

THE SUCCESS OF AFRICAN AMERICAN STEM MAJORS AT HBCUs

BY

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DISSERTATION

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## ABSTRACT

According to the Obama Administration, we need a workforce that is going to be STEM ready because this is the only way that the U.S. will be able to compete on a global level with other nations. However, in order for students to be successful in a major in STEM, they need a supportive environment, smaller class sizes, faculty encouragement and support, tutoring services, peer support and accessibility of office hours (Perna, 2009). Students that attend HBCUs reported that professors at HBCUs go out their way to work directly with STEM students in and outside the classroom (Fries-Bitt, Younger & Hall, 2010). However, African Americans that attend HBCUs graduate in STEM majors at a higher rate than their counterparts at PWIs and are more likely to pursue graduate study.

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## CHAPTER 1

### INTRODUCTION

According to the Obama Administration, the U.S. needs a workforce that is going to be STEM ready because this is the only way that the U.S. will be able to compete on a global level with other nations (U.S. Commission on Civil Rights, 2010). The Bureau of Labor (2011) has reported that there will be more jobs within the next ten years in Science, Technology, Engineering and Math (STEM). According to the U.S. Department of Commerce report of 2011, students that major and graduate in STEM fields are said to earn 26 percent more than their counterparts in non-STEM fields. The major and occupation one chooses can have a significant impact on the amount of money one makes in a lifetime. According to the U.S. Census Bureau (2012) someone who majors in computer science, engineering, science, math, business, physical science or a social science earns more over their lifetime (2.9 million) than someone who majors in liberal arts (2.1 million). The U.S. Census Bureau goes on to state that majors in engineering can be expected to earn 3.5 million in a work lifetime. Managers in engineering can make 4.1 million while service workers that work in jobs working with people such as at a fast food place can make about 1.4 million in a work lifetime. However, in order for students to be successful in a STEM major, they need a supportive environment, smaller class sizes, faculty encouragement and support, tutoring services, peer support and accessibility of faculty office hours (Perna, 2009).

According to the U.S. Commission on Civil Rights' report, *The Educational Effectiveness of Historically Black Colleges and Universities (2006)*, a HBCU is described as "one that existed before 1964 with a historic and contemporary mission of

educating blacks while being open to all” (p. 1). During the 1970s, Black students at HBCUs graduated college at higher rates compared to those who attended predominantly White Institutions (PWIs). African Americans attended HBCUs, which are located mainly in the South, because they wanted an education and due to segregation, Blacks were not welcomed at PWIs (NCES, 2013). Today there are 105 HBCUs located in 19 states; 49 are private and 51 are public (NCES, 2013). However, the number of Black students that attend a HBCU have decreased over time. The number decreased from 18% in 1976 to 9% in 2011 (NCES, 2013; United Negro College Fund, n.d.). The revenue HBCUs made in 2010-2011 was 8.5 billion (NCES, 2013). Of the 8.5 billion, 1.7 billion came from student tuition and fees (NCES, 2013).

### **Importance of HBCUs**

In the appendices, I have comprised the mission statements of each university that my participants attended. The mission statements are important for my study because many of the statements discussed having students that they would want to be contributors in society. Some of the statements also discussed community engagement. The mission statements give a description of the values and standards of a university that the university wants to uphold.

Education has been an important concept in the African American community. African Americans understood the importance of education because during slavery they held secret meetings, known as “stealin’ the meeting,” to teach each other how to read and write (Anderson, 1988, p.17). Education meant “liberation and freedom” to them (Anderson, 1988, p. 17). HBCUs were established in order for African Americans to gain access to higher education because they were not able to attend institutions with their

white counterparts (Anderson 1988; Hale, 2006). Private philanthropy was the only way these colleges were surviving in the South (Anderson, 1988, p. 239). The first HBCU, Cheyney University in Pennsylvania was founded in 1837 (Redd, 1998). Lincoln University in Pennsylvania was founded in 1854. Wilberforce University in Ohio was founded in 1856 (Redd, 1998). Cheyney, Lincoln and Wilberforce University were the first set of HBCUS founded before the Civil War. In 1865, Shaw University was the first HBCU to be founded in the South after the Civil War. More colleges were established after the Civil War under the Freedmen's Bureau (Redd, 1998). The following universities were established under the Freedmen's Bureau, Howard University, Clark Atlanta University, St. Augustine's College, Fisk University, and Johnson C. Smith University. Churches also founded universities such as Tougaloo College, Dillard University and Talladega College. The Second Morrill Act of 1890 was established in order to establish land grant institutions for African Americans (Redd, 1998). After this Act was passed, there was the development of nineteen HBCUs (Redd, 1988). During this time HBCUs were providing African Americans with the basic skills they needed in order to survive (Anderson, 1988).

Today HBCUs continue to create educational opportunities for African Americans. However, several HBCUs are in jeopardy of closing due to low enrollment and financial reasons. For example, in 2013, Wilberforce University was in jeopardy of closing due to low enrollment and not having enough funding. Wilberforce was only granted 5 years of accreditation while most universities are granted accreditation for 10 years. St. Paul's College, a HBCU in Virginia closed in 2013. Morris Brown College in Georgia lost their accreditation in 2002 and also closed due to financial reasons. The

following HBCUs have closed due to financial reasons or natural disasters: Bishop College, Friendship College, Daniel Payne College, Mary Holmes College, Western University, Prentiss Institute, Mississippi Industrial College, Leland University, and Kittrell College. During 2014, enrollment has declined at Cheyney University, Texas Southern University, Lincoln University and Florida A&M (Rivard, 2014). Due to the budget cuts, these universities have experienced staff layoffs. North Carolina Central eliminated 55 jobs in 2014 (Rivard, 2014). South Carolina State University laid off 90 part-time employees in May 2014 (Rivard, 2014). Staff and instructor layoffs impact students because they will not get individual attention they need for their studies and also there would be larger class sizes. HBCUs are struggling to stay open and if this continues to be a trend then HBCUs will cease to exist. Since HBCUs produce the most Black STEM majors, the loss of these institutions would have significant implications for the number of Blacks in STEM fields.

### **Purpose of Study**

The purpose of this study is to examine the supportive factors unique to HBCU college contexts that contribute to the success of African American students in a STEM major. The supportive factors are necessary to identify because HBCUs are effective producers of African Americans in STEM majors. Studies have focused on the success of students at same sex HBCU institutions but not at co-ed HBCU institutions (Perna, Lundy-Wagner, Drezner, Gasman, Yoon, Bose, & Gary, 2009) HBCUs tend to have fewer resources resulting in less well-equipped physical facilities and lower faculty salaries compared to PWIs with more resources. It is imperative to understand the support at the HBCU for students because this appears to have an impact on the increase in the



amount of students that have graduated from HBCUs that majored in STEM fields.

### **Significance of the study**

Addressing the research questions will make a contribution to science, technology, engineering and math (STEM) because it will contribute to our understanding of how to recruit and retain more African American students in STEM fields. It will also show the support that African American students need in order to be successful while they pursue their STEM degree. Furthermore, studying successful African American students that have matriculated at a HBCU will shed light on how to create an environment that is conducive to helping African American students at other institutions become successful while matriculating through a STEM major.

### **Research Question**

The following research question will be addressed:

What do African Americans perceive to be the supportive aspects in pursuing their STEM degrees at a HBCU?

Qualitative research, specifically a phenomenological approach will be utilized to answer this research question. Creswell (2014) defined phenomenological research as “the process in which the researcher identifies the essence of human experiences concerning a phenomenon as described by participants in the study” (p. 121). In this study, the phenomenon of interest is the successful matriculation of these students at HBCUs. Understanding the experiences of African American STEM students that attended a HBCU is important because it will contribute to the literature related to improving the access and retention of African American students in STEM disciplines. Being able to study individuals’ lived experiences as demonstrated in phenomenological research will make a contribution to understanding the meaning of how these students

persisted and matriculated through a STEM major.

### **Cultural Capital Wealth**

Yosso's Cultural Capital Wealth (2005) discusses the capital students bring with them to their college environments. Cultural Capital Wealth has been used to discuss communities of color and how these students navigate through racism and injustice at PWIs. However, scholarly research has not used Cultural Capital to discuss the capital students of color gain at their respective HBCU institutions. It is significant for this research because students at HBCUs received cultural capital from their institution. Pierre Bourdieu (1977, 1986) describes cultural capital as something that can be turned into economic capital over time. Bourdieu posited that people with social capital include those that have gained in which they receive a benefit of formal and informal networks. An example of social capital is someone receiving a job due to someone they met through a friend. One can gain status and privilege through social capital (Bourdieu, 1977). According to Bourdieu, families play an intricate part in producing capital for their members (Bourdieu, 1977). This theory relates to this study because students at HBCUs experience a family environment on campus in which they share and produce capital amongst each other. Even though Cultural Capital Wealth research discusses minority students capital in white spaces, I discussed the capital African American students have gained from their HBCUs. Yosso (2005) looks at Cultural Capital Wealth through six forms of capital, which are aspirational, linguistic, familial, social, navigational and resistant.

Aspirational capital refers to “the ability to maintain hopes and dreams for the future, even in the face of real and perceived barriers” (Yosso, 2005, p. 77). Linguistic

capital “includes the intellectual and social skills attained through communication experiences in more than one language and/ or style” (Yosso, 2005, p. 78). Familial capital “engages a commitment to community well being and expands the concept of family to include a more broad understanding of kinship” (Yosso, 2005, p. 79). This form of familial capital can involve community settings or schools. Social capital is “the networks of people and community resources” (Yosso, 2005, p. 79). Navigational capital is “the skills of maneuvering through social institutions” (Yosso, 2005, p. 80). Resistant capital “refers the knowledge and skills fostered through oppositional behavior that challenges inequality” (Yosso, 2005, p. 80). Yosso’s Cultural Capital (2005) is necessary to understand because HBCUs have cultural capital that students gain while attending these institutions.

I utilized Yosso’s theory to explore how African Americans who attended and graduated from HBCUs and majored in STEM fields, successfully matriculated. I examined what role the support these students received played in helping these students persist in STEM majors. Using this perspective helped me to understand the success of African Americans who matriculated from co-ed HBCUs in a STEM major, providing a different perspective than their counterparts that have attended same sex institutions.

### **Conclusion/ Findings**

This study found the type of support African American STEM alumni received at a Historically Black College and University. This study demonstrated students needed many areas of support and resources in order to thrive in a STEM environment. Research questions were semi-structured interviews that discussed the success stories of African American STEM (Science, Technology, Engineering and Mathematics) majors. Themes

found throughout the interviews were reasons for attending a HBCU, feeling valued, faculty engagement, mentorship, peer support and parental support, STEM organizations and preparation in K-12 schooling. These were all factors that contributed to students becoming successful in a STEM major.

### **Definition of Terms**

The following terms are used throughout this document. The definitions are provided below.

**Minority-** Racial and ethnic minorities belonging to one of the following groups: Black or African American, Asian American, Latino or Hispanic Origin, American Indian and Alaska Native, Native Hawaiian and Other Pacific Islander.

**Underrepresented-** to represent in numbers that are disproportionately low. In this study, African Americans are the group that is underrepresented in STEM fields.

**Persistence-** “the progressive reenrollment in college, whether continuous from one term to the next or temporarily interrupted and then resumed” (Pascarella & Terenzini, 2005, p. 374).

**Educational Attainment-** defined as the number of years of schooling completed or degree completed

**Success-** is defined as having graduated from a HBCU in a STEM major.

**STEM-** Acronym for Science, Technology, Engineering and Math.

**HBCU-** Historically Black College and University

**PWI-** Predominantly White Institution

**Alumni-** Any student that graduated from a HBCU and pursued a STEM major.

### **Organization of the Dissertation**

Chapter one provides an overview of the problem, purpose/significance of the study, rationale, history of HBCUs, research questions and theoretical framework. Chapter two provides a literature review focusing on the History of HBCUs, HBCU environment, precollege requirements for a STEM major, persistence, retention, mentoring, academic integration, and preparation for African American students in college. Chapter three describes the proposed research methods and detailed timeline for the study. Chapter four describes the participants' profiles in this study. Chapter five describes the analysis and findings in this chapter. Chapter six describes the summary and the recommendations of this study.

