elicit student behaviors:

I have biweekly meetings with Phil and Collin so I talk to them about [my academics] and then it was stuff that I kinda already knew, I just didn't do it. So just having them like reiterate it was what got me to do it.

In the previous quote, Amanda, a first year student chemical engineering, acknowledged that she had prior knowledge about the information being discussed in advising, but the reiteration of this information propelled her progression. Similarly, Vivek changed his behavior after he realized the staff was invested in his success, and they would continue to intervene until he improved his academic status. When I asked Vivek what was his biggest challenge in college, he stated:

My issue was I was lazy. I didn't wanta go to class or didn't wanta do certain things. CSP really, you know always being on us, contacting us, making sure we're doing things, that really helps us students. You know, it helps the students that just don't have the motivation, too.

The consistent pressure that the program staff placed on Vivek motivated him to overcome his laziness, listen to the advice of the staff, and perform better. Thus, Vivek completed his college degree in five years with a 3.0 GPA. Some administrators may feel less

inclined to deal with student attitudes such as those exhibited by Vivek, but the CSP staff saw potential in him such that they continued to show care despite his behavior and reluctance to follow through (Bensimon, 2007).

Encouragement

The program staff is very effective with encouraging participants. They reassure the students that they are capable of success, and aid the students in their educational pursuits. Within the university, some staff are not as supportive. For instance, several CSP participants experienced discouragement from university advisors to persist in the STEM disciplines. These interactions further exacerbated their existing challenges with self-efficacy and confidence. For instance, Roger shared his experiences with unsupportive academic advisors:

...first, you make it past your advisor who may, who may or may not like have faith in you or, you know, are firm believers in statistics. Well, technically people who fail this class aren't cut [out] to be an engineer or you know, whatever the case is. So I mean, once you get past the barrier of awful advisors, then you get to the point of like now I'm in.

Roger, a Black male junior in mechanical engineering, experienced some academic hardships early in his college career. Due to some of his low course grades, his advisors dissuaded him from persisting in the STEM disciplines. Conversely, CSP staff anticipated potential academic pitfalls and supported students regardless of their academic challenges. For example, Anthony, a Black male senior in Information Technology, asserted that CSP encouraged him throughout his challenges:

Well I definitely think that the program kept me here. I think without the program I would've been recessed. [For instance,] one of my semesters I was put on academic probation. So I had to like get above a 2.5 to stay here. Phil encouraged me and told me everything I needed to do to [return to good academic standing]. And you know since then my grades haven't dropped that low.

Unlike the feedback Roger received from university advisors, Phil's response to Anthony's challenges was comforting and hopeful. Moreover, Phil's encouragement and academic advice was instrumental in Anthony improving his grades and persisting in STEM.

Student Accountability

Setting high scholastic expectations and holding students accountable for their academic success are essential values within CSP. Student accountability entails ensuring that students understand the expectations of the program (i.e., attitudes and behaviors that support STEM achievement) and holding them responsible when they fail to comply. Staff recognize that many of their program participants enter higher education with gaps in their knowledge and understanding of STEM content areas, but they do not perceive these students as less capable of learning. Students are provided with individualized academic support and advising so that they can excel in their STEM courses. Poor performance due to a lack of effort or a failure to seek help are unacceptable behaviors. CSP staff are willing to help students when they experience academic difficulty, but they do not allow students to make excuses for underperformance.

Cameron, a first year engineering student, explained:

It's easy to talk to like Mr. Smith and the other adults and they help you out, like they make you feel bad for not doing what you're supposed to do or make you feel like you should be doing this, so just do it. I guess it's motivational, in a way.

Cameron pointed out the juxtaposition of administrators who "help you out" and "make you feel bad." What Cameron describes is a form of accountability. These interactions with program staff are not particularly enjoyable, but they are helpful with facilitating Cameron's success. For example, he states their approach is "motivational" such that he needs this occasional reminder that he can and should perform better. His concluding statements further explicates that proactive caring is uncomfortable, but it may be useful for motivating and holding some underserved students of color accountable for their academic success.

In a focus group discussion, several students explained some of the unproductive behaviors students engage in while in college and how the program enacts consequences for these activities. The conversation began with me asking students about how the program influenced their smooth transition from high school to college:

Interviewer: So in what ways did the program help you to make a smooth transition from high school to college?

Michael: I would say that was big for me, too, cuz you don't have parents [telling you] what to do or what time you gotta be home. I would be out kinda too late sometimes and do things I probably shouldn't be doing so. That can also be detrimental, like big time cuz you would think you're okay. You don't really think about it cuz you're so young. Your discipline has not really came into play yet so you're not really paying attention til those semester grades come. So like wow. Hits you like...that's not a good feeling.

Antonio: Gotta go talk to Phil [program director]

Interviewer: Why would you go talk to him? What would he do?

Michael: He's like the enforcer. He put you back into your place.

Interviewer: And how did he go about doing that?

Antonio: He'd make up rules. Just bring them back [to my attention], like I told you. So we talked about it.

Michael recognized his lack of maturity and discipline as impediments to his academic achievement necessitating Phil to institute an accountability measure. Under these circumstances, program staff co-create formal accountability plans and goals with the students. Students are reminded of practices and habits that will ensure successful pathways to STEM degree completion or their alternative options. Consequently, students such as Michael possess a variety of opinions about Phil. Michael called him "the enforcer," and other students characterized him as intimidating. However, the majority of students realized his motives and actions stemmed from a genuine care for student success.

Directness was another tactic used by program staff. Throughout my conversations with CSP staff, they talked about their approach to student accountability as tough love. They had a strong desire to prepare students for the rigorous STEM academic environment which meant students could not afford to make excuses as to why they were not going to complete certain program tasks. From the staff's perspective, a failure to complete all program requirements communicated a lack of commitment to earning a STEM degree. For instance, Collin told a student "deal with" the challenges of his demanding work and academic schedule:

Interviewer: Do you find [working and balancing your academic responsibilities] to be a challenge?

Steven: I do just because it seems like I work every time I'm actually motivated to study. So there are times, it's just like right in, right after I get out of class, I go straight to work and then I come straight to here. And after a while, it kinda just builds up to a point where I just like, okay, can I just sit down? But after repetitively doing it, I think I'm okay.

Interviewer: For the challenges you might be dealing with, what kind of information have you discovered that you needed to know to deal with those challenges?

Steven: I was told it was just life and you just gotta deal with it.

Interviewer: Who told you that?

Steven: Probably Collin

Interviewer: Okay. And what was he referring to, do you remember?

Steven: Just the fact that I didn't feel like I, I didn't wanta go from work and then come all the way here directly, cuz I was gonna get off from work while CSP, or while study hall is going on. So I'm already late and I'd just rather go to my room and study, what I was doing before. He was like, no, you just gotta get up and come to CSP. Sorry.

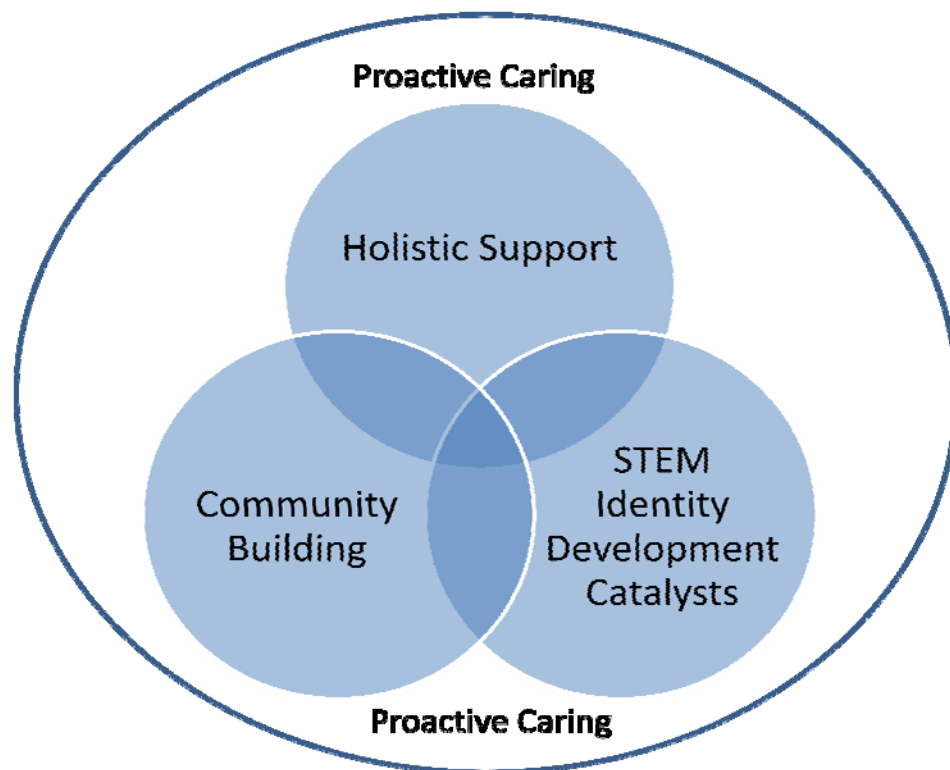
Though Collin was straightforward in his response to the student he still demonstrated a level of sympathy concerning his plight—having to balance coursework, a campus job, and program expectations (e.g., mandatory recitation). Moreover, the program provides ample resources and support for students to achieve their goals, but it does not coddle them. Students

are expected to succeed, and they are held accountable when they do not. The staff deals with students in an honest but caring manner such that their egos remain intact, and they are empowered to arrive to the decision that is most appropriate for their circumstances.

Emergent Model

The emergent model from this study illustrates the programmatic influences on college readiness and retention among underserved students of color in STEM (Figure 5.1). The model represents the nuances and complexities of the “black box” of the college student experience (Padilla, 2009, p. 22). In the current, study the “black box” represents the happenings within CSP.

