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Historically Black Colleges and Universities (HBCUs) Serving as a Community Cultural Wealth for African Americans Who Enroll in STEM Doctoral Programs

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HISTORICALLY BLACK COLLEGES AND UNIVERSITIES (HBCUS) SERVING
AS A COMMUNITY CULTURAL WEALTH FOR AFRICAN AMERICANS WHO
ENROLL IN STEM DOCTORAL PROGRAMS

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ABSTRACT

The purpose of this multiple case study was to gain a more in-depth understanding of how Historically Black Colleges and Universities (HBCUs) serve as a form of Community Cultural Wealth for African American students and how HBCUs impact their decision to pursue a science, technology, engineering, and math (STEM) doctoral degree. In order to conduct this research study, in-depth, semi-structured interviews were used as the primary data sources. Additional data sources included demographic surveys, photo elicitation, and online resources. The primary research question used to guide this study included:

- What aspects of CCW do African American students at HBCUs believe influence and assist them in enrolling in STEM doctoral programs?

  Additionally, the following questions were included to guide this study:

- How do the experiences of African Americans at an HBCU affect their decision to enroll in a doctoral program?

- What factors impacted African American students from HBCUs decision to enroll into a doctoral program?

The questions were posed to explore the connection between African Americans who attend HBCUS and their enrollment into a STEM doctoral program. The main themes that emerged from the data were the following: (a) HBCUs serve as a source of Community Cultural Wealth in a number of ways; (b) faculty and peer to peer engagement; (c) exposure to research; (d) an aligned research agenda within the doctoral program; (e) a supportive graduate school environment; and (f) financial assistance to

pursue a PhD. The findings were interpreted and situated in the context of existing literature and the conceptual framework of Community Cultural Wealth. Implications for policy/practice, study limitations, recommendations for future study, and the conclusion were also presented.

KEYWORDS: Historically Black Colleges and Universities, STEM, African American doctoral students.

DEDICATION

 This dissertation is dedicated to those who paved the way for me (family, friends, teachers). Without your support, prayers, and love none of this would have been possible. To those who have found inspiration in my pursuit of a PhD, I pray this dissertation motivates you to pursue your dreams. Remember with God all things are possible.

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CHAPTER ONE

INTRODUCTION

<u>Background of the Study</u>

The presence of certain groups of races and ethnicities in science, technology, engineering, and mathematics (STEM) education and employment differs from their representation in the U.S. population. African American employees are underrepresented in the STEM field (National Science Foundation, 2015). The underrepresentation among African Americans is rooted in differences in current and historical participation in STEM higher education and differences in educational attainment and in pre-college course taking and achievement (NSF, 2015).

The National Science Foundation (NSF) reported the number of bachelor's degrees awarded to African Americans in STEM fields has increased, but at a slower pace than the number of bachelor's degrees earned by Blacks in other fields (National Science Foundation, 2011). Due to the slow pace of degrees earned, African Americans lag behind their White counterparts among bachelor's degree recipients in STEM fields. To increase the representation of African Americans in the STEM disciplines administrators, faculty, policymakers, and other stake holders must gain an understanding of successful methods and strategies that assist Blacks in navigating through the STEM education pipeline.

Historical Black Colleges and Universities (HBCUs) have gained a reputation for implementing effective strategies for ensuring the success of African Americans in the STEM fields (NSF, 2011; NSF 2015). From 2002 to 2012, HBCUs conferred 20% of

engineering Bachelor's degrees, and 25% of science Bachelor's degrees awarded to

Black students (Williams & Preston, forthcoming). Williams and Preston (forthcoming)

discovered, "during this period, HBCUs award at least 1 in 5 of every Bachelor's degrees

earned by Black students in many science and engineering subfields." Moreover, one-

fourth of Black science and engineering doctorate recipients earned their baccalaureate

degree at an HBCU (Williams and Preston, forthcoming). Williams and Preston

(forthcoming) identified the top ten institutions where Black science and engineering

doctorate recipients complete their undergraduate education are HBCUs.

      Scholars have shown how HBCUs are not only successful in graduating students

with a degree in the STEM fields, but are also successful in producing students who

continue in the educational pipeline towards a doctoral degree. According to research on

preparing underrepresented students of color for doctoral success, eight of the top ten

institutions that prepare African Americans for entering doctoral programs were HBCUs

(Lundy-Wagner, Vultaggio, & Gasman, 2013). Other studies have shown a

disproportionately large percentage of Black students who have earned or were currently

working on a doctoral degree had a HBCU background (Joseph, 2013; King &

Chepyator-Thomson, 1996; L. W. Perna, 2001) Through quantitative analysis researchers

have shown HBCUs to be an effective source of higher education for African Americans

students to succeed in STEM and go on to pursue a doctoral degrees (Burrelli &

Rapoport, 2008; Sibulkin & Butler, 2011; Solorzano, 1995).

      As it pertains to producing African American graduates earning a doctoral degree

in STEM, HBCUs successfully compete with the nation's best universities, including Ivy

League Universities, elite private colleges, and flagship state universities (Toldson, 2015). Nine of the top ten baccalaureate-origin institutions that produced African Americans in science and engineering doctorate recipients were HBCUs (Fiegener & Proudfoot, 2013). According to NSF, out of the top 50 institutions that produced African American graduates who go on to received their doctorates in science and engineering were 21 are HBCUs (Fiegener & Proudfoot, 2013). Nearly 30% of African American STEM doctorate recipients from U.S. universities earned a bachelor's degree from an HBCU. These institutions are especially important in the field of agricultural sciences, physical sciences, biological sciences, and mathematics (NSF, 2015).

A possible rationale for the high number of HBCU graduates who enroll in doctoral program was the encouraging environment and the Community Cultural Wealth these institutions provide, including peer support groups, networking, opportunities, undergraduate research opportunities, and academic support services (Perna et al., 2009). While researchers have shown that HBCUs were successful in producing African Americans who earned a doctorate in the STEM fields, there is a need for a more in-depth understanding of the methods and strategies implemented by HBCUs to produce a disproportionately high percentage of African Americans who enroll in a STEM doctoral program. The methods implemented by HBCUs will help increase the number of well-prepared minority students, along with institutions of higher education in their efforts to strengthen the academic preparation of students of color at the undergraduate level (Maton & Hrabowski, 2004) The assumption is that African American students have the potential to achieve academic success given high expectations and the proper

environmental support, such as the kind they receive at HBCUs (Maton & Hrabowski, 2004). This dissertation examines the positive academic potential of African Americans and HBCUs, while countering the negative stereotypical images that often dominate public attention. Therefore, this study specifically seeks to explore the academic and social experiences of African Americans who received a baccalaureate degree from an HBCU and enroll in a STEM doctoral program.

Statement of the Problem

In the past when studying African American students in higher education, researchers often focused their agenda on students at the undergraduate level (Allen, Epps, Haniff, 1991; Allen, 1992; Frist-Britt &Turner, 2002; Harper, 2007; Rovai, Gallien, & Stiff-Williams, 2007). There are a limited number of studies that addressed African Americans in graduate and professional school. The few studies that address African Americans graduates or doctoral students focused on socialization (Gardner, 2007; Ellis, 2001), mentoring (Felder, 2010), stereotypes (Taylor & Antony, 2000), and the overall doctoral experience (Williams, 2000; Williams, Brewley, Reed, White, & Davis-Haley, 2005; Nettles, 1990). Further, there are very few studies that address the factors that influence African Americans doctoral students to enroll in their various programs.

Scholars' knowledge on this topic is limited because most scholars have explored graduate enrollment using quantitative methods and national data sets, which do not adequately represent students who are currently pursuing graduate education (Millet, 2003). Many studies do not disaggregate the data among graduate and professional

programs such as masters, law, or doctoral, making it extremely difficult to distinguish various nuances within each groups of students. Such research may lead to institutional interventions that may assist in producing more individuals pursuing a doctoral degree in the STEM fields.

While there is more disaggregated data on Africans Americans in STEM fields, even as it pertains to their representations in doctoral programs and the success of HBCUs production of African Americans in STEM fields, there is a lack of understanding about experiences of African Americans doctoral students' before deciding to enroll in a STEM doctoral program. Literature has limited the HBCU experience to peer-to-peer mentor, faculty of the same race and gender, and a positive undergraduate experience (Gasman & Nuguyen, 2014). Limiting the HBCU experience can be deceptive as many programs and institutions of higher education attempt to implement strategies used by HBCUs. These findings may also limit the value policy makers, funders, and society as a whole place on HBCUs.

<div align="center">Purpose of this Study</div>

Not only is there a lack of literature on the enrollment of doctoral students, but also the literature that exists is heavily quantified, limiting the contextual knowledge of African American doctoral students, what is influencing them to enroll into a doctoral program, and how they are gaining access to doctoral programs. In addition to the quantitative research that shows the success in HBCUs sending students into doctoral program in STEM, this study provides a more in-depth analysis into how various HBCUs are providing students with the tools to enroll in doctoral programs. The investigation of

students' experiences may help explain why HBCUs produce a disproportionately high percentage of African Americans who enroll in doctoral programs. Findings from this study may provide various communities, institutions, and programs with ideas for strategies and methods that can be used to increase the number of African American doctoral students in STEM and other fields.

Research Questions

The primary research questions used to guide this research study were:

(a) What aspects of CCW do African American students at HBCUs believe influence and assist them in enrolling in STEM doctoral programs?

(b) How do the experiences of African Americans at an HBCU affect their decision to enroll in a doctoral program?

(c) What factors impacted African American students from HBCUs decision to enroll into a doctoral program?