## CHAPTER 2

### LITERATURE REVIEW

#### **Enrollment at HBCUs**

HBCUs play a pivotal role in graduating African Americans in higher education (Brown & Davis, 2001). The alumni at Historically Black Colleges and Universities play an important role in recruiting African American students to enroll at their institutions (Freeman, 1999). Owens, Shelton, Bloom & Kenyatta (2012) stated the following universities between 2001-2009 graduated the most African Americans in STEM disciplines compared to PWIs. Grambling University, Alabama State University and Florida A&M University graduated the most students in Computer Science. In Engineering, North Carolina A&T State University, Morgan State University and Florida A&M University graduated the most students in this field. In Engineering Technology, North Carolina A&T State University, South Carolina State University, and Prairie View A&M University graduated the most students in that area. In Biomedical Science, Xavier University of Louisiana, Howard University and Jackson State University graduated a large amount of students in this field. In the field of Mathematics/Statistics, Morehouse College, Spelman College, and South Carolina State University matriculated a significant amount of students in this major. In Physical Science, Xavier University of Louisiana, Florida A&M University, and Howard University graduated the most students in this field. These schools were the top 10 producing STEM programs for African American graduates from 2001-2009.

According to the U.S. Commission on Civil Rights (2010), HBCUs have poor physical facilities, faculty are offered less pay, and the university is given less money per

student with few resources. HBCU students tend to be less affluent than students attending PWIs and less academically prepared. However, HBCUs have smaller enrollments of students, “a lower student-faculty ratio, and higher-student faculty interactions” (USCCR, 2010, p.1). Additionally, students at an HBCU are more likely than African Americans at a PVI to engage in research with faculty.

Low-income African American students that attend HBCUs perform well despite being academically underprepared in K-12 education (Palmer & Gasman, 2008). Palmer & Gasman (2008) discuss the importance of social capital and how it helped eleven African American men persist and achieve success on a HBCU campus despite these students coming from economically disadvantaged backgrounds. This study demonstrated that students that formed relationships with faculty and administrators were able to receive support and were encouraged by them to “participate in student support services, campus organizations, internships and scholarship programs” (Palmer & Gasman, 2008, p. 58).

Mentorship was important to student retention and persistence at the HBCU (Palmer & Gasman, 2008). According to the same study, African American students’ peers played a role by helping them to persist and network socially or academically. These students expressed their peers were doing well academically which pushed them to persist and want to do well themselves. African American students at HBCUs also reported feeling “valued, challenged, supported and nourished” (Palmer & Gasman, 2008, p. 58).

### **Fostering Learning at HBCUs and PWIs**

Students that attend HBCUs are more likely to complete a bachelor’s degree than

their counterparts at PWIs (Pascarella & Terenzini, 2005). African American students that attend HBCUs believe they have been well prepared and report having high career aspirations compared to their counterparts at a PWI (Pascarella & Terenzini, 2005). Pascarella & Terenzini (2005) show that there is “evidence to suggest that student critical thinking, analytical competencies, and general intellectual development are enhanced by an environment that stresses close relationships and frequent interaction between faculty and students and faculty concern about student growth and development during college” (p. 206). African American students attending a HBCU have an educational attainment that is far ahead of their counterparts at a PWI (Pascarella & Terenzini, 2005).

HBCUs are shown to foster the learning of African Americans despite the institutional disparities in financial resources. According to a study that compared African American students at HBCUs and PWIs, African American students were able to “enroll in more hours, have higher expectations for completing a baccalaureate degree, were satisfied with their college experience, live on campus, receive encouragement from friends to continue their enrollment, have more positive relations with peers and faculty members, perceive faculty members as being concerned with students’ development and teaching, be more involved in campus clubs and organizations, and report more positive residence hall life experiences” (Terenzini, Yaeger, Bohr, Pascarella & Nora, 1997, p. 10). This same study reported African American students were less likely to transfer schools overall. Minority students that participate in research programs early are more likely to want to pursue a STEM major in college (Fakayode. 2014). Minority students’ involvement in research during their first or second year of college increases their likelihood of graduating in a STEM major (Fakayode, 2014). Minority students that



participated in a research program at Winston Salem State University, a HBCU, reported that they felt challenged, were more able to think critically and felt more confident in working on their own and in teams; additionally improvement was seen in their verbal and written communication, and they wanted to pursue research in their future (Fakayode, 2014).

Black students at PWIs often report experiencing isolation, alienation, and little support (Allen, 1992; Benton, 2001). Black students at HBCUs appear to have an easier time adjusting at HBCUS because they tend to have positive self-images, supportive environments and positive psychosocial development compared to their counterparts on PWI campuses (Allen, 1992; Fleming, 1984). Black men experienced less anxiety about interpersonal relationships and they felt greater acceptance at a HBCU than on a predominantly white campus (Allen, 1992). Black males also showed an increase in gaining more academically and wanting to compete academically compared to black males at PWIs (Allen, 1992). For black females, they chose their majors based on interaction with students and faculty (Allen, 1992). Negative racial experiences that occur for minority students as undergraduates can have a negative impact on their social and academic experiences and impact their degree completion (Chang, Sharkness, Hurtado, & Newman, 2014).

According to the Urban Institute report, “Capacity Building to Diversify STEM: Realizing Potential among HBCUs”, 34% of the African Americans enrolled in the program, Historically Black Colleges and Universities Undergraduate Program (HBCU-UP) received a graduate degree compared to 20.5% of African Americans nationally (2010). HBCU-UP had alumni from five sites for this study from Bennett College,

Hampton University, North Carolina A&T State University, and Tougaloo College. HBCU-UP helped fund in areas relating to “curriculum enhancement, professional development, undergraduate research, collaborations with other research institutions and other activities that meet institutional needs” ( 2010, p.12). HBCU-UP has been successful because universities that had this program for five years have experienced successful students in algebra, pre-calculus and calculus 1 which are gateway courses for students wanting to pursue STEM majors. Other courses that have shown improvements as demonstrated for STEM majors are biology 1 and physics 1. Twenty-five percent of these students have engaged in research projects while enrolled as undergraduates. These students were more likely to be fully employed in a STEM field after they graduated. This report also found that students that receive STEM degrees from a HBCU have a greater chance of pursuing a graduate degree in a STEM field. Students in this study reported that 50% of their faculty were African American. At PWIs, African Americans may comprise 5 to 6 percent of the faculty.

### **Support on HBCU campuses**

Preparation and support for African Americans to be successful in college is critical. Students need to receive support on campus from their peers, faculty and staff in order to succeed and persist in college (Harper & Quaye, 2009). African Americans need to have academic advisors that are able to support them. “Black students face challenges beyond academic preparation and ability that impact their chances to succeed at college” (Guiffrida, 2005, p. 99). An example is the cultural challenges students experience when they adapt to being on campus their freshmen year. One of the most important people that an African American student encounters on campus would be their advisor; one of the

people that are pivotal to helping that student acclimate to the campus (Guiffrida, 2005). Guiffrida's study demonstrates that a counselor in various academic programs on campus is necessary for an African American student to succeed.

Palmer, Davis and Thompson (2010) discuss the importance of administrators and STEM coordinators at a Mid Atlantic University on a HBCU campus and their relevance for creating programs that helped African American STEM majors succeed. They highlighted three programs. One program is the Pre-Accelerated Curriculum in Engineering program which helps admitted freshmen students with their math and critical thinking skills. This program helped students improve in these skills before they took the placement tests so they could place out of developmental mathematics. These students were provided support from peers and tutors. They were introduced to the engineering curriculum through undergraduate students and faculty and this helped students persist to graduation. Foundations of Mathematics, (FOM) another STEM program, also helped admitted freshmen develop their math skills online so they could score high enough where they placed out of developmental mathematics courses (Palmer, Davis & Thompson, 2010). A third program is called WebWork, which provided tutoring services to students online with difficult math courses such as pre-calculus and calculus. A fourth program is a program called Fast Track where juniors and seniors worked with freshmen providing assistance on how to succeed in a STEM major. Specifically these upperclassman students put on workshops for freshmen such as "Mastering Mathematics," "Making It In Engineering" and "Planning to Graduate" (Palmer, Davis & Thompson, 2010). Black students that have instructors that look like them are more able to persist in Science, Technology, Engineering and Math (Price, 2010).

## **College and STEM Readiness**

David Conley (2012) asserts a four part model that defines college readiness for high school students. The basic four dimensions are key cognitive strategies, key content knowledge, academic behaviors, and contextual and awareness skills. He believes all four intertwine at some point. When he discusses cognitive strategies, he is referring to strategies that “enable students to learn, understand, retain, use and apply content from a range of disciplines” (Conley, 2012, p.33). Key cognitive strategies also refer to ways students approach problems. Key content knowledge refers to having the basic skills from core subjects to apply in college. A student should be able to understand when they master a subject area and when they need help; the ability to reflect on improvement (Conley, 2012). “Contextual factors encompass primarily the privileged information necessary to understand how college operates as a system and culture” (Conley, 2012, p. 40). According to Conley, students should be able to understand what they need to apply to schools, how to complete FASFA forms, information on how to gain support services on campus and information about placement testing. Conley (2012) believes students that are economically well-off are more likely to have access to this information, compared to students from working-class families and first generation students.

According to the National Science Foundation, in order for a student to be considered STEM Ready, they need to have four years of math including geometry, algebra one and two, trigonometry, statistics, pre-calculus or calculus, three years of a laboratory science including chemistry, biology, physics and/ or earth science. A student should also have four years of English, two years of foreign language and three years of social studies including U.S. History, U.S. Government and/or world history or

geography and economics. In order for a student to be college ready, the student would need English, Mathematics, Reading and Science. Table 1 shows that, in 2012, 67% of high school graduates met the English College Readiness Benchmark, 52% in Reading, 46% in Mathematics, 31% in Science and 25% met all four benchmarks (ACT.org). This demonstrates that in 2012, 75% of the U.S. high school graduates did not meet the 4 benchmarks that would indicate readiness for college or a STEM major in college. Even though students may complete high school, they are still unable to gain access to a STEM major if they do not perform well academically.

**Table 1. Percent of 2012 High School Graduates That Met Benchmarks by Subject Area**

<b><u>Subject</u></b>	<b><u>Benchmark Percentage</u></b>
English	67%
Reading	52%
Mathematics	46%
Science	31%
All 4 subjects	25%

Source: ACT.org

Table 2 illustrates the striking differences between black and white students in meeting these subject area benchmarks. Thirty-six percent of African Americans met the benchmark in English, 22% in Reading, 15% in Mathematics, and 7% in Science (ACT.org). These statistics from the College & Career Readiness 2012 research from ACT.org demonstrate that African American students still lag behind compared to their white counterparts and there has not been significant improvements since the previous report in 2009. If students are not college ready then they are not prepared to major in a STEM major because students that are behind in science or math will have a hard time placing into courses they need for their STEM major. If they complete the prerequisite courses and gain access to a STEM major, this has implications for time-to-degree due to

the additional semesters needed. In order for students to be STEM ready they have to be college ready meeting the requirements in order to be successful in a STEM major from their precollege courses.