Figure 6.1 Model for Programmatic Influences on College Readiness and Retention among Underserved Students of Color in STEM



The *proactive caring* is the outer circle within the model, because it embodies the philosophical underpinning and approach to student services within CSP. Program staff

proactively engages students to address their needs while demonstrating a genuine concern for their success (i.e., college readiness and retention). Proactive caring appears in a circular formation to signify that it is boundless with respect to time. The effects of caring continue even beyond the time students are a part of the formalized program. Students continue to seek out support from the program staff, and the staff reciprocate with care and service to the student.

Holistic support, community building, and STEM identity development catalysts comprise the strategies and practices within the program, thus forming the inner Venn diagram. The overlapping composition of the diagram demonstrates the interrelatedness of these individual elements and their corresponding strategies and practices. For instance, there is a direct relationship between strengthened competencies and increased confidence. As students become more competent in their academic subjects, they also become more confident in their identities as STEM persons. Connections can also be found between *holistic support* and *community building*. Specifically, the relationships that students cultivate in the program support their academic and transitional needs among other areas. Lastly, *community building* and *STEM identity development catalysts* overlap with regards to praise and celebration. Within the program, there are formal and informal mechanisms for recognizing academic achievement and success in STEM. Students who earn this recognition feel more affirmed in their identities as STEM persons.

Summary

In this chapter, I reported on the strategies and practices employed in the Comprehensive STEM Program (CSP) that addressed academic and context-specific knowledge attainment, sense of belonging, and science identity development. Four themes emerged (i.e., proactive caring, holistic support, community building, and science identity development practices) that I organized in a Venn diagram containing holistic support, community building, and science

identity development practices with proactive caring representing an outer rung. I presented this conceptual model to illustrate how the program employs various tactics to facilitate college readiness and retention among the students.

This chapter was comprised of four sections. The first section revealed an array of steps the program takes to create a sense of belonging for their student population. Community building among the staff, peers, and upperclassmen known as peer mentors led to strong and meaningful relationships. A by-product of these endeavors was the notion of an all-encompassing familial atmosphere.

The second section considered the programmatic practices that catalyze STEM identity development. Student and staff perspectives revealed that enabling students to develop their competence in turn increases their confidence. Additionally, undergraduate research experiences captured all three of the factors (e.g., competence, performance, recognition) significant to establishing salient science identities. When analyzing examples of praise and celebration, findings suggested that these expressions may be instrumental in retaining students on the verge of major changes.

The third section provided an overview of the model for programmatic influences on college readiness and retention among underserved students of color in STEM. The fourth section detailed proactive caring illustrating the philosophical underpinnings and the program's approach to underserved students of color. Some researchers may consider these actions to be coddling, but they were effective with the given student population. Additionally, the students did not perceive these activities as rudimentary or overbearing, but as an extension of care.

In the final chapter, I discuss critical points that can be extracted from this study and its implications for policy, practice, and future research. Specifically, the findings have implications for institutional policies and practices designed to support students of color in STEM and state

and federal policies interested in increasing underrepresented groups in the STEM disciplines.

Finally, implications for future research center on longitudinal and multi-site case studies geared towards understanding factors that influence persistence and success of underserved students of color in STEM.

CHAPTER 7: DISCUSSION, IMPLICATIONS, AND CONCLUSION

In this chapter, I revisit the purpose of this study and research questions, summarize key findings with respect to the existing literature, and provide implications for practice, policy, future research, and theory.

Research Questions and Purpose Revisited

The purpose of this study was to understand how the strategies and practices employed in a STEM enrichment program facilitate college readiness and retention among underserved students of color in STEM. I used an integrated framework comprised of the Expertise Model of Student Success (EMSS), sense of belonging, and science identity as a lens to explore programmatic features that undergirded student success in STEM. This study contributes to the extant literature concerning underrepresented groups in the STEM disciplines. In contrast to many existing studies emphasis was placed on underserved students of color participating in a STEM enrichment program.

I applied a single-case study design (Yin, 2003). This approach allowed me to examine the nuances of the institutional context and program. Since the study focused on underserved students, I was interested in selecting a program whose stated mission reflected this student population and one that had successfully supported them. I interviewed 50 individuals: 42 current and former program participants, 2 administrators, 2 instructors, and 4 recent baccalaureate recipients and former program participants. A conceptual model for understanding College Readiness and Retention among Underserved Students of Color in STEM emerged from the findings. The research questions that guided this study were:

- How does a science, technology, engineering, and mathematics (STEM) enrichment program facilitate college readiness and retention among underserved students of color at a predominantly White, large, public, research university?

- What strategies and practices support academic and context-specific knowledge attainment, sense of belonging, and science identity development?

I address the second question related to strategies and practices applied within the Comprehensive STEM Program (CSP) in response to my primary research. Moreover, I organize the discussion of this chapter through the following themes: college readiness, institutional retention, and STEM retention. I reference the strategies and practices related to these themes to elucidate the role of CSP in supporting students' college readiness and retention.

College Readiness

There are a growing number of efforts centered on defining and addressing college readiness among students entering postsecondary education (Conley, 2010; Long & Boatman, 2011; Perna & Thomas, 2006; Venezia & Jaeger, 2013). Recent statistical reports indicate that 40% of first-year students will need to enroll in at least one remedial course (Long & Boatman, 2011). Among underserved students the number of remedial courses may be higher, and it may take longer for them to complete remedial courses (Bahr, 2010). CSP institutes a number of strategies and practices to mitigate the consequences of poor pre-college preparation. These approaches are critical in helping students make a successful transition into postsecondary education. In some ways, the program seeks to address in six weeks shortcomings that have existed for four or more years (Bahr, 2010; Moses & Cobb, 2002). Specifically, the summer months allow students to address cognitive gaps and build knowledge about college expectations in a relatively safe and supportive environment. For instance, Alex emphasized that the summer program allowed him to “make mistakes” that would be otherwise harmful to his achievement during the academic year.

Summer Instruction and Mastery Learning

Many students expressed initial struggles in the summer mathematics courses due to three reasons: (1) lack of advanced math in high school, (2) poor math teaching in high school, (3) “shaky” math foundation. These issues concerning pre-college math exposure and course offerings may stem from the lack of urban teachers who teach math and science without the degrees in these areas. In some urban school districts, only 50% or less of the teachers who teach math and science actually have degrees in these areas (Obama, 2012). Consequently, most CSP participants underscored that the summer program and weekly assessments facilitated cognitive gains in their understanding and application of math concepts. The program informed the students of knowledge gaps through the weekly assessment process, and they used small-group instruction, individual support, feedback, and corrective action to rectify deficiencies. Some participants contended that they would have entered the academic year unaware of these of these gaps if not for the summer program.

Mastery learning is the approach that undergirds the summer instruction. Providing ample opportunities for students to continuously improve until they learn a skill or concept is integral to comprehension, retention, and application (Michael, Dickson, Ryan, & Koefer, 2010). One of the critiques of mastery learning is the amount of time it takes to work with students who require more academic support (Guskey, 2007). Within the summer program, time is not a constraint as compared to the traditional academic semester. Students spend a combined 17 hours a week in class instruction and recitation. This format provides plenty of time for remediation, feedback, corrective action, and enrichment. Conley (2010) argued this approach should be utilized in pre-college settings. Unfortunately, due to the variance in pre-college contexts, quality of teachers and educational offerings, and national curricular standards many students do not experience this rigor and support within secondary schools (Conley, 2010; 2013).

Academic Behaviors and Cognitive Strategies

Most of the students in the current study matriculated from high school contexts in which they were academically successful without exerting much effort. A recent study using self-reported data uncovered that urban high school students studied zero hours per week and still maintained a high GPA (Harper, 2014). These students understood the difference between studying and doing homework, and many engaged in the latter instead of the former. They also listened intently to the teacher, took notes in class, and completed their homework in school, but they did not study for their courses (Harper, 2014). Given these circumstances, it is understandable that students advance to college ill-equipped for the rigorous academic environment and unaware of the tools necessary to succeed. As a result, CSP provided both instruction on how to use academic resources (e.g., tutoring, study aids) and how to engage in the academic environment (e.g., go to office hours; sit in the front of class).

CSP also normalized help-seeking behaviors and working within groups. CSP staff used academic and social spaces to assist students in building relationships. As the students established trust they more willing to work together and seek out one another for academic support. For instance, Gary stated in chapter six that he was hesitant to receive assistance from his peers, because he perceived such requests as a weakness. In contrast, in a learning community in which everyone is providing or soliciting support, concerns with being weak become less important to the overall goal of success. Conley (2010) wrote about training students to think and work independently, and Landis (2013) underscored this recommendation especially within the context of the STEM disciplines. College and career environments require a substantial amount of team-oriented projects (Landis, 2013). Lastly, Treisman (1992) found that the success of Asian American students was due to their working together in small groups. He

applied these same behaviors in his work with African American students resulting in significant increases in their academic achievement.

Another subset of students discussed ways in which the summer instruction influenced their mindset. In particular, the program was fostering the students' habits of mind. Scholars assert that these are important requisite skills for college achievement (Conley, 2010; Perna & Thomas, 2006; Venezia & Jaeger, 2013). The classroom instruction, recitation, and engagement in the problem-based learning activities helped students to develop their metacognitive abilities. Other tactics included scaffolding academic tasks, helping students think through problem-solving approaches, and promoting group work. Collectivist tradition among communities of color could be used to encourage more collaborative learning (Gay, 2002; Kendricks & Arment, 2011). Thus, CSP motivated students to work collaboratively during the bridge program such that students continued to leverage these relationships and sources of support throughout the academic year.