Significance of this Study

Although African Americans are not overwhelmingly pursuing doctoral degrees, especially in STEM fields, researchers have failed to gain an in-depth understanding from those who have successfully navigated the STEM education pipeline and enrolled in doctoral programs (McCullam, 2011). Literature surrounding doctoral students' transition from HBCUs into doctoral programs was typically quantitative examining the number of student that graduated from these institutions. A limited number of studies have examined how and why students from HBCU STEM programs pursue doctoral degrees (Gasman & Nguyen, 2014; Gray, 2012). The majority of the qualitative research

examined Black doctoral students' experiences and persistence within various doctoral programs (Felder & Barker, 2013; Garrett, 2006; Lewis, Ginsberg, Davies, & Smith, 2004). Therefore, more qualitative research needs to be conducted regarding Black students' transition into doctoral programs, especially students from HBCUs. In addition research should be conducted to focus on how HBCUs are providing students with the tools to enroll in doctoral programs.

This study addresses why African American students chose to enroll in STEM doctoral programs, what encouraged them to enroll, and what their HBCU did to assist them throughout the process. In essence, I am looking to analyze and understand the trajectory of African Americans once they have enrolled in a STEM doctoral program. Trajectory analysis involves a variety of questions and captures key elements to offer compelling insights into how students transcended odds and managed to persist (Harper, 2007). Haper (2007) stated, "this type of qualitative data gathering recognizes students as informants who can speak to what worked well or proved harmful for them" (p. 58). It is important for stakeholders to understand what students experienced along their journey from attending an HBCU to their doctoral program, which could identify and examine educational programs and practices that otherwise may have remained unrevealed. Findings such as this could also inform policy and practice in new, instructive ways (Harper, 2007).

The United States competitive survival depends on their ability to diversify at the doctoral level, especially within the STEM fields (Figuera & Hurtado, 2013). Therefore, this nation must utilize the resources that are readily available to be successful. To be

competitive in a global market, more encouragement, resources, and support must be provided to people from a range of backgrounds and experiences, including those who have had limited access historically to pursue doctoral education, especially in STEM disciplines (de los Santos, Jr. & de los Santos, 2003). If the stakeholders are interested in producing more STEM doctoral students from historically marginalized groups, they should look to HBCUs for examples. HBCUs were established with the sole mission of educating African Americans, and have proven to be successful in producing African Americans who eventually pursue a doctoral degree in the STEM fields (Owens, 2014; Williams & Preston, forthcoming).

<u>Research Design and Methodology</u>

Nettles (1987) and Stanfield (1994) noted that the quality of life for minority students has been under-examined and calls for more qualitative research. Therefore this study has implemented a qualitative research design. Qualitative research allows individuals to articulate holistic explanations of how they construct their experience and realities (Stanfield, 1994; Stage & Maple, 1996).

In this particular study, I used a holistic multiple-case study design (Yin, 2014). By using a multiple case study, I was able to explain the outcomes related to the research question. Each participant served as a case, representing the uniqueness and diversity students experience by attending various HBCUs. Yin (2014) stated: "selecting such cases requires prior knowledge of the outcomes, with the multiple-case inquiry focusing on how and why the exemplary outcomes might have occurred" (p. 62). The strength of this qualitative research is its ability to provide a voice for students representing the

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different types of HBCUs and how they assisted them with enrolling in their doctoral program.

The primary method for collecting data was through interviews, incorporating multiple semi-structured and structured interviews. During the data collection period, I accessed online documents and information about the different programs used to recruit or influence students to enroll in graduate school. Examples of these programs were graduate school fairs held at the undergraduate schools, recruitment visits to graduate schools, and/or pipeline programs set up between undergraduate institutions and graduate schools.

In order to allow participants to express their own personal views of the impact HBCUs had on their decision to enroll in a doctoral program, this study also utilized photo elicitation (Harper, 2002). Participants shared a picture from their undergraduate experience at their HBCU. The pictures represented what participants found to be most impactful from their undergraduate experience in influencing them to enroll into a doctoral program. The addition of photo elicitation provided a more robust understanding of the participants' experiences while they attended their HBCU.

<u>Conceptual Framework</u>

Community Cultural Wealth (Yosso, 2005) was used as a theoretical framework to determine and examine the dynamics between HBCUs and their African American students who enroll in STEM doctoral programs (see Figure 1.1). Community Cultural Wealth focuses on and learns from various cultural knowledge, skills, abilities, and contacts possessed by socially marginable groups that often go unrecognized and

unacknowledged (Yosso, 2005). HBCUs serve as a form of Community Cultural Wealth for many African American students who find it difficult to navigate through the educational pipeline. Within this framework, there are various forms of capital nurtured including aspirational, navigational, social, linguistic, familial, and resistant capital (Yosso, 2005). Aspirational capital is the ability to maintain hopes and dreams for the future, even when facing barriers, whether real or perceived. Linguistic capital is the intellectual and social skills attained through communication experiences in more than one language. Familial Capital refers to cultural knowledge nurtured among family that carry a sense of history, memory, and cultural intuition. Social capital is a network of people and community resources. Navigational capital refers to the ability to maneuver through social institutions. Resistant capital is the knowledge and skills fostered through oppositional behavior that challenges inequality. By utilizing this framework, this study drew on the six forms of capital that African Americans gain from HBCUs as they transition from undergraduate to a STEM doctoral program.

Linguistic
captial ;
Familial
Capital

Social capital;
Aspirational
Capital

Resistence
Capital;
Navigational
Capital

HBCU Graduate in STEM
Doctoral programs

Figure 1.1 Theoretical Framework of HBCUs providing Black students with Community Cultural Wealth to enroll in STEM doctoral programs.

Limitations

There are different factors the researcher cannot control, causing limitations to the study. The first limitation is the holistic multiple-case study cannot be generalized. In qualitative research, the sample size is typically small, therefore reducing generalizability (Patton, 2002). A second limitation is the information gathered in this study may not represent the experience of all African American students who attended an HBCU and later enrolled in a doctoral program. Another major limitation of this study is the participants. When interviewing the participants, it is not guaranteed that the participants provided truthful responses, or they might not be able to recall all the events that took place in the past. Since there are a limited number of HBCUs, participants may have been cautious of the language used during the interviews so they are not easily identifiable. Participants may also be aware of the negative perspection of HBCUs, which

may deter them for sharing any real negative experiences during their time there.

Definition of Terms

For the purpose and consistency of this study, the term African American refers to any individual who identifies as Black or are of African decent and are American citizens. The terms "African Americans" and "Black" will be used interchangeably throughout this research. The term "doctoral student" refers to a student who is seeking a doctor of philosophy in a given field. For the purpose of this study the STEM disciplines will be examined. The term "STEM" stands for Science, Technology, Engineering, and Mathematics. Specifically this study acknowledges those fields designated by the National Science Foundation (NSF) as STEM (e.g. Chemistry, Computer science, Bioengineering, Material Engineering, Microbiology, ect.) (Breiner, Harkness, Johnson, Koehler, 2012). The term "Historically Black Colleges and Universities (HBCUs)" refers to any college or university established prior to 1964 whose mission was, and is, the education of Black Americans, and that is accredited by a nationally recognized accrediting agency or association (Knight, Davenport, Green-Powell, Hilton, 2012).

Organization of the Study

This dissertation is presented in six chapters. Chapter one included an introduction to the study, statement of the problem, purpose of the study, significance of study, research question, theoretical framework, limitations, and the definition of terms. Chapter two is the review of the literature, which encompasses literature on HBCUs, historical perspective of STEM in education, African Americans in STEM, pathways to doctoral programs for African Americans, origin of baccalaureate degrees for African

American doctoral students, and the theoretical framework. Chapter three provides the

proposed methodology of the study that includes the rationale for the research design,

research questions, overview of research site and participants, data collection, data

analysis, and statement of subjectivity. Chapters four through seven tell the story of the

four participants individually. Chapter eight provides a cross case analysis of the four

participants. Chapter nine gives a summary of the entire study, discussion of the findings,

implications for future research and practice, and conclusions.

CHAPTER TWO

REVIEW OF LITERATURE

Introduction

Chapter two is a review and summary of relevant literature related to the influence and assistance HBCUs provide African Americans with enrollment into STEM doctoral programs. When studying African Americans in STEM fields, it is imperative to understand the historical context of the STEM disciplines and the lack of African Americans presence. Conversely, it is equally imperative to understand the historical and present context of HBCUs in the higher education landscape, especially within the STEM fields. Having a better understanding of these concepts helps better explain the need and success of HBCUs in producing African Americans within the STEM educational pipeline.

The chapter begins by providing an overview of HBCUs. I identified the success HBCUs have in educating African Americans in the STEM fields. I identify factors that influence African Americans students to enroll into doctoral programs and the origin of Baccalaureate degrees for Black doctoral students. After a review all factors and origin of baccalaureate degrees, I discuss critiques and limitations to the current body of literature. Following is the explanation of the theoretical framework that guides the research. To conclude, relevant concepts from the literature were used to create a new conceptual model that aids in understanding how HBCUs serve as an avenue for assisting Black students to enroll into doctoral programs.

<u>Historically Black Colleges and Universities (HBCUs)</u>

Before the start of the U.S. Civil War, only a few institutions of higher education had been established for "free" Blacks. These institutions were; Lincoln University and Cheyney University both located in Pennsylvania, and Wilberforce University in Ohio (Albritton, 2012; Gasman Tudico, 2008; Jackson & Nunn,2003). After the end of the Civil War, African Americans were afforded more opportunities to gain some form of education. With such opportunities available the Freedman's Bureau, the freedmen's Aid Society, the American Missionary Association, and other church based affiliates began opening colleges specifically for the education of Blacks in America (Albrittion, 2012; Knight, Davenport, Green-Powell, and Hilton, 2012; Rovaris, 2005;). Black colleges were established out of the exclusionary and discriminatory laws and practices of American society during that time (Jackson & Nunn, 2003; Knight et al., 2012). From 1865 to the 1960s, the majority of Blacks in American who attended college enrolled in a Black Colleges (Palmer & Gasman, 2008).