**Table 2. Percent of African American& White 2012 High School Graduates That Met Benchmarks by Subject Area**

<u>Ethnicity</u>	<u>Benchmark Percentage</u>	<u>Subject</u>
African American	36%	English
White	77%	
African American	22%	Reading
White	62%	
African American	15%	Mathematics
White	54%	
African American	7%	Science
White	38%	

Source: ACT.org

Math is a gatekeeper course that students need in order to be STEM ready (Business Higher-Education Forum, 2011). About one in six students were considered proficient in math and had an interest in wanting to pursue a STEM major (Business Higher-Education Forum, 2011). These were students that had taken the ACT exams in 8<sup>th</sup>, 10<sup>th</sup> and 12<sup>th</sup> grade (Business Higher-Education Forum, 2011). Fifteen percent of 12<sup>th</sup> graders were interested in pursuing a major in STEM but they were not proficient in math. Out of the 12<sup>th</sup> graders, women represented the majority (Business Higher-Education Forum, 2011). A report “Engage to Excel: Producing One Million Additional College Graduates With Degrees in Science, Technology, Engineering and Math,” (2012) found that students that score 22 or higher on the ACT are considered proficient in math and are shown to have success in college.

There are many reasons students pursue a major in STEM from high school.

Factors that contribute to a student choosing their career are concern and encouragement from someone, positive reinforcement and attitudes, expectations, interest and aspiration and role model influences (Atwater & Russell, 2005). The information a student receives from home can impact them in various ways during their undergraduate years. Atwater & Russell (2005) interviewed eleven participants and this study revealed the participants' family stressed the importance of education. One student discussed how doing homework was expected of them. These students shared how their parents impacted them pursuing a STEM major. One student said, "I guess growing up in my house my mom made a big thing out of what subject you were best in because she is an educator. So she was like, you know you are the science person. So I felt like, okay, I'm the science person. And ever since I was little I was always the one, you know how little kids are always like I want to be a fireman, or a lawyer? Well, I was always like I just want to be a doctor" (Atwater & Russell, 2005, p. 10). Another student discussed because their family was in the medical field, they found this field to be interesting by stating, "Well my science history extends from my family. My mother is a registered nurse and my sister is a registered nurse [laugh]. My whole family is basically in the medical field. I grew up with my mom coming home describing who died on the table and stuff that happened at work. And I am, like, it's exciting. I always grew up with that interest in science and especially in high school when we did dissecting. So that's basically my foundation and my interest in science" (Atwater & Russell, 2005, p.10).

Another student discussed their reason for pursuing a STEM major from experiencing their siblings pursuing a higher education by saying, "My oldest brother has a master's degree. My second oldest brother has a master's degree and a PhD. My third

oldest brother has a master's and is working on his PhD. My fourth oldest brother is currently completing his PhD. I'm finishing my undergraduate, and then I will go to get my master's, then to medical school. My sister is in junior college back home. So it's kind of like this is what we have to do. But they (my siblings) have all had the same desire to do well and strive well in life and school. Because they (my siblings) know that my parents sacrificed so much during their lives and they (my parents) omitted lots of things they probably wanted to do to see that we did well. And it's kind of a way of giving back to them" (Atwater & Russell, 2005, p. 10).

Another student explains how they decided on choosing their career. The student said, "My mother and grandmother all worked so hard to get me through middle school, so I decided to take a high-paying job. The first high-paying job that came to mind was a doctor or scientist. You could have a low-paying, middle-paying, or high-paying job, and one thing I always wanted to do was help my family" (Atwater & Russell, 2005, p.11).

Choosing a STEM major is influenced by one's high school courses in math and science, access to AP courses, SAT scores, gender, parent's level of education, occupation and income level (Melguizo & Wolniak, 2012). Minority students that attend Historically Black Colleges and Universities are more likely to major in STEM than minority students that attend Predominantly White Institutions (Trent, 2006).

Certain majors such as Math and Science are shown to facilitate job promotions for an employee such as an increase in pay. Math and Science majors are said to experience increased pay within the first four years compared to education majors in the workforce (Roksa & Levey, 2010). The U.S. Census Bureau reports that by 2050, Hispanics will comprise the majority of American citizens. This means that if we get



more minorities to pursue majors in STEM fields, then the U.S. will be able to compete with other countries on a global level. Minorities are said to offer a solution to meeting the demands of a global economy if they choose to major in STEM fields (Melguizo & Wolniak, 2012). Bachelor's degree earning can increase 25% to 35% based on the graduate's major. (Terrenzini & Pascarella, 2005). According to U.S. News & World Report article entitled, "STEM Education is the Key to the U.S.'s Economic Future," the Manufacturing Institute and Deloitte center cannot find people for 600,000 STEM-related jobs that are currently unfilled. Students that major in STEM would be able to fill jobs as these majors are among the highest in demand.

The 2011 ASHE report, "Factors that Influence Success Among Racial and Ethnic Minority College Students in the STEM Circuit," states that predictors for successful minority STEM students are economic factors, institutional type, campus environments, interactions with institutional agents, psychological factors, and STEM-specific opportunity and support programs (p. 53). This report shows that summer research programs help to push minorities to pursue STEM majors. The "economic influences" are the affordability of college, financial aid and the part-time job a student may have working on campus. The "institutional type" refers to minority-serving institutions because they provide minority students with supportive environments. The "campus environments" are climate and culture of STEM departments in addition the role both play in the lives of their students on campus. "Interactions with institutional agents" refers to the influence of faculty members, peers and academic advisors that help minority students navigate campus. The "psychological factors" are how one perceives one's self and the ability to establish one's goal. "STEM-specific opportunity and support

programs” refers to undergraduate research programs and support from STEM faculty and peers. These are all considered to be predictors of success for minority students in STEM fields.

### **African American Students in STEM Majors**

According to the National Science Foundation in 2006, 34 percent of African American college freshmen were interested in pursuing majors in STEM compared to 29.5% of White Freshmen. In 2002, 40% of Historically Black Colleges and Universities produced the majority of STEM majors for African American students. In 2004, there was an increase in the amount of African Americans that graduated with a computer science and engineering degree (NSF, 2007). Morehouse College and Spellman College were shown to produce the highest number of math majors.

Only 17% of scientists and engineers that have these jobs are African Americans (NSF, 2000). Small groups of Africans Americans become scientists, mathematicians, and engineers. If African Americans are going to pursue a degree in Math, Science, Technology, Engineering then they need to have the courses from High School in order to persist. The courses that African American students take or don’t take can negatively impact the degree they choose to pursue in college. African Americans disproportionately lack access to AP courses in math and science in high school. When students are able to take AP courses where they are able to gain the content knowledge and cultivate their academic self-efficacy in these subjects, they are more likely to pursue a degree in that major.

From 2006-2010 nine HBCUs produced the largest amount of STEM doctorate recipients (NSF, 2014). In 2010, HBCUs produced 33% of bachelor’s degrees in

mathematics and 37% of bachelor's degrees in the physical sciences (Gasman & Nguyen, 2014). According to the 2014 report by The American Institute of Research by Rachel Upton & Courtney Tanenbaum, "The Role of Historically Black Colleges and Universities as Pathway Providers: Institutional Pathways to the STEM PhD Among Black Students," provides insight that Blacks that earned degrees between 2005 and 2010, more than a third earned their undergraduate STEM degree from a HBCU, and 12% earned their doctoral degrees at a HBCU. The following HBCUs were the top ten producers of STEM PhDs from Black students according to the same report, Howard University, Meharry Medical College, Florida A&M University, Alabama A&M University, Morgan State University, Clark Atlanta University, Jackson State University, North Carolina A&T University, Morehouse School of Medicine and Tennessee State University. The same report concluded that Morgan State University and North Carolina A&T University produced the most PhD recipients in engineering while Howard University, Meharry Medical College, Florida A &M University and Alabama A&M University produced the most STEM PhD recipients across many STEM disciplines.

Today more women are enrolled in college compared to men (NSF, 2006). However, the amount of women that are in STEM majors lag behind their male counterparts. Research has shown that some African American women show interest in science during high school. Women's experiences in STEM education vary by race. (NSF, 2000). African Americans are shown to have a more positive attitude about science than any other racial group (Hanson, 2006). African American girls are shown to be more positive about pursuing a degree in science than their white counterparts (Hanson, 2006). African American women express an intention more than other groups

to enter the field of mathematics (Hanson, 2006). African American women experience racism and sexism when pursuing a major in the sciences. Many times African American students are unaware of the contributions of other African Americans in the sciences and not having an African American mentor or teacher to encourage one also creates a barrier (Hanson, 2006). Many universities that encourage an African American scientist are usually Historically Black Colleges and Universities but not Predominantly White Institutions (Hanson, 2006).

Women appear to earn more degrees in chemistry, biological, agricultural and social sciences (NSF, 2012). However, women continue to enroll at lower rates than men in engineering, computer sciences, physical sciences and economics (NSF, 2012). In the fall of 2009, women accounted for half of 611,600 science and engineering bachelor degrees that were conferred (NSF, 2012). In 2009, the U.S. conferred 41,000 science and engineering doctorates (NSF, 2012). In the workforce, women tend to have different occupations than their male counterparts that majored in the same field (NSF, 2012). Women with degrees in science and engineering are employed in fields at the following percentages, social sciences at 53%, biological and medical sciences at 51% while engineering is at 13% and computer and mathematical sciences at 26% (NSF, 2012). This demonstrates that women continue to be underrepresented in the science and engineering occupations even though they have the same credentials as their male counterparts.

Harper, Carini, Bridges & Hayek (2004), surveyed 1,167 undergraduate African Americans at 12 HBCUs about their engagement on campus. This study found that women reported academics being more rigorous than the men. This same study found

men reported having more interaction with faculty members than women. Fleming (1984) also reported a similar pattern; male students had more interaction with faculty members.

HBCUs play a big role in fostering women to enter careers in Science, Technology, Engineering and Math (Solorzano, 1995). This study looked at the origins of bachelor degrees from African American doctorates in science and engineering.

Solorzano (1995) found that Howard University produced the most African American females that went on to produce doctorates in science and engineering between 1980 and 1990. Borum & Walker (2012) interviewed twelve African American women that accounted for their undergraduate and graduate experiences in the fields of mathematics. Seven of the twelve women attended an HBCU. They discussed their success being due to the support they received from their peers and faculty. One key factor was they were encouraged to pursue doctoral study in mathematics. Other key factors at HBCUs that helped the women become successful were programs that were offered prior to them entering the first year of college, which helped one to transition from high school to college. In addition, some of the women at HBCUs participated in undergraduate research programs, which helped one of them to continue and decide to pursue a major in mathematics. This study discussed the experiences of African American women that attended HBCUs compared to their counterparts at PWIs during undergrad. These women also discussed their graduate school experiences. Women that attended the PWI discussed how they were the only ones in their classrooms. They felt during study sessions they had to prove their intelligence to their peers. One woman discussed how professors were surprised she was in their course and one professor would check the attendance to make sure all the correct students were in her class. Another student noted how a male

professor told her to choose another major but she later on realized that he was sexist and wanted to keep the field male dominated. The women that attended HBCUs discussed having supportive mentors and also supportive peers that they studied with in groups.

The Chronicle of Higher Education Article entitled “STEM stories” tells the stories of four successful black men that graduated with a PhD in a STEM field. One of the men, Karl A. Walker attended Morehouse College and said, “Going to an HBCU was affirming. Seeing all the black doctors and professors was motivating.” This same student discussed his experience going from a HBCU to a PWI and discussed the challenges he experienced. He stated “I had people in my corner, but I did see how the cultural differences made an impact. People who culturally identify with the professors had a better time and better recommendations. I didn’t have that support. In a lot of my classes, I was the only black male. In my program most people were Asian. Asian professors picked up Asian students. White professors picked up White students” (p. 1).