College Knowledge

Conley (2010) asserts that secondary teachers and administrators could do more to facilitate the transition from high school to college. He proposed strategies such as aligning course expectations to college standards, using college-ready seminars to teach self-management skills, and incorporating college-ready assignments (e.g., rigorous research projects). In the absence of exposure to these entities, students must ascertain this information on their own. CSP addresses some of the aforementioned content through the summer program and throughout the academic year via academic advising and the first-year seminar. For instance, there was a lot of emphasis on telling students to go to office hours, how to appear attentive in class, or how to use their peers effectively.

Most of the participants concurred that adjusting to the class schedules and time differential in college was critical to their success. CSP provides resources to assist students in dealing with this issue. For example, participants were encouraged to use the summer program schedule to organize their time and given handouts and planners to learn how to prioritize activities and monitor their time usage. In the recent literature, time management has been linked to more comprehensive approaches to self-management and self-regulation (Komarraaj & Nadler, 2013). Research demonstrates that students should be provided with an overall strategy that assist them with managing their time, identifying appropriate study space, pursuing help-seeking and collaborative learning opportunities, and metacognitive and test strategies (Malhotra & Mehta, 2015; Winne & Nesbit, 2010).

Institutional Retention

As stated in chapter 4, there are a number of new and recurring programs and initiatives taking place at Jefferson State, what makes CSP unique is its seamless integration of services and activities. Another strength of CSP is its philosophy and approach regarding proactive caring. In this section, I discuss proactive caring, common first-year experiences, and wrap-around services.

Proactive Caring

Proactive caring, as operationalized in CSP, integrates notions of proactive advising (Earl, 1987) and the ethic of care (Gilligan, 1979; Noddings, 1984; 2013). First, the staff were available to students whenever and wherever possible within reason. They developed bonds and trust with the students such that students felt comfortable with seeking out their services when they experienced academic difficulty or needed support in other areas. The students did not perceive the staff as overbearing or acting in manner of *in loco parentis*. In contrast, they described the staff's tactics as genuinely caring about their well-being and success. According to

Varney (2007), “[proactive] advising is not ‘hand-holding’ or parenting, but rather active concern for a students’ academic preparation...[and a] willingness to assist students” in meeting their academic, professional, and personal goals (paragraph 2). The staff demonstrated “active concern” through their program development, attention to student needs, and a genuine concern for their well-being and success.

In the present study, the staff’s approach to caring seemed to have more depth than proactive advising alone. Though care or caring has been identified as an element within proactive advising, the caring aspect of the staff’s approach with students was relational, situational, and individualized. In an article documenting the practices of Towson University’s administrators, Woodus indicated that intrusive caring was “gently but firmly prying into every aspect of the freshman’s life, probing for problems” (de Vise, 2010, paragraph 22). In order for administrators to effectively “probe” they must first establish a trusting relationship with the student. Due to this initial step, CSP staff knew how to show care for different kinds of students. Their interactions were differentiated. Some students they were stern and direct with while others they showed more compassion and empathy for their circumstances. The staff was only able to respond in these varied ways because they knew their students; they understood their circumstances; and they wanted to help them advance their lives through the attainment of a STEM degree.

The staff spent a considerable amount of time getting to know the students, their backgrounds, goals, and aspirations. On one occasion when I was having an informal conversation with the program director, Phil, his telephone rang. The caller on the line was a local landlord inquiring about two of his former CSP participants. The two students were seeking to secure an apartment in the area. He served as a reference for these students and provided confirmatory information that they would not harm the property or the community. When Phil

completed his phone call, I stated, “you know a lot about your students,” and he stated, “Tonisha, that’s because I care.” These kinds of behaviors and attitudes are meaningful to students. The participants in the current study spoke at great length about wanting to be cared about and respected.

In an era when content-matter dissemination and accountability are increasingly reified, it is crucially important to see and treat our students as whole people rather than consumer-critics so that the dominant reductionist and consumerist traditions can be challenged and ultimately transformed. (O’Brien, 2010, p. 109)

As O’Brien alluded to in the aforementioned quote, retaining students makes good business sense, but beyond that administrators should seek to create environments in which students feel belongingness, valued, and a part of a community. CSP’s attention to the whole person influenced their abilities to get results and motivated students to fully engage in the program components. Strayhorn’s (2012) work on sense of belonging concurs with these findings. According to Strayhorn (2012), “When needs are met, optimal functioning is possible” such that students perform well academically when they feel like they belong (p. 74). Though program activities were mandatory, there were no institutional policies requiring students to stay in the program. The students stayed because they wanted to, and they saw significant gains in their development. In the broadest sense, these behaviors and outcomes attune to educational learning goals: cognitive, affective, and psychomotor (Guskey, 2013). The students made cognitive gains, they felt good about themselves and their abilities, and they demonstrated their knowledge in an academic context. The achievement of these learning goals was predicated on a foundation of proactive caring established by the CSP staff.

Common First-Year Experience

Many students reported substantial satisfaction with being a part of CSP. They appreciated the camaraderie among their peers, emphasis on academic excellence, and the

support of the staff. The first year of college is one of the most critical years for establishing initial achievement (Reason, Terenzini, & Domingo, 2006) and cultivating one's personal development (Reason, Terenzini, & Domingo, 2007). Thus, CSP contains eight program components that are designed to advance an intentional and integrated first-year experience. These activities help students to transition into college and support their academic and social adjustments. Previous studies have discussed the significance of the first year of college and best practices for ensuring a smooth transition and retention to the second year (DeAngelo, 2014; Kuh et al., 2010; Tinto, 2012). Students who participate in these programs typically benefit from higher retention rates, engagement, and levels of achievement (Kuh et al., 2011; Suzuki, Amrein-Beardsley & Perry, 2012; Walpole, 2008). These successful outcomes can be attributed to having a common first-year experience that includes high-impact practices, meaningful relationships, and wrap-around services.

High-Impact Practices. Much of what takes place in CSP is consistent with the Association of American Colleges and Universities' (AAC&U) high-impact practices. In fact, CSP's program offerings contain qualities of five of the 10 teaching and learning strategies: first-year seminar and experience, common intellectual experiences, learning communities, undergraduate research, and collaborative assignments and projects (Kuh, 2008). To a lesser extent, CSP also engages students in community service and aids students in preparing for internships. These experiences provide opportunities for collaborative and experiential learning, strengthening of intellectual competencies, problem-solving and team-work, and greater awareness of disciplinary contexts and content.

Relationships. CSP leverages the relationships established through the summer program to advance the academic and retention goals of the program. Over time, the students and staff become more like family than just peers. Numerous studies assert that communities of color

value a collectivist tradition and family-oriented environment in college (Carson, 2009; Kendricks & Arnett, 2011). Strayhorn (2012) also found that students of color are less likely to persist in the STEM disciplines when they lack friends.

The CSP relationships address both social and academic needs. Students in the current study underscored that they felt more comfortable with the college environment due to their friendships. They were also more apt to assist others in their academic pursuits. For instance, Autumn noted that if one student knew the course material he or she was responsible for explaining it to the entire group.

Wrap-Around Services

Many participants valued that CSP offered many of the services and activities they needed to be successful in college. The “one-stop shop” nature of the office where the program was housed reduced the amount of time and effort needed to navigate the relatively large campus setting to access certain resources (Seymour & Hewitt, 2007). Specifically, students emphasized the importance of academic advising, recitation and tutorial services, and financial and professional support being available within CSP.

Academic Advising. Many students noted the differences in CSP’s approach to academic advising and what they experienced with university or college advisors. Some students asserted that the university or college advisors were friendly and experts in prescriptive advising, but many lacked the holistic and individualized approach consistent with developmental or proactive advising. Advising literature suggests that with special student populations, such as the students in the current study, the aforementioned approaches may lack depth (or do not go far enough) to address the systemic and institutional barriers that these students have faced (Varney, 2007; 2012). Underserved students need more than just course scheduling assistance and periodic notices about institutional policies (e.g., drop/add dates, enrollment dates, etc). Though this

information is helpful it sometimes fails to address the academic and context-specific knowledge necessary to overcome institutional barriers to retention and achievement (Padilla, 2009).

Underserved students need a combination of prescriptive and proactive advising (Varney, 2012). For instance, several CSP participants pointed out that some advisors readily discouraged them from persisting in the STEM disciplines due to their underperformance in a course. In some cases, the students were not provided with information about repeat credits, alternatives for course completion (e.g., if below junior status, take at a community college and transfer the course credits), or aids to improve conceptual knowledge (e.g., Schaum's manual, Khan Academy). These conversations left the students with diminished self-esteem with little to no direction or guidance for next steps. In contrast, CSP staff were reliable sources of information and knowledgeable about resources. According to Varney (2007), proactive advisors must be abreast of campus resources to best serve their student population. As Storm commented, many students prefer not to meet with several different advisors to have their questions answered or needs addressed. Thus, having wrap-around services such as advising in one location is important to students (Kuh et al., 2010).

Recitation. Recitation provided space, time, and structure for students to review concepts and receive academic assistance from their coaches and peers. As one student posited, "...it's not like we have to make time [or] someone can't make it. It's a designated time. You know where it's at. It's always gonna happen that way." The inclusion of recitation simplified the process of designating time to study and engaging in other educationally purposeful activities. It also helped students to more easily locate academic support, because the academic coaches would be available in the space. Research shows tutoring continues to be a staple in the academic lives of students (De Backer, Van Keer, & Vlacke, 2012). However, beyond tutorial and academic

assistance, what CSP offers is the structure necessary for students to be proactive about studying and opportunities for collaborative learning.

Financial and practical support. As previously noted, CSP is unable to provide full academic scholarships to its participants. Unlike some STEM enrichment programs (Stolle-McAllister et al., 2011; Tsui, 2007), they do not have the financial means to support students in this manner. However, students emphasized that the office assists them in a myriad of other ways that have financial consequences. Some students highlighted the small book scholarships the program provides, or the ways in which the program helps them in securing departmental or institutional scholarships. CSP also has a book and laptop loan program. These relatively small sources of support may translate in keeping students from working too many hours to be able to afford these entities. These small gestures may prevent students from experiencing negative impacts on their academic performance and persistence (Torres, Galbraith, & Merrill, 2012; Ziskin, Torres, Hossler, & Gross, 2012).