In 1965, the Higher Education Act of 1965, Title III, Congress formally acknowledged Historically Black Colleges and Universities (HBCUs) as institutions whose principal mission were and is to education Blacks in America and were accredited and established before 1964 (Knight et al., 2012; UNCF, 2015; White House Initiative on Historically Black Colleges and Universities). In 2016, there are over 100 public, privates, 4-year and 2-year HBCUs (Brown & Davis, 2009; Jackson& Nunn, 2003; Knight et al., 2012). HBCUs vary in size, curriculum specializations, and many characteristics. The one commonality across HBCUs is their historic responsibility as the

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primary providers of postsecondary education for Africans American in a social

environment of racial discrimination (Brown & Davis, 2009). In addition to providing

educational opportunities for Black Americans, HBCUs were among the first institutions

to enroll student irrespective of race, creed, gender, or national origin (Allen &Jewell,

2007).

HBCUs play an important role in providing educational opportunities for under-

represented students (Knight et al., 2012). HBCUs often time admit students who

otherwise might not attend college due to social, financial, or academic barriers. These

institutions take pride in their ability to take low socioeconomic and academically

underprepared students and provide them with an opportunity to gain a higher education

(Allen, 1992). HBCUs excel in their ability to create effective learning environments in

which underserved students (i.e. Blacks, first-generation, low-income) are educated

regardless of academic preparation, socioeconomic status, or life circumstances (Allen &

Jewel, 2003; Kim, 2002; Kim & Conrad, 2006: Palmer & Gasman, 2008).

Although HBCUs only represent 3% of the nation's institutions of higher

education, they have and continue to play a major role in providing educational

opportunities for historically marginalized groups of people (Knight et al., 2012). HBCUs

graduated one-quarter of African Americans who earn undergraduate degrees (Knight et

al., 2012). HBCUs also produced a disproportionately high percentage of political

leaders, lawyers, doctors, and Ph.D. (Kim & Conrad, 2006; Knight et al., 2012). Studies

have shown that HBCUs produced a larger percentage of STEM bachelor's degrees

among Blacks than predominantly white institutions (PWIs) (American Institutes for

Research, 2012; Strayhorn, Williams, Tillman-Kelly, & Suddeth, 2012; Upton &

Tanenbaum, 2014). Knight et el (2012) reported that HBCUs are imperative for creating

educational opportunities for historically marginalized groups, and will be a "cornerstone

to globalization of the current and future marketplace" (p. 223).

Research has shown African Americans students at HBCUs were significantly

more likely to have positive relationships with faculty member, due to their sense of

academic needs and aspirations (Toldson, 2013). Faculty at HBCUs tend to be more

approachable and sensitive to their cultural background (Toldson, 2013). Students at

HBCUs also felt a sense of belonging on their campuses, as displayed through the

campus environment was welcome, and a feeling of support from other students

(Toldson, 2013).

<center>Historical Perspective of STEM in Education</center>

Academics have played a major role in the construction of disciplinary boundaries

that preserve class, gender (Pawley, 2012), and race privileges in STEM fields. Frehill

(2004) stated;

> The increasing significance of engineering and STEM related fields within
>
> education use colleges to screen out those people who were not considered fit for
>
> the field is one important mechanism by which middle-class white men
>
> maintained control of the STEM profession (p. 400)

For example "engineering became more integrated into science through its

introduction into higher educational systems in the second half of the nineteenth century,

engineers became increasingly concerned with protecting the scientific status of their

field from the 'diluting' effects that they feared women and people of color would introduce (Pawley 2012 p. 63)." This statement implies that historically the majority of STEM professions were attempting to keep their field populated with White middle class males.

When taking into consideration the historical context of attempting to keep STEM disciplines populated with White males and the historical relationship STEM fields have with the military, and a weak focus on the needs of environmental sustainability, human rights, and peace (Baillie, 2006; Catalano, 2007: Riley, 2008), one is able to better understand the lack of representation of African Americans and other underrepresented groups in the STEM fields.

<u>Blacks in STEM</u>

Traditional forms of instruction and preparation for STEM subjects could possibly hinder Africans Americans to successful perform (Gasman & Nguyen, 2014). The traditional approach to obtain a STEM degree is often competitive with a "survival of the fittest" mentality and less emphasis on cooperative learning (Gasman & Nguyen, 2014). This mentality implied that a student's success is dependent on their individual skills and that the institutions of higher education holds little responsibility for whether a student succeeds or not (Seymour & Hewitt, 1997; Triesman, 1992). Many colleges and universities use a "weeding out" process within STEM discipline (Gasman & Nguyen, 2014; Seymour & Hewitt, 1997).

One of the main reasons for the lack of representation among African Americans and other minority groups in STEM fields has been attributed to academic and cultural

isolation, lack of peer support, and poor relationships between students and faculty, which causes barriers for the success of minority students by excluding them from the STEM community and various social networks (Stolle-McAllister, 2011). Often times African Americans have to deal with negative perceptions/stereotypes, the lack of support due to few same-race peers and faculty, difficulty translating curriculum into personal interests, and feeling invisible in the classroom, whether perceived or real (Strayhorn, 2010; Strayhorn, Long, Kitchen, Williams, & Stentz, 2013). Through further studies Strayhorn et al. (2013) revealed an additional academic barrier, the lack of pre-college preparation necessary to succeed in STEM fields. Often times these students lack in study skills, attend underfunded schools, lack an integration between math and science, and do not understand what it takes to succeed in college, causing a negative impact on their ability to succeed in STEM fields (Strayhorn et al., 2013). There are also many instructional and cultural norms within the STEM disciplines that have a negative impact on minority students (Johnson & Sheppard, 2004).

A more successful approach is needed to develop systems that foster communication among the various support offices and encourage them to work together to foster student success (Seymour & Hewitt, 1997; Treisman, 1992). An even more effective strategy, especially among Blacks, was for colleges and universities to create a more inclusive and diverse curriculum to represent today's STEM classrooms and draw from illustrations and authors that vary in terms of gender and race (Armstrong & Thompson, 2003; Seymour & Hewitt, 1997). Access to mentors and role models for

Blacks in STEM fields were another way to foster a successful environment (Palmer & Gasman, 2008).

Faculty and administers at HBCUs have implemented strategies to ensure Africans Americans successfully graduate with degrees in STEM fields. Thus giving them the reputation for producing STEM graduates and sending these students into graduate and professional programs (Gasman& Nguyen, 2014). Research on HBCUs and STEM education reported the success of HBCU students was attributed to a classroom and campus culture predicated on communal success as opposed to a 'weed out' culture based on competitiveness and individualism. Working together, as opposed to against each other is a major factor in the success of HBCUs.

HBCUs' Contribution to STEM

Although HBCUs have currently and been historically underfunded compared to PWIs, these institutions have a reputation for producing a large percentage of Black graduates in STEM fields (Owens, et al., 2012;Palmer, Davis, and Thompson, 2010; Upton & Tanenbaym, 2014; Gasman & Nguyen 2014). HBCUs graduated 40 percent of Black students with degrees in biological science, physics, chemistry, astronomy, environment sciences and mathematics (Owens et al., 2012; Palmer, et al., 2010; Toldson, 2013). Owens et al., (2012) conducted a study examining the success HBCUs have in producing African American STEM graduates over a span of nine years. Between 2001 and 2009 HBCUs accounted for 46% of African Americans with a bachelor's degree in engineering and mathematics, 48% with degrees in biomedical science, 45% with a bachelor's degree in engineering technology, and 47% of bachelor's degree in

physical sciences (Owens et al., 2012). HBCU possess several institutional characteristics and practices that contributed to such a high turnover in African American's being success in STEM, including: structural characteristics, the cooperative rather than competitive peer culture, faculty that encourage and promote students' success, the accessibility and use of academic supports, and the opportunity to conduct research at the undergraduate level(Perna, Lundy-Wagner, Drezner, Gasman, Yoon, Bose, & Gary, 2008).

Gasman and Nguyen (2014) determined four major themes that HBCUs provide their students to be successful in STEM fields: (a) Celebrating success in STEM, (b) peer mentoring peers, (c) undergraduate research, and (d) same gender and race faculty role models. Celebrating success in STEM: HBCUs create an atmosphere that celebrates and encourages participation and accomplishment within STEM disciplines. In addition, HBCUs have created an environment where they exhibit their belief in the ability of Black students to succeed. Peer Mentoring Peers: HBCU have established a climate in which students support one another rather than compete against classmates. Undergraduate Research: Many students at HBCUs participate in undergraduate research. Many students claimed that participation in undergraduate research opportunities created a passion for scholarship and that exposure to the research of their peers was inspiring. Same Gender and Race Faculty Role Models: HBCUs have a diverse faculty members with the STEM discliplines, with higher numbers of African American professors in comparison with their counterpart institutions.

Lewis et al. (2013) determined four major themes that contributed to the success of African American students at HBCUs in STEM disciplines; (a) pre-college expriences, (b) self-motivation and attitudes, (c) the impact of race, and (d) the impact of gender. Pre-college experiences, students expressed having powerful influence and an academic foundation needed to be successful, which is contradictor to most studies on African Americans in STEM fields. Self-motivation and attitudes, participants acknowledge they would not have endured to graduate were not for self-motivation. The impact of race, some participants used this as a tool for motivation, while other saw no need to acknowledge their race because they were attending a HBCU. The impact of gender, especially for female participants used the stereotypes surrounding their gender to push them even harder to successfully graduate.