Jelani Zarif, an African American male that majored in STEM discussed how at a young age in fourth grade when he learned about photosynthesis and physics he became interested in science. He specifically chose to go to Morehouse College. Another man interviewed, Juan E. Gilbert, said he liked to watch sci-fi movies when he was eight years old and this made him interested in science. He also talked about an African American professor who was the second person at his school to graduate with a PhD in Computer Science. This professor also recommended to him that he would make a great professor one day. He claimed his program was isolating and even though he received his PhD, he told himself that he would not bring in just one minority student to his lab but more than one so that student would never have to feel isolation like he did in his program. Another

male, Ryan Charles Hynd discussed how he became interested in math when he went to Community College. He had the opportunity to do the Berkeley EDGE program that recruits underrepresented students into STEM fields. He believed this program gave him a chance and helped him by, “introducing me to some professors, gave me pointers to the graduate school application process and it showed me that I had a chance to go to a top graduate school like Berkeley” (p. 1).

Jet (2011) conducted interviews with four African American males that graduated from HBCUs during their undergraduate education and pursued majors in mathematics. All four of these men were in graduate programs at PWIs. Their names were Antonio, Rico, Dedrick and Roger. Reflecting on his experience at an HBCU, Antonio revealed that he liked the small class size, his school felt like a brotherhood, everyone knew each other at the school and that he did not feel afraid asking for help from his peers in class. He revealed most of his professors were alumni of his university and the professors looked like him and provided help even when he was not enrolled in their course. He also tutored students and mentored children outside of the university. Rico attended the same university as Antonio. Rico shared that he had established a successful way to study and he believed his success was due to his math professors and his peers especially when he studied in groups with his peers. Dedrick revealed his reason for enrolling at a HBCU was due to watching the TV show “A Different World” (1987, Cosby). He also revealed that his cousin was pursuing the same major and professors provided individual help when he did not understand course material. In addition, he spoke up in class if he did not understand something. He also felt a greater connection to African American mathematics professors that looked like him. Roger attributed his success to working

with peers. At an HBCU, all four of these males experienced a positive racial climate, professors that prepared them and influenced them and a supportive environment, which helped them to be successful in their major.

### **Student Success Literature**

Because the aim of this research is to understand the experiences of HBCU students that graduated in STEM majors, I utilized several theories related to student retention, persistence and success. The following paragraphs will address theories of the success of students, peer involvement, peer interaction, faculty support and student involvement.

Students that are able to acclimate to their campus are more likely to persist. Students who drop out are those that did not adapt to their campus environment socially or academically (Tinto, 2007). Some students drop out because they lack time management skills, they are academically unprepared to handle the rigor of the program, they are unsure of what they want to major in during college, or they realize college is not for them (Daley, 2010). Some students do not have enough money in order to stay enrolled in school and others are not able to adjust from high school to college (Daley, 2010). When students receive social support from their peers, which can include studying together or sharing information amongst each other, they are more able to persist (Tinto, 2005). This is consistent with Yosso's idea of familial capital. Students that take part in social activities on campus or are involved in student groups are more likely to do well in school (Fisher, 2007.) Minority students at PWIs that are involved in extra-curricular activities are less likely to leave their university setting and drop out (Fisher, 2007).



Yosso's theory discusses the importance of "family" on campus. Familial capital can refer to one's peers. The support of peers has played a significant role in the success of African American students that have majored in STEM (Perna, Gasman, Gary, Lundy-Wagner, & Drezner, 2010; Perna, Lundy-Wagner, Drezner, Gasman, Yoon, Bose, & Gary, 2009; Palmer, Davis, & Maramba, 2011).

In the context of African Americans that have attended HBCUs, Tinto's theory has only been applied in the context that it needs to include the outside support systems such as family support and mentorship African Americans receive, in addition to including students of color (Palmer et. al, 2011). This theory has been applied to successful African Americans that have matriculated and attended PWIs.

Guffrida (2006) states many minority students have ties to the community outside of campus such as their cultural traditions or family that helps them to stay and persist in college. This supports Yosso's Cultural Capital Wealth model that states that students gain familial capital at their institutions. However, students also gain other types of support that contribute to them being successful at their undergraduate institutions.

Chickering & Gamson (1987) note that there are seven principles that contribute to the success of students in undergraduate education. These principles are (1) contact between students and faculty, (2) development of reciprocity and cooperation amongst students, (3) encourages active learning, (4) gives prompt feedback (5) emphasizes time on task, (6) communicates high expectations, (7) respects diverse talents and ways of learning (Chickering & Gamson, 1987, p. 3). Tinto & Pusser (2006) note that there are five areas that promote student success. These areas are (1) institutional commitment (2) institutional expectations (3) support (4) feedback (5) involvement or engagement.

Engagement is shown to be a main predictor of success (Tinto & Pusser, 2006).

Engagement is defined “as participation in educationally effective practices, both inside and outside the classroom, which leads to a range of measurable outcomes” (Harper & Quaye, 2009, p. 2). Students are able to persist when they are integrated into their community academically and socially (Tinto, 1993). Tinto (1993) states that when students are able to integrate socially and academically, they are more able to build strong ties to their university meaning a student feels more committed to being there. When students have strong ties to their university they are least likely to drop out (Tinto, 1993). When students drop out it is because they do not feel connected to the university and this can include faculty, their peers and the environment (Tinto, 2000). African American students at HBCUs feel more comfortable at their university inside and outside the classroom, which demonstrates that when they feel connected to their university, they are able to persist in a STEM major due to the support they receive.

Astin (1993) describes the importance of the peer groups as, “the single most potent source of influence on growth and development during the undergraduate years” (p. 3). Interaction with peers contributes to social self-confidence, leadership skills, and interpersonal skills (Reason, Terenzini & Domingo, 2006). Peer Interaction has shown to be critical to students achieving undergraduate success (Kallahan, 2009).

### **Peer Interaction**

Peer interaction influences students’ cognitive development, identity development, self-confidence, self-efficacy, and social and academic integration into the college environment (Pascarella & Terenzini, 2005). Peer interaction is shown to have an impact on students academically and socially (Massey, 2003). The theory of peer

influence states, “ academic aspirations and achievement are strongly shaped, especially in adolescence, by social pressures emanating from the people that students encounter in their schools and classrooms” (Coleman, 1961). Students usually seek out other students that are similar to them (Massey, 2003). Students with high academic aspirations usually seek out those with similar expectations for academic success; students with low academic aspirations usually seek out students with similar expectations for success (Massey, 2003). Social interaction amongst students helps to shape their learning experiences on campus (Kallahan, 2009).

### **Student Involvement**

Student involvement on campus is imperative (Harper & Quaye, 2009). Student involvement is the forming of one’s identity on campus, positive image about one’s self, and acclimation to campus (Harper & Quaye, 2009). Student interaction can be defined as “engagement with diverse peers in discussion and exchange of ideas and perceptions both inside and outside of the classroom” (Luo & Jamieson-Drake, 2009, p. 69). Harper & Quaye (2009) discussed that when students are part of organizations on campus, they are more likely to want to execute their responsibilities because other students depend on them. These same students are less likely to drop out of school than their peers that are not interested in joining organizations (Harper & Quaye, 2009). A qualitative study done by Guffrida (2003) with eighty-eight African Americans enrolled at PWIs demonstrated how student organizations have played a pivotal role in the lives of these students. These organizations supported students and helped with integration into PWIs (Guffrida, 2003). These organizations provided a network system for African Americans. Through networking, African Americans are able to receive the support they need through

establishing relationships with mentors. African American mentorship is important because it helps African American students to gain information and support needed from people that look like them if they could not find them through their campus environment. From black organizations, black students felt as though they were able to do community service activities and give back to the black community in addition to gaining support from these organizations (Guffrida, 2003). This would help students to feel more accomplished (Guffrida, 2003). Black student organizations provided them with “a place where they felt comfortable letting their guard down to dress, talk and socialize in ways that were comfortable and familiar without fear of perpetuating negative black stereotypes” (Guffrida, 2003, p.309). The results showed that each organization the students discussed helped them to socially integrate into the predominantly white university. Students discussed feeling a cultural connection and a sense of identity from being in these organizations. These organizations were academic honor groups, political organizations, student government, Greek societies and religious groups (Guffrida, 2003). These groups helped students to connect with faculty, community service activities and allowed them to feel comfortable around people like them.

Students at HBCUs describe their university being supportive and caring (Palmer & Gasman, 2008). A positive environment between professors and students is good because for African Americans it can be a predictor of student success (Benton, 2001). Many black students look for other black students in hopes of avoiding experiences of isolation (Benton, 2001). Students also establish social networks within organizations such as black student unions or historically black fraternities and sororities. Family support, encouragement from teachers, motivation and perseverance are key factors that

help students succeed that pursue to major in science fields (Chang et al., 2011). Students that attend HBCUs feel activities they would like to engage in align more along their interests than at a PWI (Fries-Bitt & Turner, 2002). Students that attend HBCUs feel like they are with family and experience high levels of confidence due to positive faculty and peer interactions (Fries-Bitt & Turner, 2002). Students that participate in summer research programs are able to persist more and are able to figure out their career or graduate plans (Chang et al, 2011).

Overall, in order for African American students to persist and retain in STEM majors, they need supportive faculty, administrators and support from their peers. Colleges can improve the persistence of minorities in STEM majors by having students study with their peers, participate in academic research and participate in clubs/organizations (Chang, Sharkness, Hurtado & Newman, 2014).

### **Summary**

Chapter 2 provided the history behind the enrollment of HBCUs, fostering learning at HBCU's and PWI's, support on HBCU campuses, college and STEM readiness, African American Students in STEM majors and the conceptual framework. Chapter 3 will provide the research methods for this study.

## CHAPTER 3

### RESEARCH DESIGN AND METHODOLOGY

#### **Organization of Chapter 3**

Chapter 3 will describe the research design, research question, participants, data collection, limitations and data analysis.

Previous research has focused on quantitative methods to examine undergraduate minorities in STEM and their success at Predominantly White Institutions (Chang, Cema, Han & Saenz, 2008; Cole & Espinoza, 2008). Previous qualitative research has been done to study the success of African American students in STEM through case studies and interviews with students that attended all female or all male HBCU institutions. The present qualitative research will focus on studying African American alumni that have attended co-ed and single gender HBCU institutions that majored in STEM and were successful. Previous research has focused on the inadequacies of African American students and their lack of preparation courses that they need to become STEM ready as shown in the white house report “Federal Science, Technology, Engineering and Mathematics (STEM) Education Five Year Strategic Plan” (Whitehouse, 2013). According to [successfulstemeducation.org](http://successfulstemeducation.org) article, “Preparing Students for College and Careers in STEM,” “the majority of U.S. students particularly low-income and minority youth lack foundational skills and knowledge in science, technology, engineering and mathematics” (National Research Council, 2013, p.1).

This qualitative study of successful African American STEM major alumni suggests that there is “something special” about the HBCU college context that has helped these alumni become successful. Many of the participants had different reasons

for deciding to attend a HBCU. However, they all discuss their experiences in a positive manner. I will also discuss their reason for pursuing a STEM major and deciding to attend a HBCU. Member checking was done by emailing students their responses to questions from the interview. I used Miles, Huberman & Saldana's (2014) analysis method of "(1) data condensation, (2) data display and (3) conclusion drawing/verification" (p. 12). First, I analyzed the data by doing a transcription of the interviews. Second, I carefully read the transcript to better understand the information that was being discussed. The data were aggregated into subthemes and interconnecting themes and codes were developed.

### **Research Design**

The design for this study is qualitative, specifically, a phenomenological approach. Creswell (2014) defined phenomenological research as "the process in which the researcher identifies the essence of human experiences concerning a phenomenon as described by participants in the study" (p. 121). In this study, the phenomenon of interest is the successful matriculation of African American students in STEM majors at HBCUs. Successful matriculation is defined as those students that graduated from a HBCU with their baccalaureate degree.