Professional development. Numerous participants also indicated that the program helped them with their professional needs. Among the most cited outcomes were communication skills, resume development, and networking opportunities. The National Society of Black Engineers (NSBE), academic advising sessions, and the first year seminar aided students in obtaining greater awareness in these areas (Newman, 2011).

STEM Retention

Psychosocial

Some potential threats to success and retention in STEM for underserved students of color lie within the psychosocial experience. Specifically, dealing with bias and discrimination may be disruptive to the academic experiences of some students (Steele, 1999). As reported in the current study, students of color found it difficult to join project groups in classroom settings

and study groups in out-of-the classroom environments. Women of color also expressed that they encountered both racial and gender bias. Some of the strategies and practices to mitigate these circumstances emphasized in CSP were having difficult conversations, reinforcing contributions and belongingness to STEM, and focusing on academic performance. While these first two practices may be useful preparatory measures or coping strategies (McGee & Martin, 2011), the latter may have a counter effect (Lehto et al., 2013). Public health research on the notion of John Henryism suggests that coping mechanisms that focus on performance alone may result in serious psychological and physiological consequences (Lehto et al., 2013). With the rise in student mental health concerns in postsecondary education (Renn & Reason, 2013), the added stress of biased incidents can lead to attrition as a form of resistance (Strayhorn, 2012). Though some students find “proving others wrong” to be an effective strategy for managing bias in STEM environments (Moore et al., 2003), other students may become too overwhelmed with the task of debunking stereotype amid pursuits of academic excellence (McGee & Martin, 2011; Seymour & Hewitt, 1997). Thus, some of the attempts that CSP made to prepare students for these environments were useful, but more intentional efforts and strategies for addressing intersectional discrimination (e.g., race and gender) may have been more beneficial (Ong et al, 2011).

Confidence, undergraduate research, and praise and celebration

In the current study, confidence, praise and celebration, and undergraduate research experiences served as STEM identity development catalysts. Stronger confidence and forms of praise and celebration validated that the students had the competence and ability to perform in STEM contexts. Undergraduate research provided opportunities for students to experience all three entities within the science identity framework: competence, performance, and recognition. These elements fostered the students’ emerging identities. As students became more affirmed in

their identities they had greater assurance that they would persist in their STEM disciplines. For instance, Janine mentioned that she had considered changing her major until she received an award for best GPA in computer science. Another participant, Storm, asserted that she knew she was an engineer, because she was able solve difficult engineering problems, work with diverse colleagues in the laboratory, and perform a variety of tasks with excellence for her faculty mentor. These experiences resulted in an invitation to her faculty mentor's home for dinner. The extant literature supports these findings in that confidence, recognition, and performing scientific tasks lead to greater satisfaction with and commitment to the STEM disciplines (Eagan et al., 2013; Hurtado et al., 2010; Hurtado et al., 2011). Studies also show that these students have better academic outcomes and higher rates of persistence (Slovacek et al., 2012).

Connections to the Model for Programmatic Influences on College Readiness and Retention among Underserved Students of Color in STEM

I organized the discussion section under the headings of college readiness, institutional retention, and STEM retention to elucidate particular strategies and practices that more directly related to these outcomes (see Table 7.1). As stated in chapter 6, there is much overlap between the major themes in this study: community building, STEM identity catalysts, and holistic development. For instance, certain aspects of holistic support are more salient to college readiness (e.g., transitional). Likewise, there are elements that have a greater influence on institutional retention (e.g., practical). Then, there are factors that are specific to STEM retention such as psychosocial support. When students spoke about biased incidents they encountered these accounts were often in the context of STEM classrooms.

As previously noted, proactive caring represents the outer circle, because it encapsulates all that is happening within the program as the guiding philosophy and approach to its inner workings. The model is illustrated in a Venn diagram to show the overlapping nature of the

major themes in this study (see Figure 7.1). This image also attunes to the multiple dimensions inherent in college readiness and retention. For example, the competencies gained through summer instruction and mastery learning is instrumental to STEM identity development.

Figure 7.1 Model for Programmatic Influences on College Readiness and Retention among Underserved Students of Color in STEM

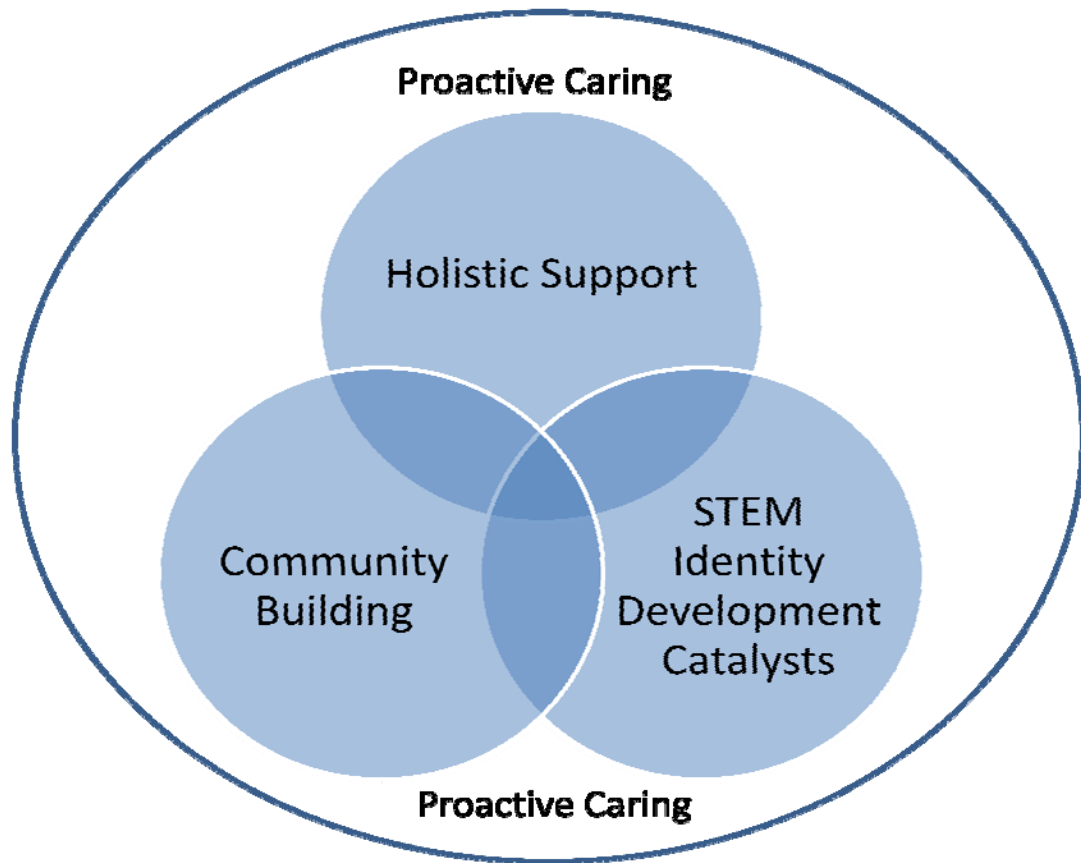


Table 7.1 Program Components and Emergent Model

	Summer Bridge Program	Residential Housing	Math Course Clustering	Weekly Recitation	Peer Mentoring	Academic Advising	First Year Seminar	Undergraduate Research
Proactive Caring	X			X		X	X	
Holistic Support	X		X	X	X	X	X	
Community Building	X	X	X	X	X	X	X	
STEM Identity Development Catalysts	X			X				X

Implications for Practice

A Note to Start-ups

For programs early stages of development, using a comprehensive, integrated model similar to the eight program components featured in the CSP program will ensure that students receive support for college readiness and retention. Existing research affirms that these kinds of programs work best for first-year students, and they bring cohesion to the first-year in college (Perna et al., 2009; Wawrzynski & Jessup-Anger, 2010). Program administrators should also consider frameworks such as those used in this study to plan and implement STEM enrichment programs. The Expertise Model of Student Success (EMSS) helps administrators to reverse

engineer their programs through considering what barriers exist in the institution and developing an intervention can mitigate potential impediments to student success. Sense of belonging considers what environmental factors and institutional agents may be influential in creating experiences in which students feel valued and cared about. How administrators create belonging experiences will depend on the institutional contexts and available resources (e.g., financial, human capital). Finally, the science identity model can assist administrators in thinking about activities and services that might promote competence and opportunities to perform and receive recognition. Using a theoretical framework to plan a STEM enrichment program can be instrumental in developing a sound infrastructure for assessment, evaluation, and research, too.

A Note to Existing Programs

Though CSP provides a myriad of services to its students there are some areas the program administrators would like to increase or strengthen their support to students. Financial constraints prevent them from being able to hone these areas. One mechanism that may be useful to existing programs is collaborating with institutional researchers or social scientists to assess and research student outcomes. Evidence-based practices are more likely to be attractive to potential donors or other external funding sources. Since many of these programs spend most of their funds on direct costs, collaborating with institutional researchers and social science faculty may provide opportunities to reduce monies spent on assessment and research. Any new grants acquired through these collaborations could include budgetary line items for the researchers' ongoing evaluation services. Convening meetings such as Understanding Interventions that Broaden Participation in Science Careers (2015) seeks to promote these kinds of collaborations inviting practitioners, social scientists, and natural and physical scientists to their conferences to discuss STEM intervention programs and effective methods for studying and implementing these programs.