Palmer, Davis, and Thompson (2010) analyzed theories from the literature and examined the practice of a an HBCU to gain insight about the uniqueness of their STEM initiatives and impact it had on the success of their African American students. Palmer et al. (2010) determined that the program implemented by this particular HBCU aimed to foster students' academic and social integration by helping them adjust to the rigors of the STEM curricula and the expectations of faculty, opposed to weeding students out. The program also introduced them to support resources that can help them maximize their potential. Students were exposed to research/training and a mentoring component (Palmer et al., 2010). Palmer et al. 2010 was only able to research one program which is consist with Toldson (2013), which suggested that a few institutions have formal programs to recruit minority students in STEM.

The findings from the research conducted by scholars (Gasman & Nguymen, 2014; Lewis et al., 2013; Palmer et al., 2010; Toldson, 2013) illustrated that students' experiences at HBCUs differ based on the institution they attend. Literature (Lewis et al., 2013; Palmer et al., 2010; Toldosn, 2013) also showed that most HBCUs lacked funds and resources in comparsion to there counterpart institutions. Lastly, researchers (Gary, 2012; Gasman & Nguyen, 2014) recommended more knowledge of what HBCUs were doing to produce a high percentage of success African Americans within the STEM pipeline, especially with the lack of funds, support, and resources that many PWIs have.

Pathway to Doctoral Programs

Dawkins (2006) examined the McKnight Doctoral Fellowship Program in the state of Florida. This program focuses on providing academic, social, and motivational support to Black students who are in pursuit of a doctoral degree. The results from this program indicated that from 1984 to 2006 Florida awarded a total of 559 fellowships. Of the recipients, 226 earned doctoral degrees and 262 are actively pursuing their degrees, yielding a completion/retention rate of 87.3%. Pascarella, Wolniak, Pierson, and Flowers (2004) conducted a three-year longitudinal study of graduate degree plans of African American, Hispanic, and White students at 18 four-year institutions. This study showed that African American graduate degrees were positively influenced by socioeconomic background, secondary school achievement, and by college experience (e.g., academic effort/ involvement, effective teaching, and interaction with peers). Pascarella et al. (2004) also suggested that being female and older in age also contributes to plans to pursue a graduate degree. Davidson and Foster-Johnson (2001) examined ways to attract

and retain students of color. They argued that effective and positive mentoring within departments can improve the graduate school experiences for students of color and assist in their postdoctoral work.

Regarding gender, Strayhorn et al. (2012) examined the factors that students at HBCUs considered when choosing a graduate school. The studies showed that both Black men and women considered the same three factors when deciding which graduate school to apply to (reputation of school and faculty, proximity to home or work, and availability of an academic program), but findings did show a slight difference between men (2.8%) and women (12.85%) who consider access to financial aid and costs of tuition and fees.

<u>Baccalaureate degrees for Black doctoral students</u>

Throughout the literature, studies showed that attending a HBCU increased the likelihood that a student would pursue a doctoral degree at some point (Joseph, 2013; King & Chepyator-Thomson, 1996; Perna, 2001). The research concerning the baccalaureate origins of African American doctoral students has been broken down into many areas such as gender (Strayhorn et al., 2013; Wolf-Wendel, 1998), HBCUs (Burrelli & Rapoport, 2008; Joseph, 2013; Strayhorn et al., 2013) and general studies (Lundy-Wagner et al., 2013; Sibulkin & Butler, 2011). Most of the studies looking at the gender of African American doctoral students have dealt with women (L. Perna et al., 2009; Wolf-Wendel, 1998), while Stayrhorn et al., (2013) looked at graduate school choice for both male and female HBCU bachelor's degree recipients. Perna (2009) and Wolf- Wendel (1998) identified the baccalaureate origin of European American women,

African American women, and Latinas. This study showed that both single-sex and coeducational HBCUs were top producers of baccalaureate degrees for African Americans who go on to earn a doctoral degree.

With convincing data that points to HBCUs as a major contributor to baccalaureate origin of African American doctoral recipients, researchers have taken interest in examining many aspects of this phenomenon (Burrelli & Rapoport, 2008; Joseph, 2013; L. Strayhorn et al., 2013). Joseph (2013) gave more of a documented analysis of the impact HBCUs have on African American doctoral students. This analysis utilizied social capital to point out how HBCUs are the starting point for many African American PhDs in the STEM fields. Unlike other research, Joseph (2013) contextualized HBCUs as vehicles of social capital (Bourdieu & Passeron, 1990) for most Black doctoral students by explaining how students gain research experience in the disciplines and are prepared to make the transition into a doctoral program.

The general studies that examine the baccalaureate origin of African American doctoral recipients were mainly quantitative (Lundy-Wagner et al., 2013; Sibulkin & Butler, 2011) Sibulkin and Butler (2011) found that HBCUs were slightly more likely to produce doctorate-earning graduates- 31% in 2001-2005 in comparison to the 28% of Black graduates produced by HBCUs in 1991-1995. The result also explained "the number of Black doctorates during 2001-2005, who earned their bachelor's degree from an HBCU during 1991-1995 (2,508), was 2.3% of the 106,936 total Black college graduates from HBCUs. The number of Black doctorates (5,609) who earned their

bachelors of science from predominantly white institutions (PWI) was 2.1% of the 270,760 Black college graduates from PWIs" (Sibulkin & Butler, 2011 p. 10).

The results revealed that Black doctoral recipients were slightly more likely to earn their bachelor's degree from an HBCU than from a PWI. Lundy-Wagner et al. (2013) used data from Survey of Earned Doctorates (SED) and the Integrated Postsecondary Education Data System (IPEDS) survey to identify the baccalaureate origins of African American, Latina/o, and Asian/Pacific Islander students who earned a doctoral degree between 1995 and 2005, and identified the top ten producing institutions for each racial/ethnic group. The results showed that eight of the top ten baccalaureate origin institution of African American who earned a doctoral degree between 1995 and 2005 were HBCUs.

<u>Baccalaureate Degrees for Blacks in STEM Doctoral Programs</u>

Researchers have paid special attention to African Americans in the STEM doctoral programs with low representation. A number of studies address the baccalaureate origins of African Americans who enrolled in STEM doctoral program. Soloranzo (1995) specifically looked at the doctorate production and baccalaureate origins of African Americans in the sciences and engineering. The findings are consistent with literature, which illustrated that Black females and males are underrepresented overall, especially in the fields of science and engineering, and that there are gender differences in doctorate production and baccalaureate origins. Soloranzo (1995) also aligned with other research revealing that HBCUs remain the major producers of Black undergraduate students who pursue science and engineering doctoral degrees.

Burrelli and Rapoport (2008) examined the role HBCUs play as baccalaureate-origins for Blacks in science and engineering that have been doctorate recipients within the past two decades. This research takes the examination a step further by comparing HBCUs to non-HBCU institutions, two different Carnegie types of institutions, and a select group of baccalaureate colleges. The study found HBCUs were among 20 of the top 50 baccalaureate-origin institutions that produced the highest number Black science and engineering doctorate recipients in 1997-2006.

More recent research determined that approximately one third of Black STEM PhD recipients who earned their doctoral between 2005 and 2010 reported starting their STEM education at an HBCU (Upton and Tanenbaum, 2014). Although most Black STEM PhD recipients earned their bachelor's or doctoral degree at PWIs, attending an HBCU for a bachelor's degree or graduate degree was more common among African Americans, and Black women; all groups who are currently among the most underrepresented in STEM fields (Upton & Tanebaum, 2014)

Data has shown that HBCUs play an integral role in the African American pipeline to a STEM doctoral degree, but very few studies speak to how HBCUs are able to produce a disproportionately high number of students who go on to enroll in STEM doctoral programs. Gary (2012) identified several themes that accounts for African Americans who attend HBCUs to remain in the STEM education pipeline and their persistence. Parents seem to have some influence in students' decision to attend an HBCU and based their selection on the institution's reputation of producing students in STEM. Students also expressed a positive relationship with faculty and peers (Gray

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2012), which is consistent with the finds of Perna et al. (2008). Unfortunately students in this particular study expressed shortcomings at their various HBCUs in resources and academics. To compensate for their shortcomings in resources and academics, HBCUs provided their students the opportunity to participate in various research programs (Gary, 2012).

<div align="center">Theoretical Framework</div>

Bourdieu and Passeron's (1990) work surrounding social and cultural capital was not originally established for historically marginalized groups, but has been used as one of the explanations as to why students of color do not succeed academically at the same rate as Whites (Yosso, 2005). Bourdieu referred to cultural capital as an accumulation of cultural knowledge, skills and abilities, possessed and inherited by privileged groups in society. He explained that cultural capital, social capital, and economic capital are acquired in two ways: (a)through family and/or (b) formal education. Therefore, the concept developed by Bourdieu and Passeron (1990) means dominant groups in society are capable of maintaining power because of the ability they possess to acquire and learn strategies to form capital for social mobility (Yosso, 2005), which in many ways can exclude historically marginalized groups.

Although Bourdieu's work seeks to provide a critique of social and cultural reproduction, his theory of cultural capital can encourage the belief that some communities are culturally wealthy while others are culturally poor. Bourdieu's belief identifies White, middle class culture as the standard, or in this case, traditionally White institutions (TWI) as the standard, subsequently causing all other forms or expressions of

<div align="center">28</div>

'culture', or institutions to be judged in comparison to this 'norm'. Cultural capital is not simply inherited or possessed by the middle class, but rather it refers to an accumulation of specific forms of knowledge, skills and abilities that are valued by privileged groups in society (Yosso, 2005). For example, predominantly White institutions (PWIs) are generally more selective with admission process, are assumed to provide a "rigorous education," and are flooded with resources (Hebel, 2001).