In this research, I described the phenomenon of alumni that attended a HBCU and majored in STEM and successfully graduated. This is a phenomenon because HBCUs produce the largest number of Black STEM graduates at the undergraduate level. This phenomenon would be useful if applied to helping Predominantly White Institutions graduate more minorities in STEM. In qualitative research, "the researcher keeps a focus on learning the meaning that the participants hold. This involves reporting multiple

perspectives identifying the many factors involved in a situation, and generally sketching the larger pictures that emerges” (Creswell, 2014, p. 186).

## **Ethics**

This study was approved by the University of Illinois at Urbana-Champaign Institutional Review Board. The approval letter is in the appendices. All participants reviewed and signed the Informed Consent form (Appendix C) before proceeding with the interview. Pseudonyms were used to obscure their identity.

## **Research Question**

The following question was be addressed:

What do African American students perceive to be the supportive aspects in pursuing their STEM degrees at an HBCU?

The research question relates to the theoretical framework on cultural capital wealth because the support the students received were from their HBCU campus. HBCUs created a supportive family environment and also peers played an intricate role in helping students at these universities succeed.

## **Participants**

Participants were bachelor’s degree alumni recruited from the Historically Black Colleges and Universities. My goal was to interview at least 10 participants. I chose ten participants because I thought that would be a good amount of people to interview. I sent out my recruitment script to a past student that I knew attended a HBCU and is currently pursuing doctoral study at a PWI. That student passed my recruitment script along to other past HBCU alumni in STEM fields through different channels of students that are part of National STEM organizations. After I was able to interview one person, that same



participant would pass my information along to someone else they knew that attended a HBCU and also was pursuing STEM in a graduate program. The criteria for participation was: (1) self-identification as African-American (2) Completing a Bachelor's in Science, Technology, Engineering and Math at an HBCU (3) Currently be enrolled as a graduate student. Snowball sampling was used to identify participants. Snowball sampling is a research technique used to identify participants that will assist the researcher in recruiting other participants for the study. Snowball sampling can be “emergent and interactional” and can also contribute “an invaluable type of knowledge” (Noy, 2008, p. 327). Snowball sampling was beneficial in this case because alumni were able to refer other alumni that have majored in STEM.

In order to recruit potential participants, I contacted graduate student colleagues about my research study and explained the participant criteria. Several individuals displayed interest in participating. Based on those conversations, the following recruitment procedure was proposed. A graduate student colleague informed me of a HBCU-to-PWI program for HBCU alumni. Contact with members of this program provided me with access to several potential participants and began the snowball sampling process. Participants from this program provided me access to their friends that attended other universities and majored in STEM.

### **Data Collection**

The data collection consisted of semi-structured interviews. The interview questions were developed based on the research question, previous research and the theoretical framework. The interview protocol is in Appendix D. I utilized these sources to develop the interview protocol by reviewing previous research. This allowed me to

understand the supportive aspects or factors that African American students at a HBCU received while majoring in STEM. The participants were interviewed on Skype and on the phone. This caused the interview to be interactional and interviewing helped bring knowledge that would not have been able to be found if a survey had taken place.

Interviews took place over the phone. The duration of the interviews were approximately 1.5 to 2 hours. Each interview was digitally recorded and kept in a password-protected file with access only by the researcher.

Creswell (2014) stated, “The researcher keeps a focus on learning the meaning that the participants hold” (p. 186). “At the root of in-depth interviewing is an interest in understanding the lived experience of other people and the meaning they make of that experience” (Seidman, 2006, p. 9). In my research, I understood the lived experiences of my participants and the meaning they derived in order to contribute to the body of literature about the success of minorities in STEM disciplines. The stories of participants are important (Seidman, 2006). As the interviewer, the stories of these past students are important because most of the literature discussed the inadequacies of these students but not the success of how they got to matriculate and be successful. “This involves reporting multiple perspectives identifying the many factors involved in a situation, and generally sketching the larger pictures that emerge” (Creswell, 2014, p. 186). “Interviewing is most consistent with people’s ability to make meaning through language” (Seidman, 2006, p. 14). “It is a way to gain insight into educational and other important social issues through understanding the experience of the individuals whose lives reflect those issues” (Seidman, 2006, p. 14). Hearing from participants, their understanding gave insight to

what can be done at other institutions in order to help continue the success of African Americans in STEM.

### **Limitations**

Limitations to generalizability for this study are presented here. First, participants did not attend the same HBCU so some of their experiences vary based on the institution they attended. The research population of African American HBCU graduates in STEM fields is relatively small. Study participation relied on who wanted to volunteer to be a part of this study. The participants received degrees in various STEM majors so their experiences reflected a range of fields within the STEM disciplines. Methodological limitations are alumni referred each other because I did not have full access to a group of potential participants. There were certain things participants would not remember due to the amount of years they are removed from their undergraduate institution. Additionally, since there are more men than women in STEM majors, my study had more men than women. Limitations for interviewing are that the questions are more open-ended while quantitative research the questions are more close-ended responses (Creswell, 2014). Limitations to snowball sampling are I had access to participants that could possibly be friends and might have the same conceptions or notions about questions I may ask while if I asked another person that was in a different major at the same school, that person might have a different perspective.

### **Data Analysis**

The data were analyzed using Miles, Huberman & Saldana's (2014) method of "(1) data condensation, (2) data display and (3) conclusion drawing/verification" (p. 12). First, the data was analyzed by doing a transcription of the interviews. Second, material

was scanned to simultaneously figure out the depth of information that was being discussed. The data were aggregated into subthemes and interconnecting themes (Creswell, 2013). In this case as described by Boyatzia (1998), “a theme is a pattern found in the information that at the minimum describes and organizes possible observations or at the maximum interprets aspects of the phenomenon” (p. vii). In this case, the phenomenon is the supportive aspects that contribute to African American students persisting and matriculating through a STEM major at a HBCU. Then, codes were developed through the emerging information collected from participants (p.199, Creswell, 2014). Last, an interpretation was made of the findings, that is also known as drawing a conclusion as referred to Miles, Huberman and Saldana (2014). The interpretation helped the researcher to make sense of the results (Lincoln & Guba, 1985). A “rich, thick description” of the participants’ major, support they received and the school they attended and reasons for pursuing a STEM major was reported because this helped in terms of learning more about the background of the participant. This information included the STEM major of the participant, the HBCU University the student attended, and a brief listing of the supportive aspects reported by each participant that contributed to their persistence and matriculation. Validity was facilitated through member checking. Each participant received an email of their transcription interview and was be able to check to see if there were any discrepancies from their comments from the interview questions.

### **Summary**

Chapter 3 provided the research methods for this study. Chapter 4 will provide the participants profiles.

## CHAPTER 4

### PARTICIPANT PROFILES

#### **Organization of Chapter 4**

Chapter 4 provides information regarding the participants' profiles. It will provide descriptive information on the HBCU institution the participant attended as well as their major field of study. The participants' names are pseudonyms to protect their identities but the college/ university is factual information.

Alvin attended North Carolina Central State University. He majored in biology and is currently pursuing a combined MD/Ph.D. program in neuroscience at a school in the Northeast. North Carolina Central State University offered him the most financial support and that is why he attended. When he was choosing an undergrad major, he was initially undeclared and later applied to the School of Music. Eventually, he changed to become a Biology major.

Brian attended Albany State. He majored in computer science. He is currently pursuing his doctorate in computer science at a university in the South. He chose to attend this HBCU because it was close to his home. He chose this major because he was interested in how things worked. He also enjoyed working with technology.

John attended Albany State. He majored in math. Originally, he applied as a Music major. However, the day before school was orientation for incoming Freshmen for all majors. During orientation at his school, when they called out the music majors he did not move but when the engineering majors were called, he moved and realized he needed to major in math since he was good at it. He received a full scholarship as a math major. John is currently pursuing a doctorate in Statistics at a university in the Midwest.

Lisa attended Howard University. She graduated with a degree in chemical engineering. She is currently pursuing a doctorate degree in chemical engineering at a school in the Midwest. Lisa decided to pursue a degree in engineering because she wanted a job where she would be stable and have support even during a recession. She decided to enroll at a HBCU because this is where she received the most comprehensive financial aid package.

Madison attended Albany State. She majored in mathematics. Currently, she is pursuing her doctorate in statistics at a school in the Southeastern region of the United States. Madison received the most money from this school so she chose to attend. She originally started as a computer science major but realized she did not like it and she knew she liked Math so when someone suggested to change to a Math major she made that decision.

Nathan attended Elizabeth City State University. He majored in Computer Science. He received a full scholarship to college. He attended a PWI in the southern region. He realized in high school he was good with technology and wanted to major in that field. His parents also attended this HBCU.

Nick attended North Carolina Central State University. He majored in chemistry. He attends a PWI in the Northeast majoring in math pursuing a doctorate. His original major was music. However, his friends motivated him to pursue chemistry. His brother graduated from a HBCU and that was one of his reasons for attending a HBCU.

Paul attended North Carolina A&T State University. He graduated with a Bachelor of Science degree in mechanical engineering. He attended a PWI in the Midwest to pursue his Masters in mechanical engineering. He realized in high school he

wanted to pursue a degree in engineering after building a roller coaster for a class. His first two years of undergrad he received a partial scholarship. His last two years of undergrad he received a full scholarship.

Sharon attended Hampton University. She majored in physics. Sharon is currently pursuing a doctorate in applied physics at a university in the Midwest. Sharon's parents were very encouraging about her attending a HBCU because they did not have a good experience at a PWI. She only applied to HBCUs. Originally, she applied to Hampton as a journalism major but switched to chemical engineering after her mother told her she did well in math and science and could do writing on the side. However, after she switched, she went to a orientation session before school started and spoke with other women who were doing physics and they convinced her that she could do more with physics so she switched her major to physics.

Susan attended North Carolina A&T State University. She majored in biological engineering. She attended a PWI in the Midwest and received a Masters Degree in biological/agricultural Engineering. She realized she wanted to major in engineering when her mother would enroll her at a young age from middle through high school in math camps, science camps, and engineering camps. She knew she wanted to pursue an engineering degree from the 5<sup>th</sup> grade.

Tyler attended Morehouse College and majored in physics. He chose to go to Morehouse because they gave him a full scholarship. He currently attends a university in the West pursuing a doctorate in engineering and energy and resources. He chose to major in engineering because he was good in math and science. The way the world worked interested him and he was interested in "If-then statements."

Table 3 contains each participant's pseudonym, gender, undergraduate and graduate major, and the institution where they earned their bachelor's degree.

**Table 3. Participants' Pseudonym, Gender, Undergraduate Major and Graduate Major, Institution Attended**

Pseudonym	Gender	Undergraduate major	Graduate major	HBCU Attended
Alvin	Male	Biology	Neuroscience	North Carolina Central State University
Brian	Male	Computer Science	Computer Science	Albany State
John	Male	Mathematics	Statistics	Albany State
Lisa	Female	Chemical Engineering	Chemical Engineering	Howard University
Madison	Female	Mathematics	Statistics	Albany State
Nathan	Male	Computer Science	Computer Science	Elizabeth City State University
Nick	Male	Chemistry	Mathematics	North Carolina Central State University
Paul	Male	Mechanical Engineering	Mechanical Engineering	North Carolina A&T State University
Sharon	Female	Physics	Applied Physics	Hampton University
Susan	Female	Biological Engineering	Biological/Agricultural Engineering	North Carolina A&T State University
Tyler	Male	Physics	Engineering and Energy and Resources	Morehouse College

Each of the participants indicated that they had been involved in one or more STEM organizations during their undergraduate enrollment at an HBCU. Table 4 contains a list of these organizations for each participant.