Existing programs should also pursue opportunities to collaborate with faculty. The extant literature confirms the benefits of faculty interactions to student success (Kuh et al., 2010). CSP staff encouraged students to attend professor office hours and discussed the importance of cultivating relationships with faculty, but beyond these recommendations few programmatic features incorporated faculty in the planning and implementation of the program. This phenomenon is consistent across many institutions and programs due to traditional divisions between student affairs and academic affairs and their individual roles and responsibilities (Banta & Kuh, 1998). Institutional policies could help to augment faculty and staff collaborations. The role of policy in promoting such collaborations will be discussed later in this chapter.

Specific to CSP

Diversify speaker series. Within the last two years, CSP has worked to expand the program and increase the number of non-engineering participants. Yet, some of the activities are still primarily geared towards engineering students. For instance, many of the non-engineering students insisted that the program should include more science speakers during the summer seminars. In particular, Legacy, a Black female student in actuarial science, pointed out that these seminars would be more engaging if there were more representation of speakers in the sciences. This suggestion is important, because students of color often lack role models in the STEM disciplines (Allen-Ramdial & Campbell, 2014; Ong et al., 2011). Many of the speakers selected for the seminars were professionals of color, but they were exclusively engineers. Being able to see people that look like one's self discussing their professional lives and responsibilities allows students to envision themselves in these roles (Oyserman & Destin, 2010). Literature on possible selves (or future selves) posits that one can be influenced toward goal orientation by contextual factors such as exposure to positive role models (Oyserman & James, 2009). Thus,

diverse representation in its broadest forms (e.g., race, gender, discipline) can be instrumental in generating exploration of and strengthening commitment to STEM careers.

Heterogeneous mix of participants . Some of the participants recommended that CSP staff recruit a more diverse array of program participants. This comment entailed both racial/ethnic diversity and academic ability. When I asked Emily, how CSP could improve their program, she frankly stated, “recruit more students like me.” Emily was a woman of color and an above average achiever in mathematics. In her interview, she revealed that she was drawn to CSP, because the letter sent to prospective participants spoke about diversity. She felt the program contributed to her success in helping her adjust to the social climate in college. Moreover, Emily suggested the program could benefit from including more students with a range of cognitive abilities. She expressed that this configuration of students could engage in mutually beneficial relationships. Studies that examine ability grouping in educational environments underscore Emily’s sentiments (Boaler, 2008). These studies suggest a heterogeneous mix of students can minimize stigmatization of programs like CSP. Though CSP is designed to be an enrichment program and not for “under-performing” or “low-achieving” students these types of programs often get labeled as such (Seymour & Hewitt, 2007). Additionally, a mixed-ability learning communities may raise the overall aspirations and achievement levels of the entire group (Boaler, 2008).

Other participants also indicated that CSP staff should identify ways to increase the racial and ethnic diversity of the program participants. For instance, Dr. Diana Ellis reflected on her own experiences as a participant in a similar program during her undergraduate education. During her interview, she elaborated on the myriad of benefits garnered from the program including interacting with diverse collegians. CSP has mostly Black or African American students and smaller proportions of Asian American, Latino, and White participants. Since many

of the students at JSU matriculate from secondary schools in the state, one could argue that CSP is representative of its local population. However, CSP may want to consider collaborating with admissions counselors who focus on out-of-state recruiting to yield more racial and ethnic diversity.

More variety in summer course offerings. Many of the former program participants and STEM baccalaureate recipients suggested that the summer course offerings be expanded to allot more opportunities for analytical thinking and skill development. For instance, Jamal, a Black male baccalaureate recipient in mechanical engineering, remarked:

[CSP]...gave me a leg up in the sense that I got to take a couple classes that were pretty formal and they tried to tailor them towards the same way that a typical professor would. Like my computer programming class, I [received an A in] that class with no problem, just because I basically took the class in the summer program. And the [lecturer] they had instructing [the class] was really serious, she understood, and was a pretty good teacher...

During Jamal's tenure in the program, there was a math, science, writing, and computer programming course. Over the years CSP has tried different configurations of courses seeking to maximize the summer learning experience and address courses that appear during the first year in college. The course Jamal mentioned is atypical within the first year curriculum, but meaningful to STEM degree attainment. Likewise, William, a Black male junior in mechanical engineering, recommended that CSP add project-based courses to the summer curriculum. He contended:

I feel like that one project kind of opens your mind up to a lot of different things. It doesn't have to be a lot of projects just one project will have you thinking in that mindset. That's what I've noticed. That kind of happened to me in my internships. I mean CSP could've did that too though. Put you in groups...just one project.

As previously stated, the math support provided in the program assisted students with cultivating their habits of mind; however, additional activities, as William suggested, could further hone these skills and abilities. The extant literature confirms the relevance of team-based projects to

sound decision-making, better communication skills, and stronger metacognitive abilities (Irving & Sayre, 2014; Meyers, Ohland, Pawley, & Christopherson, 2010). Since time constraints may limit the number of courses offered during the pre-first-year summer program, implementation of a sophomore program may address future academic needs. A number of colleges and universities have instituted sophomore enrichment programs in the STEM disciplines to continue to support academic and professional development.

Bolster undergraduate research experiences. Most of the participants concurred that engaging in undergraduate research was a worthwhile experience. They really enjoyed learning new things and working creatively to investigate scientific phenomena. However, several students expressed concerns with the undergraduate research placements being in a different disciplinary area than their major. For example, William commented:

I would say the [undergraduate research] program they should make more consistent with people's majors to help them in their own field. Because you go to class and you're in class with people whose parents are engineers and they see stuff in class and they're like yeah my dad does this. So they know what's going on, like the behavior or the mechanism or something. You're sitting there like I didn't know that at all. I just feel [the undergraduate research experience] could be more tailored to your field. I think that could be very beneficial.

All but a few of the participants were first in their families to earn a STEM degree so they had limited exposure to STEM careers and job functions. Thus, they were looking forward to their research experiences to fill in some of the gaps about the STEM profession. Since so much of the early years of the STEM programs are theoretically-grounded they were also looking for ways to apply their knowledge. While working in any research experience allows students to learn some general research skills and practices, having an opportunity to work more specifically in one's discipline or major allots for context-specific knowledge attainment. This may be an area in which more collaboration with faculty would be advantageous. Numerous studies reveal

the positive outcomes in engaging in undergraduate research (Eagan et al., 2013; Hurtado et al., 2011; Slovacek et al., 2012). Any efforts to improve those experiences warrant attention.

Faculty

Many of the participants indicated discontent with race and gender relations in STEM classroom environments after CSP. They often encountered difficulties with joining groups for class projects or establishing study groups. Some of the challenges included having to prove one's academic prowess or being given the menial tasks for the group project. Similar to practices employed in CSP, faculty may want to consider implementing some community-building activities such as helping students identify commonalities as a precursor to group work. Harper (2012) also stressed the need for professional development opportunities for faculty to minimize inequities in educational settings. A first step to this realized goal may include considering new ways to make group work more equitable.

Given the findings of this study, it would also benefit students if faculty demonstrated more care in their interactions with students in classroom environments (Noddings, 1984; O'Brien, 2010). As discussed in chapter 2, students are more likely to experience faculty care in spaces outside of classroom environment (e.g., undergraduate research). Yet, facets of proactive caring such as positive motivation and encouragement may be instrumental in creating a sense of belonging especially among students of color in STEM. For example, the participants in the current study indicated that praise and recognition was instrumental in helping them feel a sense of belongingness to the STEM disciplines. In fact, Janine, a Black female computer science sophomore, commented that she was planning to leave her STEM program until she was recognized for her high GPA. Evidence also shows that faculty support and encouragement are important to student retention and achievement (Strayhorn, 2012). As Tinto (2012) noted faculty continue to play an integral role in the lives of students. Thus, student retention should not solely

rest upon the actions of program administrators. Faculty also have a role and responsibility to support student retention and advance a caring ethos.

Implications for Policy

Federal Policy

The current study focused on a LSAMP program. These programs have shown much success nationally with significant numbers of students earning undergraduate and graduate degrees (Barrena & Veden, 2013). Given these outcomes, federal funds should continue to be allocated to these types of programs. Additional funds should also be dedicated for assessment, evaluation, and research. Many of these programs struggle to show the outcomes and impacts of their programming. Since much of funding of the program funding is spent on direct costs there is little money available for assessment purposes. In this era of accountability, the future of these programs may be in jeopardy if they are unable to provide more evidence of effectiveness.

Institutional Policy

Some scholars suggest there needs to be efforts to scale-up these programs (Espinosa & Rodriguez, 2012), but attention should be given to how scale-up efforts at a single institution complicate achievement gains and other successful student outcomes (Wang & Degol, 2013). Some studies suggest that working with students in small groups is also an extension of care (Rivera-McCutchen, 2012). This assertion seems to be accurate given the low number of participants in some of the renowned retention programs within the United States such as Posse and the Meyerhoff Scholars Program. In the current study, former program participants were concerned about the increasing number of students being served in CSP. Even the program director conjectured that he would have to create new strategies to support larger groups of students. He suggested that “pods” of 25 per discipline may be a way to maintain the smallness of the program while increasing the number of participants.

Implications for Future Research

Redefining Student and Institutional Success

Future studies should seek to identify additional measures to assess success and achievement among underserved students of color in STEM. GPAs and standardized tests scores alone do not account for the incremental achievements students may be making as they persist in their given disciplines. For instance, future studies might seek to measure self-regulation, motivation, and self-efficacy as early indicators of achievement or adequate progress to degree attainment. Consequently, Richardson, Abraham, and Bond (2012) suggested that:

Theoretical and intervention development will be best served by cross-domain collaboration to test standardized, reliable measures derived from clearly-specified process models. We recommend that researchers work towards establishment of distinct constructs identified by consensually-accepted labels and measured using scales that have been tested for their psychometric properties. We believe that this focus would result in identification of fewer key predictors of GPA. (p. 49)

Thus, the better that researchers can predict leading indicators to achievement and degree attainment, the better administrators can develop educational interventions to facilitate student success for various underserved and underrepresented populations in STEM. Additionally, Ackerman, Kanfer, and Beier (2013) pointed out that:

Traditional measures of high-school grade point average and high-stakes entrance examinations are valid predictors, especially of first-year college grades, yet a large amount of individual-differences variance remains unaccounted for. Studies of individual trait measures (e.g., personality, self-concept, motivation) have supported the potential for broad predictors of academic success, but integration across these approaches has been challenging. (p. 2)

This perspective undergirded their investigation of a first-year psychology seminar designed to teach “time management, learning skills, career planning, psychological hardiness, teamwork, and leadership” (Hagearty, 2003, p. 2 as cited in Ackerman et al.). Future studies could use similar courses in their research design to assess and predict STEM persistence.