Students who attend TWIs have acquired cultural capital because a "rigorous education," internships, and more resources are valued when seeking a job upon graduation. Conversly, institutions that focus on educating historically marginalized groups often have an open door policy with a focus on building the students' character, nurturing the student, and providing a sense of cultural pride. This cultural knowledge is very valuable to the student, but is not necessarily considered to carry any significant capital upon graduation. These forms of cultural capital that HBCUs transfer to their students are not recognized by traditional cultural capital theory.

Yosso (2005) uses critical race theory to shift the focus from the notions of White, middle class culture to the cultures of communities of color. Garcia and Guerra (2004) research concludes an overgeneralization about family backgrounds, which are exacerbated by a limited framework to interpret how individuals' views on educational success are shaped by personal "sociocultural and linguistic experiences and assumptions about appropriate cultural outcomes" (p.163). Community Cultural Wealth (CCW) looks to challenge the traditional interpretations and single use of cultural and social capital by taking into consideration historically marginalized groups.

Drawing from the work of sociologists Melvin Oliver and Thomas Shapiro (1995), Yosso explained cultural capital in many different ways that can be considered valuable to communities of color. The framework refers to culture as behaviors and values that are learned, shared, and exhibited by a group of people. Community Cultural Wealth focuses on the learned behaviors and values from a number of cultural knowledge, skills, abilities, and contacts possessed by socially marginalized groups that often go unrecognized and unacknowledged. Various forms that are expressed through community cultural wealth are aspirational, navigational, social, linguistic, familial and resistant capital.

A study has yet to apply such a framework to Black students pursuing a doctoral degree. By using CCW, I will be able to break down all six types of capital that have influenced Black students at HBCUs. Through this framework I will examine how literature on HBCUs speaks to aspirational capital, linguistic capital, familial capital, social capital, navigational capital, and resistant capital. This study allows for the expansion of literature within contextual work of CCW and provides a comprehensive understanding of the various types capitals HBCUs assist in developing Black students towards a doctoral degree in STEM fields.

Aspirational capital

Aspirational capital is the ability to maintain hopes and dreams for the future, even when facing barriers, whether real or perceived (Yosso, 2005). The resiliency is evidenced in how HBCUs allowed themselves and their students to dream of possibilities beyond their present circumstances, often without the means to attain those goals. Data

showed attending a HBCU significantly influenced African American students' aspirations for a graduate degree (Pascarella, et al., 2004).

Black Students at HBCUs tend to have high levels of educational aspiration, career aspirations and willingness to participate in community service (Wenglinsky, 1996). Students who attend HBCUs were both more academically motivated with respect to their educational goals and more likely to achieve their professional aspirations than African American student at other institutions (Wenglinsky, 1996). According to a more recent study conducted by the Gallup- Purdue (2015), Black graduates of HBCUs were more likely to thrive with social and purpose well-being, which means they enjoy what they do each day and are motivated to achieve their goals.

Linguistic capital

Linguistic capital is the intellectual and social skills attained through communication experiences in more than one language (Orellana, 2003) or in the case of HBCUs, their various forms of communication. Linguistic capital reflects the idea that Black students arrive at school with multiple communication skills (Yosso, 2005). Additionally, these students have been engaged participants in storytelling traditions, which possibly include listening to and recounting oral histories, parables, stories, and proverbs. Storytelling skills may include memorization, attention to detail, dramatic pauses, comedic timing, facial affect, vocal tone, volume, rhythm and rhyme (Yosso, 2005). Through linguistic capital the belief is expressed that language is not just words spoken or an exchange of symbols, but language is the means by which one gains knowledge of, and maintains their social, occupational, economic, or individual identity

(Collier, 2004).. Language and the way one communicates, "is directly related to how one thinks, behaves, believes, and interacts with others (Boones, 2003 p. 215).

Boones (2003) explained the pedagogical implications of call-response when it is performed in the classroom at an HBCU, and how it allow students to maintain their cultural identity by engaging in behaviors reflecting cultural values recognized by the African American community. An examination of an HBCU helps to determine through shared speech patterns, students and instructor endorse and validate their shared cultural identities, which results in both parties as beneficiaries of learning, and creates a supportive and cooperative environment. The use of ethnic dialogue in the classroom of HBCUs can result in rewarding, positive experiences from which students can personally benefit. Due to a shared language system they are receiving confirmation of their cultural identities from one another and from the instructor (Boone, 2003).

Familial capital

Familial capital refers to cultural knowledge nurtured among family that carries a sense of history, memory and cultural intuition (Delgado-Bernal, 2002). This particular capital engages a commitment to community well being and expands the concept of family to include a broader understanding of kinship (Yosso, 2005). By acknowledging the racialized and classed, familial capital expands the traditional understandings of 'family.' Familial capital is nurtured by our extended family, which may include immediate family, extended family, friends, and faculty and peers at school whom one might consider a part of the family. From these kinship ties, students can learn the importance of maintaining a healthy connection to the community and its resources

(Yosso, 2005). Family in this concept also models lessons of caring, coping and providing education, which inform our emotional, moral, educational, and occupational consciousness (Auerbach, 2007; Lopez, 2003). The family becomes connected with others around common issues and students realize they are not alone in coping with their problems (Delgado-Gaitan, 2001).

HBCUs have been acknowledged for their ability to create an inclusive environment through meaningful and lasting relationship between students and faculty that enhance students' success and retention (Fries-Britt & Turner, 2002; Guiffrida, 2005). Administrators believe relationships on campus nurture HBCU students and are family-like in nature. Hirt, Amelink, McFeeters, and Strayhorn (2008) stated, "These relationships are distinctly shaped by the ethic of care" (p.220) These relationship are formed to establish a shared moral responsibility to encourage cultural advancement. HBCUs form relationships with students so that educational institutions with an explicit mission to advance the African American community are sustained (Hirt et al, 2008). Students who attend HBCUs expressed that they form close personal relationships with faculty, whom they identified as having similar experiences when they were in college. Social networks formed amongst peers also serve to create a more inclusive climate at HBCUs. Peer support allowed students to become more active in student activities. Connections with other students allowed for a easier transition and adjustment to the college environment (Fries-Britt & Turner, 2002).

Social capital

Social capital is a network of people and community resources (Yosso, 2005). Brown and Davis (2001) constructs social capital as "a way to think about how these institutions have used their particular social and legal position in the higher educational landscape to advance the interest of African Americans" (p.41). Simply put, the relationships and networks HBCUs provide for their students become tangible and meaningful resources, which are known as social capital (Brown & Davis, 2001).

Due to the reputation of Black intellectuals and professionals among HBCUs' alumni, faculty, and staff, they serve as one of the primary producers of social capital for African American students. One way in which social capital is played out is through the institutional agents and agencies (e.g., committed faculty, compensatory curricula, alumni leaders in the profession and society) (Stanton-Salazar, 1997). Brown and Davis (2001) stated, " The institutional agents constitute an array of channels that identify, negotiate, and transmit resources, particularly formal and informal relations, that purchase opportunities for the accomplishment of HBCU's collective agenda- the educational development and attainment of African Americans" (p.41). Within the context of social capital and HBCUs, Bourdieu's theory of social capital has been used to explain how it "generates new cultural resources (e.g., networks, attitudes, behaviors, and expectations) within the environment and experiences" (Brown & Davis, 2001 p.42).

Navigational capital

Navigational capital refers to the ability to maneuver through social institutions. Historically, this infers to the skill to navigate through institutions not created with

communities of color in mind (Yosso, 2005). Navigational capital acknowledges individual agencies within institutional constraints, while connecting to social networks that facilitate community navigation through places and various spaces (Williams, 1997).

Faculty members at HBCUs also engaged with their students personally, instilled a sense of institutional pride, and provided them with the proper tools required to succeed (Berger & Milem, 2000). Not only did the faculty at HBCUs provide their student with personalized advising and active support, but they also demonstrated a higher level of confidence in the students' abilities than did White faculty (Guiffrida, 2005). HBCUs were known to successfully address any academic deficiencies in the students they admit (Harper, 2007).

Research has proven that HBCUs generally do a better job of promoting growth and development among African American students than do PWIs in areas such as cognitive development, academic achievement, educational aspirations, degree attainment, and college satisfaction (Allen, Epps, & Haniff 1991; Allen,1992; Pascarella, Bohr, Nora, & Terenzini, 1995; Berger & Millem, 2000). HBCUs also provided a form of Navigational capital as students who attend HBCUs have reported to be involved in applied internships, long-term projects and extracurricular activities (Gallup-Purdue, 2015).

Resistant capital

Resistant capital refers to knowledge and skills fostered through oppositional behavior that challenges inequality (Freire,1970; Delgado Bernal, 1997). This form of cultural wealth is grounded in the legacy of resistance to subordination displayed by

people of color (Deloria, 1969). Delgado Bernal (2001) explained that resistance can include different forms of oppositional behavior, such as self-defeating or conformist strategies that feed back into the system of subordination.