**Table 4. Participants' Pseudonym and STEM Organization Affiliation(s)**

<u>Pseudonym</u>	<u>STEM Organizations</u>
Alvin	Marc Program
Brian	National Science Black Engineers, Honors Society
John	Louis Stoke Alliance for minority participation
Lisa	Engineering Honors Society, Tau Beta Pi
Madison	Florida, Georgia Alliance for Minority Participation
Nathan	Computer Science Club
Nick	American Chemical Society
Paul	National Society of Black Engineers, American Society of Mechanical Engineers
Sharon	Society for Black Physicists
Susan	Biological and Engineering Society
Tyler	John Hopps Research Scholars Program

Table 3 contains the HBCUs the participants attended. It is important to note the HBCUs each student attended because each HBCU is unique offering students different expectations as shown in the mission statements in Appendix A. Table 3 also displays the students' gender and their majors at their undergraduate and graduate institutions. Table 4 shows the organizations these students were a part of during their undergraduate experience, which is significant to students persisting and succeeding academically on campus (Harper & Quaye 2009). Students discussed how being a part of organizations helped them to relax when they felt overwhelmed with their studies and it also provided them a platform for resources from their peers. The phenomenon I was seeking to understand was the supportive aspects that contributed to these students being successful and matriculating through a STEM major. In this study, I defined success as those students that were able to graduate their 4-year institution at their respective HBCU.

It was discovered that all of the participants had taken at least one advanced course while in high school. It is significant to discuss the pre-college academic

preparation of the participants because they had access to gateway courses they needed to be a STEM major.

Susan tested into all high school honors math and science classes. She had Calculus in high school. She was in honors Chemistry and AP physics. Paul had taken Calculus 1 and chemistry/physics. He also took AP English, AP Economics (Macro and Micro). Nick had taken AP Chemistry and Calculus. Lisa had AP Calculus and AP Physics. Brian had taken up to Calculus 3. He had taken Chemistry and Biology. He also took AP Calculus. Madison had taken trigonometry. Alvin took up to Calculus. However, he had AP chemistry, biology and physics. Sharon took AP Biology and AP Calculus. John had AP Calculus. Nathan had Algebra 2 and Trigonometry. The highest science course he had was Chemistry. Tyler had AP Statistics, AP Calculus C/Multivariate and AP Biology. Nearly all the participants took part in an AP class. My participants believed the classes they took in high school prepared them for their undergrad major in college. They also believed their major in undergrad prepared them for graduate school.

All of the participants demonstrated tenacity and resilience in graduating in a STEM major. Each one experienced some form of obstacle that would hinder them from staying in their major but they persevered. These participants all had some form of support system that helped them to pursue their undergraduate degree and they all credit someone whether it is their advisor or peer on helping them to succeed and graduate. The institutions that they attended provided all participants with research or internship opportunities in order to expand their horizons in their field of study. Most participants explained that being able to have that opportunity was critical for them making the decision to stay in that major and realize they enjoyed being in their major. Even though

all the participants attended different institutions and have different majors, they all overcame obstacles and completed their degrees.

Family income was not asked in the interview. However, participants all chose their schools based on the amount of financial aid they received. The financial aid package was critical for participants when they chose their institution. Susan indicated that, “I had a full scholarship. It made it easier to go away from home.” Tyler said, “My parents sat me down and told me what schools were offering me. I received a full scholarship to Morehouse.” Based on the interviews, all of the participants except two were a first generation college student. Even though some of the participants knew early in life they were good at math and science, many had experiences in their K-12 setting where they had an interest in pursuing STEM while others made their decision to pursue STEM when they reached the collegiate level. Participants all took part in STEM organizations while they were in college. They all also decided to pursue graduate study at a PWI institution. All of them recognized their parent(s) for helping them to continue and play a role of being supportive in their major.

## **Summary**

Chapter 4 provided the participants’ profiles. Chapter 5 will provide the research findings.

## CHAPTER 5

### FINDINGS

#### **Organization of Chapter 5**

Chapter 5 will provide the analysis and findings in this chapter. This chapter will provide information the following major themes that emerged from the interviews:

- Reasons for attending a HBCU and pursuing a STEM major
- Feeling valued
- Faculty engagement
- Mentorship
- Peer Support
- Parental Support

#### **Reasons for Attending a HBCU and Pursuing a STEM Major**

Susan attended North Carolina A&T because her mom allowed her to pick one out of state school. She visited with her mom and at the time she played volleyball in high school and the coach at this school wanted her. She and her mom went to visit the school and she enjoyed the campus and people. She said, “ It seemed I would flourish here.” When she originally applied, she was admitted as a math major. However, she changed her major to biological engineering because when she was in her hometown, a counselor in an after school program let her know that they gave out money at that HBCU for students that they recruited for biological engineering. Susan knew she wanted to do STEM from an early age. Her mom had her in a lot of programs. She was in the Midwest pre-college STEM program from 4<sup>th</sup> to 10<sup>th</sup> grade. She also took part in a math

camp from 4<sup>th</sup> to 8<sup>th</sup> grade. She knew she was going to pursue a major in STEM from the fifth grade.

Paul also attended North Carolina A&T. He chose to attend a HBCU because he attended a high school where the majority of students were white and he experienced different levels of racism and prejudice. He decided to go to a college where he would not experience that. He went on a black college tour and at that point he knew he wanted to attend a black college. His mom found out about the tour from a former band director. Paul knew he wanted to pursue engineering. Paul knew he liked engineering because when he was young he used to put a go-kart back together. When he was 16, he had his first car and was interested in the automotive of it. His senior year of high school, he took an engineering class where he designed and built a rollercoaster. This confirmed he wanted to do mechanical engineering.

Nick attended a HBCU because his brother graduated from one. From elementary to high school he was in a predominantly white grade school and wanted to be around people that looked more like him. Originally when he applied to the school he wanted to be a Music major but his friends encouraged him he was too smart to be a music major and that he should pursue chemistry. Nick's high school teacher did experiments where things exploded in the classroom.

Lisa had Howard University listed as her safety school. She chose to attend because they gave her the most money for financial aid. Lisa believed the alumni had a good network and they are approachable. She decided to pursue a STEM major because she was good in math and science and she wanted something challenging.

Brian grew up near Albany State University. Since the university was close he thought he would attend. He enjoyed working with technology growing up. He was interested in how things worked. He knew he wanted to pursue a computer science major in undergrad.

Madison had no specific reason for attending a HBCU. She knew they had scholarships for students. Her father was deceased and she knew her mom could not send her by herself. She ended up going because she had received a scholarship and did not have to pay for school. She originally came into her program as a computer science major but she did not like it. However, she was good in math and decided to change to a Mathematics major.

Alvin decided to attend a HBCU because they offered him the most money. He applied to North Carolina Central State University as a biology major because there were incentives for that major. However, other schools he applied to, he chose to be a music or philosophy major.

Sharon, a second-generation college student, chose to attend an HBCU because her parents did not have a good experience at a PWI. They pushed her to attend a HBCU. She knew she wanted to go to a HBCU because she wanted to be in a band. She wanted the social aspects and academics as well. She wanted to be in a supportive environment where she knew race would not be a factor. She originally applied to Hampton University as a Journalism major but she switched to chemical engineering realizing she did well in math and science and could do writing in her spare time. However, when she went to orientation she spoke to some other students at a fair for freshmen and she decided to change her major to Physics after she was told about the many opportunities that would

be offered to her through this major. She also received a full scholarship from the department director to pursue that major.

John chose to attend a HBCU because he did not get early admission into Georgia Tech. When he did not get in, he decided he would be a band director or music teacher. However, when he attended orientation he decided that he wanted to be a mathematics major. He remembered being one of the top students in high school.

Nathan attended his HBCU because his parents were alumni of the university. He also received a full scholarship to cover his tuition.

Tyler chose a HBCU because he received a full scholarship to Morehouse. Morehouse allowed him to see high achieving black males scholars that was interested in his education which he was not used to seeing. He also wanted to be in the band.

Analysis of the interview transcripts revealed eight themes. Themes that arose were reasons for attending a HBCU, feeling valued, faculty engagement, mentorship, peer support and parental support, STEM organizations and preparation in K-12 schooling. These themes will be addressed individually and discussed how they all intertwine together.

The participants had similar experiences because they all received support from faculty and their peers. They all were involved in a STEM organization which helped to send them to conferences. All of the alumni discussed how their undergraduate departments were supportive providing summer research opportunities. Many of the students discussed how working with faculty and being able to contribute on research projects solidified their reason for wanting to pursue graduate study. They all discussed struggling in a course whether it was in undergrad or grad where they felt they would

become close to not passing a course. They all sought out the help they needed in order to persevere and continue in their program. Most of the participants attended a HBCU because they received the most aid from that institution.

The participants had different experiences in why they chose to attend a HBCU. Some students had previously known people that attended a HBCU and asked that person about their experience. One participant discussed how one of her parents had a bad experience at a PWI and told her child to attend a HBCU because the experience would be better. The participants had different K-12 schooling. Some participants were in Honor and AP classes in math and science. One participant discussed participating in a STEM program at an early age and realizing their interests in wanting to pursue a STEM major. Another student discussed building things in a class in high school and wanting to understand how things worked which helped him to choose to pursue a STEM major. Two of the participants were not originally STEM majors when they decided to enter college. It was during that first semester at school they decided they wanted to pursue STEM majors. They all experienced some form of struggle in graduate school. Many participants discussed how the environment was not like their HBCU where it felt like a family. Many of the students felt it was a competitive environment and they had to work independently.

### **Feeling Valued**

Students felt valued by the university and they felt like they were a family. All the interviewees in my study felt that their university created a family environment. The following quotes are from students that describe how the university felt like a family environment. This refers back to Yosso's (2005) piece on familial capital. The university



provided support for students from programs on campus geared toward helping students succeed, faculty support and peer support.

Nathan described his university feeling family oriented stating,

“That my department at Elizabeth City State University was family oriented. At a HBCU everyone looks like you and is striving for the same thing but at the PWI you become a minority.”

Susan described the pride saying,

“I liked the culture. It seemed I would flourish here. In my department, we help our community. It was positive to let us support each other and we will all get good jobs after we graduate.”

Nick said the school motto was, “You can get anywhere from here.”

Lisa stated,

“Howard had a nurturing environment. The student services would give you a hug when you walked in.”

Another participant, Alvin stated,

“One reason I was able to be successful even after graduating was because the Lab I worked at doing research, I was able to take advantage in an environment that was nurturing.”

Sharon said,

“The biggest thing that I got was the support that I was able to complete the program in physics. There was no question of the physics department trying to leave me out. From day one, it was assumed I would finish and get a degree in physics. The HBCU was very supportive”

Paul said,

“The supportive environment at a HBCU is at an all time high. Students help each other succeed. You do not see that at a PWI.”

The importance of having a family environment was something critical at HBCUs. HBCUs created environments for students where they felt connected to the campus community. One student compared his experience from a HBCU to a PWI describing how he felt more supported at the HBCU than at a PWI institution. A commonality between three students is the word nurture. HBCUs created nurturing environments where students were able to flourish.

## Faculty Engagement

Faculty engagement toward students is described as the way faculty and students interact. It was clear throughout the interviews that faculty played a tremendous role in the lives of the interviewees. Faculty helped students to understand the material, met with students outside of the classroom and lent the students a helping hand whenever they needed it.

Susan said,

“My first class was intro to engineering. It was taught by a professor in my major that was enthusiastic. His enthusiasm got me excited about engineering. I felt like teachers cared about me. He would email you if you were gone for three or four days. Faculty cared and were beneficial. Some were inspiring. I modeled myself after a professor that was a woman in civil engineering in my department. She was super involved and an advisor for many organizations. She was smart and had a family. She inspired me.”

Paul said,

“The teaching style from the first engineer class I had you could tell professors wanted you to succeed. They had no problems staying late while you asked questions. They want you to come to their office hours. They are constantly challenging you. There is a motivation from the professor that they want you to succeed. They encourage you to continue to do better and challenge yourself. It was like that throughout all four years of college. When you pass they commend you.”