Broadening the conversation and research agenda concerning factors that influence persistence and academic achievement should also include institutional “milestones (Espinosa & Rodriguez , 2013; p. 141). Espinosa and Rodriguez (2013) contended that institutional measures such as “course quality, gainful employment, and availability of [scientific] equipment” (p. 141-142). Such considerations ensure that institutions are held accountable for student support and success, in the same ways, students have traditionally been the sole entity discussed regarding issues of retention and attrition (Tinto, 2012). Efforts to “fix the student” without attention to institutional factors that facilitate or impede student success limit the possibilities for improving pathways to STEM degree attainment.

Culturally Responsive Practice in Higher Education

Future research should also focus on the notion of proactive caring as a culturally responsive practice in higher education (Gay, 2002/2010). Institutional leaders are seeking new ways to close graduation gaps between students of color and White collegians amid growing public scrutiny in this area (Carey, 2008). Recent opinion editorials point to University of Massachusetts system’s President Robert Caret’s intrusive caring approach as a best practice in supporting underserved, lower-income, African American students (Harmon, 2011). However, until the present study, no known empirical study has investigated the practices that comprise proactive (formerly intrusive) caring within the context of higher education. Caret and colleagues suggested that intrusive caring entails “gently prying into the lives of students,” uncovering “problems,” and aiding students in identifying corresponding solutions (de Vise, 2010, p. 9). Yet, the current study advances proactive caring—a philosophy and approach to student retention—that incorporates contemporary anti-deficit advising language (Varney, 2012). Findings revealed there are at least six elements within proactive caring: staff availability, trust, positive motivation, reinforcement, encouragement, and student accountability.

Future studies might apply a mixed-methods research design to study these factors in other institutional contexts. The institutional setting for the current study was with select administrators at a large, public, predominantly White, research university. Some of the proactive caring elements may be more or less significant in other contexts. Additionally, quantitative inquiry might result in a construction of a scale that allows researchers and practitioners to measure proactive caring and its influence on achievement and degree attainment. As stated in the opinion editorial, proactive caring was responsible for closing the graduation gap and facilitating positive academic outcomes (Harmon, 2011). Without empirical evidence to support these claims, practitioners lack concrete information on how to institute proactive caring practices for the benefit of student success.

Alternative Lenses to Explore the Experiences of Administrators and Students

Although the conceptual framework utilized in the current study substantially examined how a STEM enrichment program facilitates college readiness and retention among underserved students, other frameworks may advance knowledge about the administrators and students in these programs. For example, the findings of this study suggest that program administrators possess implicit theories about resiliency and notions of equitymindedness. These theoretical predispositions influence their approach to designing and implementing program components. Additionally, as discussed in chapter 5, student experiences with racial microaggressions exacerbated feelings of isolation and alienation in STEM classroom environments. These encounters made it difficult for students to form project-based teams and study groups. Although I chose not to utilize the aforementioned frameworks—given the constraints of a dissertation study—they may have implications for future research.

Resiliency. Vailant (1993) contended that resilience is “self-right tendencies...both the capacity to bent without breaking and the capacity, once bent, to spring break” (p. 248).

Considering the fact that some CSP participants managed to matriculate to college despite their prior academic environment and experiences demonstrated their resiliency (Hernandez-Martinez & Williams, 2013). The program further bolstered these resilient dispositions through teaching students how to utilize them within the university environment and the STEM disciplines. For instance, the summer bridge program required students to complete weekly math assessments and incorporate subsequent feedback. When students became overwhelmed and consider giving up program instructors worked one-on-one with struggling students, and peers and mentors provided additional guidance and support. Consequently, resilient attitudes and behaviors resulted in better performance on the math placement exams (e.g., increases in scores) and first semester math grades (i.e., average math grade of 2.90). Findings also illuminated that notions about student resiliency worked in concert with equitymindedness.

Equitymindedness. CSP administrators exhibited an equity-minded disposition toward student success. For example, during one of my interviews the program director, Phil Smith, stated “it’s not fair to admit students to a university without ensuring that he or she has the appropriate resources to succeed.” Thus, caring as demonstrated in CSP was not about a “warm, fuzzy feeling that one has towards others” (Bartell, 2011, p. 66), but it was an expression of equitymindedness (Bensimon, 2007). The program created equitable conditions for retention and academic achievement for students who had been historically underserved by the educational system. The staff designed the summer bridge program courses to address cognitive gaps so that the students would be better positioned for success in their first year courses. According to Phil, due to data analytics generated from student records, Jefferson State University was aware of courses that students traditionally underperformed in. As a result, CSP staff used this information to institute their summer curriculum, and they identified course instructors who could address both remediation and enrichment in these areas. Illuminating these actions acknowledges how

administrators can be influential in cultivating student success. Moreover, Bensimon (2007) posited

In higher education, the dominant paradigm of student success is based exclusively on personal characteristics of students that have been found to correlate with persistence and graduation. Essentially, practitioners are missing from the most familiar way of conceptualizing empirical studies of student success; when scholars attempt to translate their findings into recommendations for actions, practitioners are rarely ever the target of change or intervention. (p. 452)

In the previous quote, Bensimon (2007) pointed out that practitioner knowledge and approaches are rarely considered in studies about educational interventions. The current study did address some of the philosophical underpinnings of the administrators' approaches to student success (i.e., proactive caring) and subsequent strategies and practices employed in the program. However, this study did not utilize equitymindedness as a theoretical lens to draw conclusions about how and why these activities matter for underserved students persisting in the STEM disciplines. Thus, researchers should consider this framework in future studies and investigate the role of practitioners in bolstering student success.

Racial microaggressions. In the present study, many of the program participants discussed experiences with racial microaggressions in their STEM courses. They underscored that these instances of discrimination and gendered racism contributed to feelings of isolation and alienation. For example, students reported being uncomfortably visible and questioned in academic spaces, experiencing difficulty in completing course projects due to peer perceptions about intelligence, and debunking stereotypical beliefs about minority achievement and success. These findings are consistent with recent reports generated by researchers at the University of Illinois-Urbana Champagne (Harwood et al., 2015) and Harvard University (Caplan & Ford, 2014) on racism in overt and microaggression forms. In these studies, researchers identified a number of acts that were harmful to academic and social experiences of students of color. In

contrast to these studies, the current study included perspectives from program administrators in addition to documenting student experiences. Findings illuminated some of the ways program administrators responded to and provided psychosocial support for navigating racialized contexts. Furthermore, future studies might consider using racial microaggressions as a lens to explore the psychosocial experiences of STEM students with overt and subtle discrimination and gendered racism.

Implications for Theory

New models and frameworks that theorize the experiences of underrepresented groups in STEM should attune to their multiple and intersecting identities that influence persistence, retention, and academic achievement. Because the focus of the present study was geared towards an educational intervention, little attention was given to participants' meaning-making concerning their social identities and subsequent STEM achievement and degree attainment. However, as participants discussed their experiences in STEM classrooms and their STEM identities (or lack thereof), their multiple and sometimes intersecting identities emerged as salient to their experiences, perceptions, and attitudes. These findings suggest that studies that investigate the achievement patterns of non-dominant groups in postsecondary education should be sensitive to the role of identity within those environments. There were a few instances in the present study in which participants asserted that their social identities (e.g., race, gender) did not matter as much in their college-going process. These attitudes should also be explored to discern how personality differences might account for various responses to identity and experiences within the STEM disciplines (Ackerman et al., 2013).

Some studies have explored how various identities affect the student experience within the STEM disciplines. Fries-Brit and colleagues (2012) examined the role of Black racial identity, SES, and achievement factors among undergraduate and graduate students. Carlone and

Johnson (2007) investigated women of color with a focus on their racial, ethnic, and gender identities as integral to their experiences in STEM. Strayhorn (2012) alluded to how the lack of family members with STEM degrees potentially disadvantages STEM students of color. Drawing upon these existing studies, new frameworks could be developed that show relationships or connections between other identities that further explicates STEM success such as first-generation STEM degree-seeking status.

In the current study, some of the participants were not first-generation college students in the broadest sense (i.e. first in their family to attend college, neither parent has a college degree), but they would be first in their families to earn a STEM degree. In some cases, this exacerbated feelings of marginalization. Entering academic spaces in which they lacked the vernacular, norms, and values of their peers was also difficult. In some instances, these pressures became even more pronounced than race or gender as a barrier to their full participation and belongingness in STEM environments. These findings have implications for Carlone and Johnson's model on science identity. While their model recognizes race, ethnicity, and gender as influential factors in science identity salience they do not consider other social identities such as first-generation STEM degree-seeking or socioeconomic status.

Conclusion

This study investigated a STEM enrichment program that aids in the college readiness and retention of underserved students of color at a large, public, predominantly White, research university. The findings elucidated the strategies and practices the program employed to facilitate academic and context-specific knowledge attainment, sense of belonging, and STEM identity development. Document analyses, participant observations, focus groups, and semi-structured interviews informed these findings. The emergent *Model for Programmatic Influences on College Readiness and Retention among Underserved Students* of color comprised four major

themes: proactive caring, holistic support, community building, and STEM identity development catalysts.