Higher education in the United States has a reputation for its limited access, particularly for people of color. From its establishment, institutions of higher education denied access to individuals who were not wealthy, male, and White (Brown, Donahoo, & Bertrand, 2001). Unlike other institutions, HBCUs' mission is centered on positioning, preparing, and empowering African American students to succeed in what many perceived to be a hostile society (Brown et al., 2001). These institutions promote educational attainment and advancement but also served as safe space in an otherwise racially demoralizing society. HBCUs dispelled the belief that higher education is only suitable for the rich or socially prestigious. Surrounded by a racially hostile society, these colleges and universities have established and maintained a tradition of academic excellence. HBUCs work with students who may have low grades and test scores, and due to various circumstances, may not be as well prepared for college. Brown et al., (2001) describes HBCUS as "not concerned with who gets admitted but rather what happens to them afterwards. Undeniably, HBCUs have readily accepted the challenge and continue to help students to succeed and beat the odds" (p. 569).

<div align="center">Chapter Summary</div>

Chapter II provides an overview of the literature germane for this research topic. A review of the historical context of the exclusion of African Americans within STEM fields, followed by the role HBCUs have in developing students who are successful in

STEM programs, and the role HBCUs play in providing a pipeline for African Americans into STEM doctoral programs. The theoretical framework that guides this study is also explained in great detail in this chapter. The following chapter provides a detailed description of the research design and methodology used in this study.

CHAPTER THREE

METHODS

Introduction

This chapter provides a detailed description of the research methodology selected for this holistic multiple case study. The purpose of this study is to understand the African American graduates perception on the impact HBCUs had on influencing and assisting them to enroll in STEM doctoral programs. Studies surrounding the contribution HBCUs make to the STEM fields have largely been quantitative in nature (Burrelli & Rapoport, 2008;Owen et al., 2012; Solorzano, 1995; Upton & Tanenbaum, 2014; Williams & Preston, 2017), consequently providing very little insight into what HBCUs are doing to produce a disproportionately high number of African American students who graduate with a degree in STEM fields and go on to enroll in doctoral programs. This chapter explains the research design and method for this study as well as the reasoning behind their selection. In addition, this chapter includes the guided research questions, overview of the participants and context of study, data collection process, and data analysis. In closing I discuss the limitations, the quality of research design and ethical considerations for this study.

Rationale for the Use of Research Design

Researchers have been able to provide numerical evidence of the work HBCUs have done in producing African American students who go on to enroll in STEM doctoral program. HBCUs are typically categorized as though they is one type of institutions. A multiple-case study allows me to focus on the unique aspects of various HBCUs, how

and why some out-comes might have occurred, while allowing for possible literal

replications of these conditions form case to case (Yin, 2014). A multiple case study was

selected to better understand how a wide range of HBCUs may act as a form of

Community Cultural Wealth to African Americans who aspire to pursue doctoral degrees

in the STEM fields. This design allowed the researcher to carefully examine the

experiences of African Americans who attend a variety of HBCUs. The investigation of

this research aimed to gather data on the experiences of African Americans attending an

assortment of HBCUs and how these institutions influenced and assisted them to enroll

into STEM doctoral program. A multiple case study was appropriate for allowing

participants to share a their perspective, while displaying the uniqueness of their

particular HBCU. Yin stated,

> "Each individual case study consists of a "whole" study, in which
> convergent evidence is sought regarding the facts and conclusions for the case;
> each case's conclusions are then considered to be the information needing
> replication by other individual cases. Both the individual cases and the multiple-
> case results can and should be focus of a summery report. For each individual
> case, the report should indicate how and why a particular indicate the extent of the
> replication logic and why certain cases were predicted to have certain results,
> whereas other cases, if any were predicted to have contrasting results" (p. 59).

From the previous literature and current statistics (NSF, 2015), I am able to

identify the phenomena of HBCUs producing African Americans to enroll in STEM

doctoral programs. A multiple case study creates the opportunity to study unique cases. A

multiple case study starts with recognizing what concepts or ideas bind the case together.

Generally the concepts need to be targeted; it is important to target the common factor

that provided the binding concepts (Stake, 1995). The case to be studied may each have a

different relationship with common factor (Stake, 1995). Some may be model cases,

while other may have only an incidental relationship. In this multiple case-study the binding concepts are African American students' experience at an HBCU that impacted their decision to enroll into a doctoral program.

The importance of conducing a multiple case study for this research is the ability to study how participants' HBCU experience was able to carry about this phenomenon in different environments and conditions. A multiple case study allows the researcher to examine typical HBCUs experience that contribute to African Americans enrollment in STEM doctoral programs. Stake believes, "When cases are selected carefully, the design of a study can incorporate a diversity of contexts" (p.23) Therefore, it is important to obtain a representative sample of all the cases that can be generalized. Implementing a multiple case study allows me to investigate a number of participants, while treating them as a single case, representing the uniqueness of their experience and diversity among HBCUs.

<div align="center">Research Questions</div>

The purpose of this research is to discover factors influencing and assisting African American students to enroll in doctoral programs. With a lack of knowledge as to why HBCUs produce a disproportionately high percent African Americans who go on to enroll into doctoral programs, this research discovers what those factors are, so they might be applied to various communities and institutions of higher education in order to assist in the growth of diverse doctoral students. To be more specific, this research answers the following questions:

1. What aspects of CCW do African American students at HBCUs believe influence and assist them in enrolling in STEM doctoral programs?

2. How do the experiences of African Americans at an HBCU affect their decision to enroll in a doctoral program?

3. What factors impacted African American students from HBCUs decision to enroll into a doctoral program?

Overview of Research Site and Participants

Sampling procedures

Purposive sampling was used to select participants for this study. Qualitative research typically focuses on small samples that are selected purposefully to understand a phenomenon (Creswell, 2005; Patton, 2002). The goal of purposive sampling is to achieve representativeness or comparability (Tefflie & Yu, 2007). Selecting participants consisted of using the intensity sampling approach, in which different students experiences are possible based on their institutions and field of study. In addition, purposive sampling techniques provided rich interviews with participants and solicited additional participants through networking (Merriman, 1998). A snowball sampling approach enabled me to solicit participants through referrals from existing participants (Merriman, 1998). My initial recruitment of students came through faculty from HBCUs I interviewed for the pilot study, examining the role faculty at HBCUs play in assisting African Americans to enroll in STEM doctoral program. I also recruited students from Black graduate associations on several university campuses in the southern and eastern part of the United States. For the purpose of this study, I identified potential participants

as students who graduated from various types of HBCUs (i.e. public, private, large, small) who were currently enrolled in a doctoral program.

<u>Participants</u>

I utilized criteria and network sampling (Merriman, 1998) to select participants. In this study, the criteria is students who (a) identify as African American/Black, (b) have a baccalaureate degree from an HBCU, and (c) are currently enrolled in a STEM doctoral program.

At the start of the study, I recruited and interview nine participants. Of the nine participants, three identified as men and the remaining six identified as women. All three males graduated from different small private HBCUs. For the six participants that identified as women, two graduated from large public HBCUs, one graduated from a large private HBCU, one graduated from a small public HBCU, and two graduated from the same private HBCU. To provide some consistency within the study, I decided to not include the three men in this study, since they all represented the same type of HBCU. Since there were a variety of women participants, I chose one woman to represent each type of HBCU. As a research, I must acknowledge there are many complexities that come with examining African American women in STEM fields. However, I am researching the African American population in STEM. I am not examining gender, but addressing experiences in HBCUs. I picked one gender because I was able to recruit one gender to represent all types of HBCUs to bind the cases.

Therefore, this study consisted of the four female participants, who graduated from the four types of HBCUs and directly enrolled into a STEM doctoral program. They

were chosen because I believed that understanding them will lead to a more

comprehensive knowledge and perhaps better theorizing about the collections of cases

(Stake, 2000). To protect the anonymity of the participants, they were provided

pseudonyms along with their institutions. Participants' institutions range from public to

private, and large to small HBCUs. Table 1 illustrates the four participants chosen, their

major, and the type of HBCU they represent.

Table 1 Summary of Descriptive information of Participants

Name	Age	Major	HBCU	Document
Marie	30	B.S. Biology	(Large Private)	Picture of student, classmates, and professor/mentor on a Research trip
Katherine	27	B.S. Physics/Chemistry	(Large Public)	Picture of student, classmates, and professor/mentor at graduation
Dorothy	26	B.S. Biochemistry	(Small Private)	Picture of student and Professor/Mentor on campus
Mary	24	B.S. Nuclear Engineering	(Small Public)	Picture of student and friend at graduation (participant wearing school paraphernalia)
Note. *Pseudonyms for participants' actual names and institutions				

Methods for Data Collection

For the purpose of this study I collected several forms of data:
(a) three interviews
(b) questionnaire
(c) picture of something that impacted participants' choice to enroll into a
doctoral program
and (d) online documents for each institution participants attended.

Oral interviews represent a comprehensive way for people to articulate holistic explanations of how they construct their experiences and realities (Standfield, 1994). The primary method for collecting data was through a multiple interview process, incorporating semi-structured interviews, followed by a structured interview. Given that all participants were not in the same location as me, I conducted phone and Skype interviews, and corresponded via email to ensure participants' stories were conveyed properly. For the interviews conducted face-to-face, by phone, and/or Skype I used a tape recorder, which allowed me to transcribe the interviews.

To gain a better understanding of the characteristics of the participants, each individual filled out a background questionnaire (see appendix D) before our initial interview. To minimize my personal biases, for the first interview, I allowed ample time for participants to speak freely as to how and why they entered into a doctoral program, and followed up with a list of question I generated. After participants spoke freely, I asked them a list of interview questions (see appendix E).