Nick said,

“My first semester of doing organic chemistry, the professor knew I was good at chemistry but when I took his midterm I received a “C.” The professor asked me what happened and I said I was used to math in chemistry and your class does not have that. The professor decided to have tutoring sessions with me. The professor told me to ask questions and to not worry about classmates. I asked questions and I was fine. I regurgitated the information back to him and I was able to receive a “B” in the class. I also had a student/teacher relationship I never found anywhere else. I had the teacher’s cell phone number. I was able to tell my teacher my struggles.”

Lisa said,

“There was a nurturing environment and the teachers really cared about you. Many of the professors were passionate about what they were teaching. The person I worked with doing research was very supportive. I was able to get on a paper for undergrad so that was nice.”

Brian said,

“I had a professor offer to help. I had not had anyone go above and beyond for me.”

Madison said,

“This one professor would push me to do more. Professor pushed me to present my papers and travel to conferences. I had a professor help me with a grant they had for STEM.”

Alvin said,

“Professors helped me.”

Sharon said,

“A faculty member helped me in one of my upper level courses electromagnetism. My professor in that course was helpful in my overall success because of the rigor of the course.”

Nathan said,

“Faculty taught us the foundation of computer programming, taught us how to code right away.”

Tyler said,

“Faculty made themselves available for conversations. They were humans. They gave things that challenged us but made themselves available when we needed to rise to the challenge. They valued us as individuals. They did not deride us for what they saw as failings. They sought better ways to teach the information to us. They did not make us feel horrible.”

Nick said,

“Faculty is a major component to my success in the classroom. If they are about my education, I value their time more. Faculty pushed me above and beyond.”

Faculty played an intricate role in helping students succeed inside and outside the classroom. Students felt like faculty really cared about them. Faculty checked in with students if they were missing class. When students were struggling in their course, faculty came to the rescue to help students succeed in the classroom by providing resources to help them. Faculty at these HBCUs pushed students to go above and beyond. Students were able to gain experiences such as applying for a grant and students also felt challenged.

## **Mentorship**

Mentorship was critical and played an intricate role in students' success at these institutions. Students felt they had help on their campuses. It did not matter where on campus they went, students always felt like there was someone there to help. Many of the students felt as though their mentors are responsible for where they are today. Many of the students felt as though their mentors pushed them. One student discussed how her mentor was able to help her seek out research opportunities. Another student discussed how his mentor encouraged him to attend graduate school. Another student discussed how his mentors were motivation and at times when he did not believe in himself, his mentor believed that he could do anything. Mentors were significant because they relayed information to students that they might not have gotten anywhere else on campus.

Mentors provided information to students that helped many of these students to go on and pursue graduate programs. The following are quotes on how mentorship affected these students on campus.

One student, Tyler recalls when he attended Morehouse,

“Instilled in Morehouse is the necessity of building a formal and informal environment where mentorship is valued. It takes a village to raise a child. The John H. Hopps Defense Research Program reached out to me as soon as I was accepted. Mentorship is critical from HBCUs. There is an overall feeling that if you decide to be a part of it, you are not left behind. They will help you to define yourself. Everyone felt like they were your mentor. Certain people at Morehouse felt like they were your mother, when you needed certain things done at that time. It was important. The sentiment of everyone trying to help was there.”

Alvin said the following regarding his research mentor and coach,

“The main person who served as a mentor was the guy whose lab I worked in. He is the reason where I am today. He exposed me to certain opportunities. He got me to go to a few conferences. He told me I could do something big at other universities outside of North Central. He helped me to consider research as a career instead of just medicine. He introduced me to research as a way or career path. The director of summer programs which I participated in for two summers

helped me to decide what schools I should apply for and helped me with essays. My coach helped me with career things.”

Sharon said,

“The program chair became an instrumental mentor for me at Hampton. She received her Ph.D. in physics from Hampton University. She was helpful relaying opportunities to me. She did outreach programs where she traveled to DC and she took myself and another student for a conference during my junior and senior year. She opened opportunities for me. She showed me what its like to do physics outside an HBCU. The administrative assistant was great in relaying information about summer fellowships and fellowships in general. It was her goal to make sure a student had a placement every summer.”

Chris said,

“We had faculty members that was learning about the program and they motivated students to attend graduate school during their sophomore and junior year. There was a great motivation support system”

Nathan said,

“Throughout the scholarship program, I had one main advisor and each advisor helped us. I received a lot of support. Every summer we had an internship and during the year we did research projects that I could add to my resume and experience.”

Susan said,

“The faculty at A&T were only four people. I could go to their office at any time and ask them questions. The Dean of the College of Engineering offered to mentor me.”

Nick said,

“My main two advisors was my academic advisor. He had faith in me when I did not have faith in myself. He told me to not be afraid of high goals I would set for myself. He helped me attain my double major. I had a research mentor the summer before I started my Freshmen year. I worked in the lab when the teacher did not feel well and my mentor taught me it was ok to take a break.”

Madison said,

“My mentors genuinely cared about me because they wanted to know how I was doing as a person. They wanted me to do better. I felt like they were concerned about me doing well and to be a better person and to never give up. My mentor is the reason I am into the statistics program. I did not know about biostatistics prior to graduate school.”

The students' mentors really showed they cared about their students. The mentors wanted students to succeed. Students were motivated to do their best. The mentors were very accessible to all students. Students felt like they could rely on their mentors.

My interviewees received different forms of support. All of my participants received a scholarship to the HBCU of their choice. One participant received a partial scholarship their first two years and received a full scholarship his last two years. The interviewees had peer support, faculty support and parental support.

### **Peer Support**

Throughout the interview, peers were shown to play a major role in supporting students throughout their college experience. Each participant recalled a time they studied with their peers outside of their classroom setting.

Susan said,

“ I studied with peers. I would cook and study with peers. This was beneficial to me because it helped me. We would do work and then go out. It worked for me because I am a social person. A&T was supportive”

Paul said,

“I had a study group and they would hold you accountable doing your work and meeting up at a certain time. Studying with others had a profound impact on my undergrad career. When everyone works together, everyone understands.”

Madison said,

“ I did study with other students and it was good camaraderie. It was uplifting, you help me and I'll help you. We were all trying to make it.”

Alvin said,

“It was more engaging studying and it builds this sense that we are in this together and that we are going to accomplish something.”

Sharon said,

“Actually succeeding in class, you have to study with a group. Explaining in class how you tried to solve the problem was extremely helpful. Being able to talk out the problem and go to the board are important when you discuss with other people if they can go to the board and explain it.”

Chris said,

“Studying with others, built your confidence in what you are doing.”

Nathan said,

“ We needed each other to get through class. I could ask someone else if I did not understand. We had projects and not regular homework. On Fridays we spent time together doing our work. We had two major computer labs that we worked in that was up to date.”

Students felt like peer support was critical to their success in undergrad. Many of the students felt like working with their peers helped to hold them accountable. They felt like working with their peers helped to explain misconceptions that they had about the work. Working with their peers helped one to understand the concepts. It also helped students to be able to go to the board and explain the problem when they were in class. Many of the students contributed peer support for their reason for succeeding in their STEM field and graduating.

All of my interviewees had some kind of parental support from at least one parent or both parents. My participants stated their parents supported them emotionally and was their biggest support through the highs and lows of their program.

### **Parental Support**

Students felt like their parents were very supportive. Some of their parents provided emotional support. One student had a parent that sent care packages while another student’s parents listened to him before he had to do a presentation. Students felt as though their parents were important to their success.

Susan said,

“My mom was always supportive. She told me I would be an engineer. She raised me and went back to school. Usually they say with single parents you can’t go to school.”

Paul said,

“My parents supported me by sending care packages. They helped pay part of my

tuition.”

Nick said,

“My parents were my practice buddies. Whenever I had a talk, I would do it with them so I could talk in front of people without STEM backgrounds. My parents went to every conference while I was in undergrad.”

Lisa said,

“My father paid for my room and board in undergrad. My parents provided emotional support.”

Brian said,

“Neither of my parents did not have college degrees. My mom got one after. They supported me emotionally.”

Madison said,

“My mom was very supportive and encouraging. If she had money, she would give it to me. My mom’s sister was very supportive and she would help me get my FASFA done.”

All of the participants participated in some type of STEM activity that helped them progress professionally. All the participants took part in a summer research program that helped them to develop their research skills and confirm this is the major they wanted to do.

Many of the students experienced challenges as a STEM major such as failing a course. However, this did not deter them from staying in their major. Participants sought out help from faculty and peers and overcame this challenge. Many participants also sought out tutoring services. However, some students that did not need tutoring services became a tutor for other students. Even though some students did not seek tutoring services, all of the participants sought help from their peers in order to strive in being a STEM major. However, all of the students had experienced some form of Cultural Capital Wealth (2005) while at their institution.

### **Students’ Experiences through Cultural Capital Lens**



The six forms of cultural capital, Aspirational, Linguistic, Familial, Social, Navigational, and Resistant capital, are apparent throughout my research study. Referring back to aspirational capital, students were able to maintain their hopes and dreams when they felt like they were on the verge of failing a course. Despite feeling like all hope was gone at times, the participants were able to seek out the help they needed in order to overcome staying in their major and their classes required for graduation. The participants acknowledged there were hard times when they wondered if they were going to pass a class but they were able to stay positive and maintain hope that they would succeed. In reference to linguistic capital, throughout my interviews, participants recounted stories about the support they received throughout undergrad whether it was from their family, peers, faculty or organizations. Participants referred to their HBCUs creating a family environment. Participants referred to feeling like home while they attended their institutions. The university was considered their extended family. Social capital has played an intricate part in the lives of the participants. Participants discussed how their peers helped them with their homework assignments. Participants also noted that one could not do assignments alone and that it was necessary to work with their peers in order to gain a clearer understanding of assignments that were difficult. They also felt their peers were very uplifting when times were hard regarding doing assignments and also navigating through the university. Navigational capital is present in my study because participants were able to navigate through school by learning from their peers and faculty. Many students had departments that offered tutoring services for students that were struggling in their courses. In addition, departments offered summer opportunities for students to work with faculty on a research project in STEM fields. For

many participants that solidified one staying enrolled in their major. In my study, students at HBCUs used resistant capital by attending universities that did not have access to the same resources as African American students at PWIs.

### **Summary**

Chapter 5 provided the findings and analysis. Chapter 6 will provide the conclusion and recommendations.

## CHAPTER 6

### CONCLUSIONS AND RECOMMENDATIONS

#### **Organization of Chapter 6**

Chapter 6 provides a summary of this study. It also provides recommendations. The purpose of this study was to understand the support previous African American alumni STEM majors received at their Historically Black College and University during their undergraduate years. A qualitative approach was used as the methodology to answer research questions consisting of semi-structured interviews in order to discuss the success stories of African American STEM (Science, Technology, Engineering, and Mathematics) majors. This chapter provides the conclusion and recommendations.

#### **Conclusion**

This study contributes to our understanding of the support these students receive at an HBCU institution. This study demonstrated students needed many areas of support and resources in order to thrive in a STEM environment. In order to be in a STEM major, we learn that it helps for one to have an interest from an early age but just because you do not pursue STEM early, it does not mean you do not have a chance of pursuing undergraduate study. However, there needs to be a solid foundation of math and science classes in one's K-12 schooling prior to undergrad in order to pursue the major. The success of STEM majors is important to the growth of the United States. Due to the shortage of STEM majors in the U.S. it is imperative that they invest in programs to promote the growth of STEM careers. According to the U.S. New Report of 2015 "STEM Workforce No More Diverse than 14 Years Ago" claimed that the STEM workforce is still not diverse in comparison to 2001.

### **Research Question addressed**

What do African American students perceive to be the supportive aspects in pursuing their STEM degrees at HBCUs?