Proactive caring was found to be a philosophy and approach used to support the program activities and services necessary to reach program goals. Holistic support entailed five components including academic, transitional, psychosocial, practical, and professional. These elements were influential in attending to the myriad of needs of the program participants. Community building practices created conditions for belongingness. Community building encompassed both the establishment of a familial atmosphere and relationships on three levels including peers, staff, and mentors. Participants underscored that these relationships made them feel more comfortable at JSU and aided in their academic and social adjustment to college.

STEM identity development catalysts were the ways in which the program buttressed science identity development. Many of the programs activities focused on helping students build their academic competencies. As students made academic gains they also became more confident in their abilities to perform in STEM contexts. CSP also works with JSU's graduate school and other institutional administrators to place students in paid undergraduate research positions following their first year in college. Participants benefited from feeling competent in these environments, performing scientific tasks, and being recognized by respected others (e.g., faculty). CSP also engaged in a number of activities that afforded opportunities for students to be praised and celebrated for their academic prowess.

Moving forward, institutions should seek to replicate programs similar to the STEM enrichment program presented in this study. Unlike some of the newer initiatives developing at JSU, the aforementioned strategies and practices worked in concert to address college readiness and institutional and STEM retention. Though some strategies and practices showed greater alignment with achieving college readiness or retention goals, the holistic, integrated nature of

the program made the overall transitional and adjustment process much more seamless for this group of underserved students of color.

APPENDICES

APPENDIX A: IRB Approval Letter

June 3, 2013
To: Kristen A. Renn
428 Erickson
Re: IRB# x13-553e
Category: Exempt 1.1
Approval Date
June 3, 2013

Title: A Case Study of One STEM Enrichment Program

The Institutional Review Board has completed their review of your project. I am pleased to advise you that your project has been deemed as exempt in accordance with federal regulations. The IRB has found that your research project meets the criteria for exempt status and the criteria for the protection of human subjects in exempt research. Under our exempt policy the Principal Investigator assumes the responsibilities for the protection of human subjects in this project as outlined in the assurance letter and exempt educational material. The IRB office has received your signed assurance for exempt research. A copy of this signed agreement is appended for your information and records.

Renewals: Exempt protocols do not need to be renewed. If the project is completed, please submit an Application for Permanent Closure.

Revisions: Exempt protocols do not require revisions. However, if changes are made to a protocol that may no longer meet the exempt criteria, a new initial application will be required.

Problems: If issues should arise during the conduct of the research, such as unanticipated problems, adverse events, or any problem that may increase the risk to the human subjects and change the category of review, notify the IRB office promptly. Any complaints from participants regarding the risk and benefits of the project must be reported to the IRB.

Follow-up: If your exempt project is not completed and closed after three years, the IRB office will contact you regarding the status of the project and to verify that no changes have occurred that may affect exempt status.

Please use the IRB number listed above on any forms submitted which relate to this project, or on any correspondence with the IRB office.

Good luck in your research. If we can be of further assistance, please contact us at 517-355-2180 or via email at IRB@msu.edu. Thank you for your cooperation.

Sincerely,

Harry McGee, MPH
SIRB Chair
c: Tonisha Lane

APPENDIX B: Participant Solicitation Letter

Dear CSP Students,

I am writing to request your participation in a doctoral research study. I am conducting a study that investigates the experiences of underrepresented students who participate in science, technology, engineering, and mathematics (STEM) Enrichment Program. In particular, I am interested in knowing how the Comprehensive STEM Program has helped you persist at Jefferson State University. More information can be found about this study below.

Eligible students who participate will receive a \$10 in cash.

To sign up, please use the following link:

https://docs.google.com/forms/d/1Wr8_Q_FOALVIJe3ukV7A6VnMx5T90nTSKiQiw13DZL8/viewform

The objectives of this study include the following:

1. to determine how a STEM Enrichment program aids in retention for underrepresented students
2. to identify the barriers to success most often encountered by underrepresented students in STEM at Michigan State University (MSU)
3. to ascertain the strategies and practices employed by CSP to help students deal with institutional or academic challenges, feel a sense of belonging, and develop a science or engineering identity

If you decide to participate in this study, your involvement will take about one hour of your time. You will be participating in a one-on-one interview to share information about your experiences, perceptions, and interactions as a STEM student at JSU. Your participation is voluntary. All information will be kept strictly confidential. Names will not be recorded or included in the study. Interview sessions will be audio taped to ensure accuracy. At the conclusion of the study, all audiotapes will be destroyed.

Thank you,

Tonisha B. Lane
Michigan State University
Doctoral Candidate
Higher, Adult and Lifelong Education

APPENDIX C: Focus Group Protocol

Introduction:

Thank you for your participation in this discussion. The reason we invited you to participate in this discussion is so that we can learn about your experiences at Jefferson State University and in the Comprehensive STEM Program. When responding to the questions try not to talk over anyone. Be courteous when responding. If you disagree with something, do so in a respectful manner. Remember everything you say will be completely confidential and that you can stop whenever you want.

General Experiences

- What has been your experience attending JSU?
- What do you like about attending this institution?
- How would you describe CSP?
 - What is the program doing for you?
 - What is the program lacking?

Expertise Model of Student Success

- What challenges have you experienced since you have been at JSU?
 - Possible Probe: What problems did you have to overcome in order to be successful at MSU?
- What kind of information did you need to know to deal with these challenges?
 - Possible Probe: What did you have to learn/find out in order to deal with these challenge(s)?
- How have you dealt with these challenges?
- Did anything change for you? If so, what?
 - Possible Probe: What did you do to overcome those challenges? What were the outcomes?
- How has the Scholars Program helped you to deal with these challenges? Specifically, how has program staff or participants helped you to deal with these challenges?

Sense of Belonging

Some students talk about knowing what it feels like to belong; they describe belonging as fitting in, feeling cared about, accepted, or valued by or important to a group.

- Can you tell me about times when you have felt like you “belong” at Jefferson State University?
- Are there times you felt like you did not belong? Please describe.
- Thinking about CSP, has it helped you to feel like you belong (or possibly not)? If so, what ways? If not, why not?

Science Identity

Some students talk about science identity as the attributes or characteristics that makeup a scientist/engineering or emerging scientist/engineer. Some of these attributes may include feeling competent, being able to perform in math/science settings, or being recognized as a scientist/engineer.

- Do you identify with this definition of a science identity? If not, is there something missing?
- Have you come across people who have a strong science identity? Why do you say so?
- Do you think being a part of this program helps you develop this science identity? If so, how?

APPENDIX D: Program Participant Interview Protocol

Introduction

Thanks for talking to us again. The purpose of this interview is to talk with you more about some of the things we talked about in the large group, but also to get your viewpoint on some things.

Focus Group De-brief

- First, let's talk about the focus group. What were some of the important things you think came out of that conversation?
- Is there anything you've thought about more since that conversation? Tell me about it.
- Is there anything you want to add to what we talked about, now that we're alone and you've had some time to think about it?
- Are there any questions you had left over from that conversation?

Artifact (Ask students to bring an artifact in advance that represents their experiences/interactions with the STEM enrichment program.):

- What artifact did you bring that represents your experiences with the program? Tell me about this artifact? Why did you select this artifact?

Personal Experiences

- What do you like about attending this institution?
- What has contributed to your success at this institution?
- How do you know you will earn your STEM degree from this university?
- Some students talk about knowing what it feels like to belong, can you tell me about times when you have felt like you “belong” at Jefferson State University. Are there times you felt like you did not belong? Please describe.
- Thinking about CSP, do you feel like it has helped you to feel like you belong (or possibly not)? If so, what ways? If not, why not?
 - *Possible Probes:* In what ways, did the program help you make a smooth transition from high school to college (e.g., communicating with instructors outside of class, finding academic help when it was needed, forming study groups, getting to know peers, making new friends, navigating financial aid)?
- How do you spend time with different groups of people?
 - *Possible Probes:* To get at the frequency of time spent with peers (within the program): How many of your college friends are STEM students? How much time do you spend with them hanging out or studying? In what ways, does the time you spend with them (college friends in STEM) make you feel like you “fit in” or “belong” in STEM?
- Tell me about the first time you had an interest in science, technology, engineering, or math. How old were you? What happened? What motivated your interest?
- How has your involvement in CSP helped you to develop as a (an emerging) scientist or engineer?
 - What changes or differences have you noticed in your interest, competencies to do math or science, your performance in your courses (or STEM-related co-curricular activities; e.g., Baja Formula Racing Team)?

- Do you recognize yourself as a scientist or engineer? In what ways, please explain or provide examples. (Tell me more.)
- Do your friends, faculty mentor, professors, or others recognize you for your performance in science, math, or engineering? In what ways, please explain or provide examples.
- What's been hard for you at this institution?
- Have you ever felt discouraged about continuing in STEM? If so, why? (*Possible Probe:* What was going on? What were you thinking? How did you overcome that feeling?) If not, why not? (*Possible Probe:* Other students have experienced times of self-doubt or feeling like giving up? Why were you different or what made your situation different?)
- Tell me about a time that you were struggling with a STEM course? What did you do? Where did you go for help?
- Tell me about a time you thought about being a [race/ethnicity] in the your [STEM] program. (*Possible Probe:* What was that like?)
- Do you think it would have been different if you attended another institution (i.e., community college, U of M or equivalent)? (*Possible Probe:* What other institutions did you get admitted to? Do you think it would have been different if you went to X institution?)
- Did you feel like you were prepared to attend this institution? In what ways did you feel prepared? In what ways did you not feel prepared? How do you feel about your ability to complete your degree? What has helped you to feel more/less comfortable about completing your STEM degree?
- How has the program helped you?
- Is there anything else you think it's important for us to know?