To ensure rich data and that I convey each participant's experiences correctly, I asked participants to provide a picture of something from their undergraduate experience that impacted their decision to enroll into a doctoral program. For the second interview, I asked participants to share a picture of anything from their undergraduate experience that played a role in their decision to enroll into a doctoral program, also known as a form of photo elicitation. Photo elicitation is based on inserting a photograph into a research interview (Harper, 2002).The photos were not coded, but were collected as a prompt for the interviews. Photo elicitation helps overcome the difficulties posed through in-depth

interviews, because it based upon an image that is understood, at least in part by the interviewer, the participant (Harper, 2002). In the case of this research, I allowed participants to provide their own picture. The picture served as something the participant believed impacted their decision to enroll into a doctoral program. The shared photos help to increase understanding through the interview process of what participants felt and valued from their experience at their HBCU. Moreover the method of photo elicitation help to add to the validity and reliability of this study (Harper, 2002).

The final sets of interviews I conducted were follow up interviews to give participants the opportunity to clear up or expound upon information that may not have been addressed during the initial interview. Interviews allowed participants to reflect meaningfully on whom they were before they enrolled into their particular HBCU. They were allowed to reflect how their their doctoral aspirations were developed, the role their baccalaureate institution played, and the role of significant others (for example, peers, parents, or educators) in their success. Interviews allowed for students to express the experiences they had in residence halls and classrooms, explanatory factors for active or passive engagement, environmental conditions that have fostered changes in their attitudes and behaviors, and gains and outcomes accrued through participation in enriching life experiences (Harper, 2007) that influenced them to enroll into a doctoral program.

<u>Data Analysis</u>

For each case I had participants answer the first and third research question of the study and to provide a picture with an in-depth explanation to address the second

question (Yin, 2014). These research questions were: (a) What aspects of Community Cultural Wealth do HBCUs provide in influencing Black students in STEM to enroll in doctoral programs? (b) What experiences while attending HBCUs played a role in deciding to enroll in a STEM doctoral program? and (c) What factors impacted African American students from HBCUs decision to enroll into a doctoral program? The collections of the three interviews, photos shared by each participant, and documents and information gathered online enabled me to draw a cross-case conclusion about Black students in STEM at HBCUs, and in particular the impact these institutions have on these students to enroll into a doctoral program.

I transcribed the interviews that were conducted with each participant. Each participant is expressed individually within the case report, as they expressed their different experiences at different HBCUs. After I completed the transcription, I allowed each participant to review their interviews to ensure I conveyed the participant's thoughts and experiences correctly. I also used documents and online resources from participants' institutions to member check outside programs or other components brought up by participants. This served as a form of triangulation to ensure the reliability, dependability, and credibility of this study.

Case study analysis can rely on several techniques, which might be anticipated during the initial design of the case study: the analysis can be present throughout all stages of the case study, as I gradually build an argument that addresses my research question (Yin, 2006). In case study research, data analysis has not been clearly defined (Yin, 2009), but the analysis usually consists of reviewing data, searching for patterns,

testing, and other techniques to draw conclusions about the case (Stake, 1995; Yin, 2006, 2009).

After transcribing the interviews, I used open coding to break down each case study data in order to analyze, conceptualize, and develop categories for the data (Ellram, 1996). By using open coding I was simultaneously able to make comparisons with the other cases and ask questions related to the data.

For the first step I went through the data to break down the interviews to examine closely, compare for relations, similarities, and dissimilarities. While going through data I marked concepts form the interviews with appropriate labels or codes to identify them for further analysis or common themes among participants (Khandkar, 2009). I continued to analyze the data by breaking it down into distinct idea, events or objects. I labeled the important information in the process, basing the labels on the three guided research questions. I grouped the similar information using abstract labels from the six forms of capital developed through Community Cultural Wealth, and other labels formed through the two secondary questions.

After determining the labels or codes I analyzed the data to find the similarities and grouped them into categories based on their common properties. Sub categories from the codes linked to certain categories were created if necessary (Khandkar, 2009).

The Cross case analysis involved collecting and analyzing data from multiple examples selected to inform the three research questions of interest. In order to ensure the cases aligned I utilized the analytic technique of pattern-matching (Yin, 2006).

Through the themes highlighted through open-coded I used the data collected to determine whether the patterns within the individual cases aligned with all four participants and the degree to which the conditions were substantively aligned (Yin, 2006).

I was able to draw these conclusions by going through the data and examined how each participant responded to questions from the interview protocol. I also used the picture each participant provided to determine if their stories aligned with the initial interview as well as if there were common themes shared across cases. Once the examination of the data from all participants took place I revealed the patterns from the data collection process.

The various HBCUs experiences permitted me to analyze and probe whether different HBCUs appear to share similar profiles and deserve to be considered instances of the same type of general cases (Yin, 2014). However, the utilization of the themes varied based on the participants and their experiences. Table 3 highlights the impact of each theme that was developed through the research.

Table 2 Utility of Themes based on each Case

Utility of Cases	Marie	Dorothy	Katherine	Mary
Community Cultural Wealth				
Aspirational Capital	Medium	Medium	High	Medium
Linguistic Capital	Medium	Medium	High	High
Familial Capital	High	High	High	High
Social Capital	High	High	High	High
Navigational Capital	Low	Low	High	Medium
Resistance Capital	High	High	High	Medium
Additional Multicase Themes				
Faculty engagement	High	High	High	High
Peer engagement	High	High	High	High
Supportive Research	High	High	High	High
Supportive Environment	Medium	High	High	High
Financial Assistance	High	High	High	High

High= high utility; Medium= middling utility; Low= low utility. High utility means that the case appears to be one of the most useful for developing this theme. Middling means that the case appears to be somewhat useful for developing this theme. Low utility means that the case appears to be slightly useful for developing this theme.

The findings and conclusions are provided in a single narrative form for all participants from the broader unit of analysis that serves as the main case, in addition to cross-case data from the multiple case studies (Yin, 2014). The data from both levels ultimately feed into the final case study.

I was open to participants who do not share similar experiences with other participants and provided details as to what made their experience so unique. As a researcher I must understand everyone's educational experience at an HBCU (or any institution for that matter) is not the same. Therefore, I have made sure to include other factors that have influenced their enrollment into doctoral programs that might come about before or after participants' HBCU experiences.

<u>Limitations</u>

As a researcher, I ensure the implementation of rigor throughout the study, but there are a number of possible limitations with the research. First, I heavily relied on personal interviews. Although various forms of triangulation took place, I did not have access to participants' personal information; making it more difficult to verify data obtain from one source against those from another to substantiate information acquired (Heck, 2006). However, the nature of my research questions and the design of my study to implement documentation (e.g. picture) provided by the participants supported the use of interviews as a major source of data collection and did not require additional collection methods.

A second limitation is the reliance of participants' self-reported data. All the data in this research relied on the stories of participants. Relying solely on participants as a data source can lead to the omission of information, especially since this research examines students once they were removed from their experience. It is important that my data are deemed credible to minimize this limitation (Heck, 2006). The reliance of participants' self reported data was largely backed through a process of member checking- asking participants to authenticate the interpretations of their statements, providing a picture or document from their undergraduate experience, and by checking their institution's website for possible leads to programs mentioned in the interviews.

The third limitation is transferability or generalization (Yin, 2014). By using Community Cultural Wealth as the theoretical framework within this research, played a critical role in helping to generalize the lessons learned from this study (Yin, 2014).

Therefore, I have used this study as an opportunity to shed empirical light on HBCUs

serving as a conduit for Black students into STEM doctoral programs.

<div align="center">Quality of research design</div>

It is important for the researcher to ensure the quality of their research within a

qualitative study. The quality and rigor of the research can be judged according to certain

logical tests. Concepts that offer these tests include trustworthiness, credibility,

confirmability, and data dependability (U.S. Government Accountability Office, 1990).

Yin (2014) identified several tactics for dealing with these four tests when conducting

case study research. To guarantee quality of my research, I was intentional about

implementing that various tactics across the various phases of this research.

Construct validity, as known by qualitative researchers as confirmability, helps to

identify correct operational measures for the concepts being studied (Yin, 2013). The

three tactics to increase construct validity when using case study method are; (1) multiple

sources of evidence, in a manner of encouraging convergent lines of inquiry; (2) establish

a chain of evidence; and (3) have a the draft case study report reviewed by key

informants. I addressed it by having participants fill out a questionnaire, conducting

multiple interviews, having participants provide pictures, using online documents from

participants' institutions, and having participants review their stories after they were

completed.

Internal validity, as known by qualitative researchers as credibility, main concern

is to explain how and why one event led to another. Internal validity also extends to the

broader problem of making inferences. To increase internal validity researchers much

conduct pattern matching, explanation building, address rival explanations, and/or use logic models. I addressed this by using opening coding to analyze my data, and having participants provide pictures based on their experience.

External validity, as known by qualitative researchers as transferability, deals with the problem of knowing whether a study's findings are generalizable beyond the immediate study, regardless of the research method being used. Researches should identify the appropriate theory or theoretical propositions to increase external validity. I addressed this by applying Community Cultural Wealth theoretical framework to this study.

Reliability, as known by qualitative researchers as dependability, is to ensure that if a researchers were to follow the same procedures as described by a previous researcher and conducts the same case study over again, the later investigator should discover the same findings and conclusions. Therefore, researchers should use a case study protocol and develop a case study database to ensure reliability. I addressed this by providing the questionnaire and case study protocol, which can be found in appendix D and E.

<u>Subjectivities</u>

No matter how interested in the research topic, the research cannot allow emotional attachment to "preclude the open exploratory learner's attitude that is necessary for good data collection and analysis" (Glesne & Peshkin, 1992, p. 14). Therefore, it is important for researchers to acknowledge subjectivities as part of the research process. Once the researcher's subjectivities are identified, they can be closely monitored throughout the research process so that trustworthiness is produced throughout

the research (Glesne, 2006). Trustworthiness was accomplished through triangulation within the research. These subjectivities in return can begin to contribute to the research being conducted.