This research question addresses the different types of support students received while they were enrolled in their undergraduate institutions. Agents of support in this context referred to peer support, parental support, faculty support, tutoring services, and different organizations students were involved in while they were enrolled on campus. Support could take part inside and outside of the classroom.

These interviews provided eight themes throughout the interviews. Themes that arose were a feeling valued, reasons for attending a HBCU and pursuing a STEM major, faculty engagement, mentorship, peer support, parental support, STEM organizations and preparation in K-12 schooling. Some students did mention that prayer played an integral part of them completing their studies.

### **Recommendations**

There are several recommendations going forward to further explore HBCUs and STEM majors.

1. Historically Black College and Universities are in need of support. These universities need to receive more funding because they receive the least amount of funding for support at their respective universities. HBCUs graduate the largest amount of African American STEM majors but receive the least amount of funding. More money should be put into HBCU STEM programs. One should compare the amount of money HBCUs receive per year for their STEM programs in comparison to PWIs that produce the least amount of minorities in STEM majors.

2. Future research should investigate the success of female and male STEM alumni from HBCUs in order to understand if there are unique differences amongst their college experiences regarding being a STEM major.
3. HBCU enrollments include students of many races and ethnicities. Investigating the experiences of other racial groups that attend HBCUs is also warranted.
4. Although not a focus of the current research, a study that pays particular attention to the students' socioeconomic background would prove enlightening.
5. Several of the participants recounted how they had struggled in a critical course at one point or another. In addition to the students' determination, resources were also in place to help these students improve and ultimately, be successful in the course. It is recommended that future research consider the ways in which STEM students leverage these resources to help them navigate 'weed out' courses and overcome potentially precarious academic situations.
7. This research reaffirms the importance of summer and after-school enrichment in STEM-related offerings for K-12 students. These early introductions to the gateway disciplines (e.g., mathematics, biology, chemistry, etc.) through informal and formal means were an important similarity in the participants' pre-college experiences.
8. The White House initiative, "Engage to Excel: Producing One Million Additional College Graduates With Degrees in Science, Technology, Engineering and Math," omits HBCU institutions. It is critical that HBCU be among the recipients.

The participants in this study have demonstrated that one does not need to originally be a STEM major to eventually complete a STEM degree. However, they have shown the importance of previous knowledge of math and science in order to pursue a

STEM major. The issue of HBCUs receiving less funding than other institutions demonstrates their needs to be a change in the way money is allocated toward institutions. All my participants received some form of funding which shows some of the benefits of majoring in STEM such as receiving a scholarship. There are many factors that contributed to one choosing a STEM major which could come from one's parents, an interest a student realized while attending K-12, someone telling them in college they would be good at the field. This demonstrated that encouraging a student to pursue a STEM major is something that can help a student make a decision on their next major.

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## APPENDIX A HBCU MISSION STATEMENTS

### **Albany State**

“The primary mission of Albany State University is to educate students to become outstanding contributors to society.”

### **Elizabeth City State University**

“Our mission is to promote economic, social, and environmental progress for the people of northeastern North Carolina, the state, and the nation.”

### **Hampton University**

“Hampton University is a comprehensive institution of higher education, dedicated to the promotion of learning, building of character and preparation of promising students for positions of leadership and service. Its curriculum emphasis is scientific and professional with a strong liberal arts under girding. In carrying out its mission, the University requires that everything that it does be of the highest quality.

A historically black institution, Hampton University is committed to multiculturalism. The University serves students from diverse national, cultural and economic backgrounds. From its beginnings to the present, the institution has enrolled students from five continents – North America, South America, Africa, Asia and Europe – and many countries including Gabon, Kenya, Ghana, Japan, China, Armenia, Great Britain and Russia, as well as the Hawaiian and Caribbean Islands and numerous American Indian nations. Placing its students at the center of its planning, the University provides a holistic educational environment. Learning is facilitated by a range of educational offerings, a rigorous curriculum, excellent teaching, professional experiences, multiple

leadership opportunities, and an emphasis on the development of character which values integrity, respect, decency, dignity, and responsibility.”

Research and public service are integral parts of Hampton's mission. In order to enhance scholarship and discovery, the faculty is engaged in writing, research, and grantsmanship. Faculty, staff and students provide leadership and service to the University as well as the global community.

In achieving its mission, Hampton University offers exemplary programs and opportunities which enable students, faculty and staff to grow, develop and contribute to our society in a productive and useful manner.”

### **Howard University**

“Howard University, a culturally diverse, comprehensive, research intensive and historically Black private university, provides an educational experience of exceptional quality at the undergraduate, graduate, and professional levels to students of high academic standing and potential, with particular emphasis upon educational opportunities for Black students. Moreover, the University is dedicated to attracting and sustaining a cadre of faculty who are, through their teaching, research and service, committed to the development of distinguished, historically aware, and compassionate graduates and to the discovery of solutions to human problems in the United States and throughout the world. With an abiding interest in both domestic and international affairs, the University is committed to continuing to produce leaders for America and the global community.”

### **Morehouse**

“Morehouse’s mission remains steadfast: to produce academically superior, morally conscious leaders for the conditions and issues of today, whether “today” is post-Civil War or turn of the new millennium.”

### **North Carolina A&T State University**

“North Carolina Agricultural and Technical State University is an 1890 land-grant doctoral research university dedicated to learning, discovery, and community engagement. The University provides a wide range of educational opportunities from bachelor’s to doctoral degrees in both traditional and online environments. With an emphasis on preeminence in STEM and a commitment to excellence in all its educational, research, and outreach programs, North Carolina A&T fosters a climate of economic competitiveness that prepares students for the global society.”

### **North Carolina Central State University**

“North Carolina Central University, with a strong tradition of teaching, research, and service, prepares students to become global leaders and practitioners who transform communities. Through a nationally recognized law school, highly acclaimed and innovative programs in the visual and performing arts, sciences, business, humanities, and education programs, NCCU students are engaged problem solvers. Located in the Research Triangle, the University advances research in the biotechnological, biomedical, informational, computational, behavioral, social and health sciences. Our students enhance the quality of life of citizens and the economic development of North Carolina, the nation, and the world.”

APPENDIX B  
IRB APPROVAL LETTER

June 17, 2014

William Trent  
Educational Policy Studies 351 Education Bldg  
1310 S Sixth St  
M/C 708

RE: The Success of African American Majors in STEM at a HBCU IRB Protocol Number: 14788

EXPIRATION DATE: 06/16/2017

Dear Dr. Trent:

Thank you for submitting the completed IRB application form for your project entitled The Success of African American Majors in STEM at a HBCU. Your project was assigned Institutional Review Board (IRB) Protocol Number 14788 and reviewed. It has been determined that the research activities described in this application meet the criteria for exemption at 45CFR46.101(b)(2).

This determination of exemption only applies to the research study as submitted. Please note that additional modifications to your project need to be submitted to the IRB for review and exemption determination or approval before the modifications are initiated.

We appreciate your conscientious adherence to the requirements of human subjects research. If you have any questions about the IRB process, or if you need assistance at any time, please feel free to contact me or the IRB Office, or visit our website at <http://www.irb.illinois.edu>.

Sincerely,

Rebecca Van Tine, MS  
Assistant Human Subjects Research Specialist, Institutional Review Board

c: Danielle Forbes

## APPENDIX C

### INFORMED CONSENT

**Title of Project:** The Success of African American STEM majors at a HBCU

**Responsible Principal Investigator:** William Trent, Ph.D.

**Other Investigator(s):** Danielle Forbes, Ed. M.

**Purpose of the Study:** The objective of this research is to understand the success of African American students that have matriculated through a STEM major.

**Procedures to be followed:** Each participant will be asked a series of semi-structured interview questions about their experiences while they attended a HBCU. Digital recording will be mandatory. Danielle Forbes will conduct the interviews.

**Discomforts and Risks:** There are no risks associated with this study.

**Benefits:** The significance of this research is it will make a contribution to science, technology, engineering and math (STEM) because it will contribute on how to recruit more students in STEM fields specifically African American students since they are underrepresented in STEM fields.

**Statement of Confidentiality:** Pseudonyms will be used for all participants during data collection. There will be no information that links participants directly to their university.

**Whom to contact:** RPI- Dr. William Trent at [w-trent@uiuc.edu](mailto:w-trent@uiuc.edu) or 217-333-6153. You may reach the PI-Danielle Forbes at [dforbes2@illinois.edu](mailto:dforbes2@illinois.edu) or 646-334-8792. If you have any questions about your rights as a participant in this study or any concerns or complaints, please contact the University of Illinois Institutional Review Board at 217-333-2670 (collect calls will be accepted if you identify yourself as a research participant) or via email at [irb@illinois.edu](mailto:irb@illinois.edu)."

**Compensation:** Each participant will receive \$15.00 for their participation in this study. A check will be mailed to them at their address.

**Cost of participating:** There will be no costs associated to participants.

**Voluntariness:** Pseudonyms will be used for all participants during data collection. You may withdraw from this study at any time if you feel uncomfortable or do not want to be interviewed. Your decision to withdraw will not have any effect on your relationship with your university.

**Dissemination:** The results will be disseminated for a dissertation and possible conference presentations and journal articles.



- I am 18 years of age or older. (when appropriate)
- I have read and understand the above consent form and voluntarily agree to participate in this study.
- You will be given a copy of this consent form for your records.

\_\_\_\_\_  
Participant Signature

\_\_\_\_\_  
Date

## APPENDIX D

### INTERVIEW PROTOCOL

#### Eligibility for study

- 1) Do you identify as African American?
- 2) Are you an alumnus of a HBCU that majored in a STEM field?

#### Reasons for pursuing a STEM major at a HBCU

- 1) Why did you choose to attend a HBCU?
- 2) How did you find out about attending a HBCU?
- 3) What influenced you to pursue a STEM major?
- 4) Can you describe your experiences in the classroom (Professor teaching style, faculty to student ratio, lab experience if applicable).
- 5) Can you tell me what math courses you completed in high school?
- 6) What science courses did you complete in high school?
- 7) Do you believe your math and science classes from high school were the gateway courses needed in undergrad? Why was this the case or not?
- 8) What academic challenges did you experience as a STEM major (undergrad and grad if available)? How did you overcome that challenge?
- 9) Was there a time you ever felt you were not going to pass a class or continue in your major? If so describe the experience and how you overcame it?

#### Support in STEM majors

- 10) College students can receive various kinds of support from a lot of different sources. Some of these types of support can be financial, academic, and emotional support. Sources of support can be family, friends, faculty, peers, etc. Can you talk about the types of support you received as an undergraduate and the sources of this support?
- 11) Did you study with peers inside and outside of class? If so tell me about these experiences. What effect did this have on your undergraduate experience?
- 12) Did you have a mentor or mentors throughout college? If so can you describe their influence in your life? Tell me about these experiences. If so can you describe their influence in your life?
- 13) How did faculty contribute to your success inside and outside the classroom?
- 14) What kind of organizations did you join that helped you throughout undergrad?
- 15) How did your parents support you financially and mentally while you pursued a STEM major?
- 16) Would you say the supportive environment of the university contributed to your success and if so in what ways?
- 17) Did your university, college or department have a community service requirement? If so, tell me about how this was organized? What activities did you do? How did service affect your experience on campus?
- 18) What was your most memorable experience of achieving success in your major?

- 19) Was there a time you ever felt you were not going to pass a class or continue in your major? If so describe the experience and how you overcame it?
- 20) Did you take advantage of tutoring services for your courses?

Now

- 21) How would you describe your experience of enrollment at a PWI compared to a HBCU?
- 22) In what ways, do you believe your degree prepared you for graduate school?
- 23) What advice would you give anyone choosing to major in STEM?
- 24) What supportive aspects do you think are necessary for any student that decides to major in STEM to graduate?