APPENDIX E: Alumni Interview Protocol

Thank you for agreeing to participate and provide your thought, ideas, and reflections about your experiences in college, and specifically your interactions with the Comprehensive STEM program. I am conducting this study because I am interested in how Science, Technology, Engineering, and Mathematics (STEM) enrichment programs help students of color persist in STEM disciplines. My background is in the sciences, and I was often concerned when my friends or peers were not successful in STEM. So, I am interested in knowing how students are successful throughout their college careers with the help of university services and programs.

Your participation, and the overall results of this study, will be used for my doctoral dissertation, presentations at conferences, and in publications. Please remember that your participation in this interview is completely voluntary and that any information you provide will be confidential. With your permission, this conversation will be recorded. All identifying information will be kept confidential.

- What are some of the things STEM students of color need to know to be successful at the institution?
- What are some of the things STEM students of color need to do to be successful at the institution?
- What did you like about attending this institution?
- Why do you think you were successful at this institution?
- What were some of the challenges you faced earning your STEM degree? Do you think it would have been different if you went to another type of institution (community college, U of M or equivalent)?
- Who were your role models or mentors while at the institution?
- How did you know you would earn your STEM degree from the institution?
- Some people talk about knowing what it feels like to belong, can you tell me about times when you felt like you belonged at Jefferson State University. Were there times you felt like you did not belong? Please describe.
- Thinking about the CSP, did you feel like it helped you to feel like you belonged, or possibly not?
 - *Possible Probes:* In what ways, did the program help you make a smooth transition from high school to college (e.g., communicating with instructors outside of class, finding academic help when it was needed, forming study groups, getting to know peers, making new friends, navigating financial aid)?
- How do you spend time with different groups of people while at Jefferson State University?
 - *Possible Probes:* To get at the frequency of time spent with peers (within the program): How many of your college friends were STEM students? How much time do you spend with them hanging out or studying? In what ways, did the time you spend with them (college friends in STEM) make you feel like you “fit in” or “belong” in STEM?

- Tell me about the first time you had an interest in science, technology, engineering, or math. How old were you? What happened? What motivated your interest?
- How did your involvement in CSP help you to develop as a scientist or engineer?
 - What changes or differences did you noticed in your interest, competencies to do math or science, your performance in your courses (or STEM-related co-curricular activities; e.g., Baja Formula Racing Team)?
 - Do you recognize yourself as a scientist or engineer? In what ways, please explain or provide examples. (Tell me more.)
 - Do your friends, faculty mentor, professors, or others recognize you for your performance in science, math, or engineering? In what ways, please explain or provide examples.
- Did you participate in a STEM research project with a faculty member? If so, what was that experience like? How did it make you think differently about yourself as a STEM student? future STEM professional?

Artifact (Ask alumni to bring an artifact in advance that represents their experiences/interactions with the STEM enrichment program.):

- What artifact did you bring that represents your experiences with the program? Tell me about this artifact? Why did you select this artifact?

APPENDIX F: Administrator Interview Protocol*

The purpose of this study is to understand how the strategies, practices, and policies employed in a STEM enrichment program facilitates the retention of underserved students of color in STEM, I would to ask you some questions about how the STEM intervention programs that you are involved with operates on your campus and how you view its effectiveness.

I will discuss your STEM enrichment program and its design, implementation, impact on students, and its benefits. I will use this information, along with data on STEM enrichment programs, to ultimately illustrate how such programs are designed, implemented, change over time, and affect underrepresented students in the STEM fields. If at any time, you feel that these questions could be answered by any reports or evaluations you have conducted on the program, please feel free to refer us to those documents.

HISTORY AND GOALS OF THE PROGRAM:

- I'm now going to ask you a number of questions regarding the history and goals of the program.
- Can you tell me a little bit about the program? For example...
 - When did the program begin?
 - Why was the program developed? What prompted the program's creation?
 - What is the mission or primary goals of the program?
 - How is the program structured?
 - What specific services does the program provide? (*Possible probe*: For example, does the program offer academic or mentoring services?)
- What ideas guided the design and implementation of the services offered in the program? (*Possible probe*: Did you see that students needed better opportunities for mentoring, a need to improve the climate in order to improve persistence, etc.?)
- Has the goal or the mission of the program changed since its inception, and if so, what precipitated the change?

I'm now going to ask you a number of questions specifically about the students the program serves.

- What population of students do you serve or target?
- How do you recruit prospective students to participate in the program?
- How do you determine eligibility?
- How do you advertise the program?

OUTCOMES OF THE PROGRAM:

The following questions are related to outcomes of the program. I am interested in determining how well the design of the program meets its stated goals and the needs of the students.

- Does the program meet its mission and stated goals?
- How successful is the program at achieving its stated goal(s)? By what criteria is success determined? To what do you attribute its success or lack of it?
- Has the program been formally evaluated (i.e., internally or externally)? What was the focus of the evaluation and what were the results? Would you be willing to share a copy of the evaluation(s) with me?

- What do you see as the immediate and long term impacts of this program on students? (*Possible probes*: Why do you feel that this program is beneficial to students? How do you feel that this occurs? How do you measure the impacts?)
- What component(s) appear to be most beneficial and useful to students? Why?
 - Sense of belonging is defined as perceived social support on campus, a feeling or sensation of connectedness, the experience of mattering or feeling cared about, accepted, respected, valued by, and important to the group (e.g., campus community) or others on campus (e.g., faculty, peers). Do you help students feel a sense of belonging in your program? If so, in what ways?
 - Science identity encompasses three components: performance, competence, and recognition. Do you help students develop their science identities in your program? If so, in what ways?
- Do you follow-up with program participants after receiving services? For how long and how frequently?
- Have there been any modifications or adjustments to the program? If so, how has the program changed? What informed these changes? (*Possible probes*: Did you collect and analyze data, conduct focus group interviews, or gather any other data that informed your decisions? In other words, were these modifications based on research?)
- Is there is an area of the program you would like to expand or improve upon? If so, what would it be? (*Possible probes*: Would you like to create a greater sense of belonging among the students who participate in the program? Why or why not? Would you like to intentionally cultivate the science identities of program participants? Why or why not?)

WRAP UP:

- What else is important for me to understand about the operation and impact of your intervention program on your campus?
- Is there anything else that you would like to add regarding your intervention program?

***Note:** Some questions were taken from the STEM Trends In Enrollment & Persistence for Underrepresented Populations (STEP-UP) at the University of Illinois-Urbana Champagne and adapted to fit the context of this study.

APPENDIX G: Instructor Interview Protocol

General

- What has been your experience working at MSU?
- How would you describe the Engineering and Science Summer Academy and the Diversity Programs Office Scholars Program (Scholars Program)?
 - What about the program works?
 - What is the program lacking?
- **Expertise Model of Student Success**
- Since you've been at MSU, what kinds of challenges have you seen students having to overcome?
 - Possible Probe: Everyone faces challenges to success in transitioning from high school to college or differences between high school and college. Have you seen other students of color struggle with these transitions or differences? Has anything like that happened to the students you've encountered?
- What kind of information do you think students need to know in order to be successful in college?
- How has the Scholars Program helped students to deal with those kinds of challenges?
- How has the program helped students obtain information to overcome challenges in college?
- While working with the program, have you personally helped students overcome challenging circumstances? If so, can you provide an example(s)?
- **Sense of Belonging**
- Some students talk about knowing what it feels like to belong; they describe belonging as fitting in, feeling cared about, accepted, or valued by or important to a group.
- Did you help students feel a sense of belonging with you or in your classroom? If so, in what ways? (Possible Probe: What were the strategies and practices that you implemented in your classroom?)
- Do you think the program encouraged instructors to create a sense of belonging with students or in their classroom? If so, in what ways?
- **Science Identity**
- Some students talk about science identity as the attributes or characteristics that makeup a scientist/engineering or emerging scientist/engineer. Some of these attributes may include feeling competent, being able to perform in math/science settings, or being recognized as a scientist/engineer.
- Did you come across students who exhibited a strong science (or engineering) identity? If so, what was different about them in comparison to other students?
- Were there ways that you tried to help students reflect upon their (emerging) science identity? If so, in what ways?
- Do you think being a part of this program helps students to develop their science identity? If so, in what ways?

APPENDIX H: Participant Consent Form

You are being asked to participate in a doctoral research study conducted by Tonisha Lane. You were selected as a possible participant in this study because of your current or former involvement with a STEM Enrichment Program as a staff member, current student, or alum. The purpose of this study is to gain an understanding of factors that influence the retention of students of color who participate in a STEM Enrichment Program.

If you volunteer to participate in this research study, your involvement will take up to two hours of your time. This involvement will include focus group interview and, in some cases, a one-on-one interview. Current students will also be asked to complete additional surveys in which consent will be requested at the time of dissemination.

Know that there are no physical, emotional, social, legal, or other risks expected from participating in the research study. Your decision to take part in this study is voluntary, and you are under no obligation to answer any question that makes you feel uncomfortable. You are free to choose not to take part in this study. Your decision of whether or not to participate will in no way affect your relationship with Michigan State University as an employee, student, and/or alum. All information will be kept strictly confidential. Names will not be recorded or included in the study. Interview sessions will be audio taped to ensure accuracy. At the conclusion of the study, all audiotapes will be destroyed.

If you have any questions or concerns about this study, please feel free to contact Tonisha Lane at (313) 999-4316 or shanksto@msu.edu. If you have any additional questions or concerns regarding your rights as a study participant, or are dissatisfied at any time with any aspect of this study, you may contact - anonymously, if you wish –Dr. Kristen Renn, Professor in Educational Administration, Erickson Hall 620 Farm Lane Room 425 East Lansing, MI 48824: 517-353-5979 or renn@msu.edu.

You may withdraw your consent at any time and discontinue participation without penalty. I will give you a copy of this form.

Your signature indicates that you have decided to take part in this study and you have read the information above.

Signature of participant

Date

REFERENCES

REFERENCES

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