As the researcher, I self-identify myself as an African American male, who is a graduate of two HBCUs (Oakwood University and Howard University). Although I did not obtain a degree in a STEM discipline for either of these institutions, I am a fervent supporter, lover, and advocate of the HBCU community and their existence within the American higher education system. As a result of attending an HBCU, I contributed my enrollment into a doctoral program to these institutions. I believe it is only through attending these institutions that I was given the opportunity and encouragement to continue within the education pipeline. The effects of attending these institutions continues to persist today as I serve as a supporter for these institutions through a number of internships advocating for HBCUs.

In addition to the being an advocate and graduate of HBCUs, through the interview process I began to identify with the undergraduate and graduate experiences of the participants. I recognized that even within the various disciplines that many of the experiences my participants had with faculty, staff, and peers were extremely similar to my experiences at Oakwood and Howard University. I also recognized that any of the shared experiences I had with my participants in search of a graduate school and their view of graduate school based on their experience at a HBCU.

The ability to understand and acknowledge my personal subjectivities was critical, especially during the date collection and analysis process. By being forthcoming

with my subjectivities, I was able to better understand my views on HBCUs and the role they play in influencing and assisting African Americans to enroll in doctoral programs. I also was able to better handle my subjectivities by constant reflection through the use of a research journal to ensure that my subjectivities did not appear as a hindrance within the study. Most importantly, by acknowledging my personal subjectivities, I was able to remove my preconieved notions and biases, which allowed for participants to speak freely and share their experiences based on their own personal beliefs.

<u>Chapter Summary</u>

In this chapter is a description of the research design, the rationals for the research design and methodology used in this study. This chapter also included the list of research questions explored, as well as the description of the selection of participants. Additional information is provided on the data collection and data analysis process. Lastly, potential limitations, measures to ensure the quality of research design, and the subjectivity of the researcher are also shown in this chapter.

CHAPTER FOUR

MARIE (DU BOIS UNIVERSITY)

Marie is a Ph.D. candidate in the environmental science at a private university in the southern region of the United States. She is currently researching the relationships building between scientists, businesses, and legislators, as they try to build equity in stakeholders' engagements with environmental management and policies. Marie graduated from W.E.B. Du Bois University, a large private HBCU, in 2007 with a bachelors of science in biology. While attending Du Bois University Marie was able to participate in the biology scholars program, recycling program, American Institute of Biological Sciences, Environmental Students Association, and Phi Beta Kappa Honor Society. Marie's experience is unique in that she attended two other institutions and worked for a year after graduating from Du Bois University, before settling into her program at her current institution.

Interest in the field/Ph.D.

Growing up in Baltimore Maryland, Marie has always had an interest in the environment and animals. As a child growing up Marie believed the only way to work with wild animals was to become a veterinarian. From high school until about her sophomore year at Du Bois University Marie planned to go to veterinary school. Unfortunately, there was not much support for students who aspired to be a veterinarian at Du Bois University. The majority of the career support and mentoring in the biology department went toward students with medical school aspirations.

Marie eventually found a breakthrough when she was presented with an opportunity to apply for the Du Bois University Environmental Biology Scholar program. Marie applied to this program with that idea that if she could not focus on veterinary science, maybe she could get into environmental conservation. Then she could go work in Africa with large animals, which is her big dream. Once Marie became an Environmental Biology Scholar, she began to work on a research project focusing on squirrel behavior for the last two years of her time at Du Bois University.

Through the Environmental Biology scholars, Marie was encouraged to apply for a National Science Foundation Research Experience for Undergraduates (REU). Marie's REU placed her at the University of Cape Coast in Ghana. This was her first time experiencing working in Africa as well as doing real behavioral science work with animals. From this experience Maries passion carried on, and she wanted to continue in this field of research. She wanted to work with lions, tigers, and bears, and in order to reach that point she would need to get a Ph.D. Marie essentially replaced her desire for a veterinary doctorate with a Ph.D. doctorate in environmental science.

Community Cultural Wealth at Du Bois University

<u>Aspirational Capital</u>

The role Du Bois University played in shaping Marie's aspirations in life were unique in many aspects. Before entering into higher education, Marie and her family already established that she would obtain a terminal degree. Marie also had formed her desire to work with animals as a child. She described how when she was growing up,

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"coming home with birds eggs that fell out of the nest and snakes. I rescued mice from mice traps and raised them. I didn't want to do anything else but work with animals. I don't feel that Du Bois really made a difference in that goal that was always in me."

However, Marie does believe Du Bois was influential in how her aspirations were manifested. Do to the fact that she went to an institution with no resources for veterinarian school and more resources for ecology, she ended up taking the Ph.D. route to fulfill her dreams.

Marie also credited her advisor in helping her develop her goals by modeling what an academic researcher in ecology looked like and their lifestyle. Growing up Marie did not have much exposure to areas in STEM, and in a way her advisor modeled what a desirable academic life could be like in a STEM field. Meeting her advisor showed her "if you get an Ph.D. you can live like this. You can spend your summer in Suriname, which is what he does with his wife at their summerhouse. He does research while he's down there and then goes back up for the year." While this did not influence Marie to pursue a terminal degree it did bolster her desire to go to graduate school in hopes of obtaining a PhD in environmental science.

Linguistic Capital

Marie described the environment at Du Bois University to be "very geared toward the African-American experience and there's a lot of focus on that." Conversely, as a student in a STEM discipline most classes did not allow a space for cultural relevancy within the curriculum to take place, but, the environmental science started to deal with issues related to culture and environmental justice. Marie's advisor was extremely active

in the environmental justice community. Through her advisor, Marie was introduced to environmental science as a tool of social justice and how environmental injustice manifests itself, for example "why brown fields and power plants and polluted areas are often proximate to minority communities and poor communities."

Familial Capital

Du Bois University in Marie's eye was cliquey, there's actually a fair amount of physical division and social division by major. Marie provided the following example, "I didn't have as many friends in the business side. I didn't really socialize with business school kids a lot. They were all on the other side of campus. They were always wearing suits and doing their thing and you wouldn't run into them or anything going between classes."

Once Marie spoke specifically about her program she able to articulate the type of relationships she formed while attending Du University. The environmental science program was much smaller, which cultivated a cooperative, collaborative, and supportive environment. Marie described her relationship with both students and faculty within the environmental science as a family.

Marie's cohort while at Du Bois University was quite small, with about four students including her. Within this small cohort some form of peer-to-peer mentoring took place. The small cohort also worked together on projects, traveling to various cites to conduct research. Marie believes traveling together as a cohort help to create more of a family bond between the students in her program. This family like bond allowed the students to remain in contact and good friends uto this day.

The relationship with her advisor and faculty within the environmental program was "more like a friend/mentor kind of relationship". Marie still talks to the faculty from her program. Whenever she goes back to where Du Bois University is located she makes sure to stop by and visit them. Because of this positive experience Marie now serves as a mentor to many of the undergraduates at Du Bois University.

Social Capital

One of the most beneficial experiences for Marie at Du Bois University was the access to social capital she gained through her advisor and faculty. Marie was introduced to so many opportunities that those opportunities would turn out to be extremely influential in her decision to purse a doctorate in environmental science.

Marie's very first research opportunity was through the Ecological research program at Mountain Lake biological station, a program sponsored by the NSF and Mountain Lake biological station. The faculty at Du Bois takes a group of students to this station every summer. Students are introduced to fieldwork and how to work in the field. Marie had the opportunity to go for the first time her junior year at Du Bois.

Marie was also encouraged to apply for the Ecological Society of America's SEEDs Program (ESA). The ESA program specifically engages minority students in environmental science. Through this program Marie was sent to her very first big international conference, the International Conference on Ecology. It was during this conference Marie realized where she wanted to be. She exclaimed, "It's so cool, all these people working on such interesting things, on like, wolves and caribou and lion." ESA

also provided Marie with a SEED Mentor. This was beneficial, because it provided her with a mentor outside of her faculty who provided her with a diverse perspective.

The environmental Biology Scholars program was another NSF program ran by the faculty in her program. This gave Marie and her department funds to conduct small research projects. It was through this program that Marie was introduced to the squirrel project.

Marie was encouraged by the faculty of the environmental program to apply for the NSF's Research Experience for Undergraduates (REU) in order to build up some research experience and to competitively position her for graduate school. REUs takes place all across the world, usually at universities. Through the program, Marie applied to do research in Costa Rice and Ghana. Ghana accepted her application. A professor has to apply and say, "Hey, I want to create an REU experience," and then they come up with little summer research projects and they take maybe ten to twelve undergraduate students who will come and work for the duration of the summer on this research project. It's like a trading opportunity. In Marie's case it was also an opportunity for her to spend the summer in Africa and hang out in Ghana. That was hugely influential in where she is today.

Marie was also about taking advantage of the relationship her advisor had with a professor in an environmental science program. She was able to use this relationship to enroll into her first graduate school. The professor at this graduate program is a black woman in environmental science, although technically her focus is on recreation science, which focuses on parks and how people use parks and recreation spaces and national

wilderness, national forests, etc. Regardless, her advisor thought that she would be a really good fit for Marie and a really good mentor. Marie's advisor specifically suggested that she go there. When it came time to choose between them, that's when her advisor was really like, "I think you should go where Jillian is because I know that someone will take care of you." "So I did, and I chose that particular institution." Unfortunately, she was there for two years, finished with a Master's degree, decided to leave to follow her advisor's colleague to another institution.

Navigational Capital

Marie made it clear that department at Du Bios University did not help her navigate her way to her doctoral program. The department as a whole was more interested in prepping students for the MCAT. Conversely, Marie was able to gain some form of assistance from her faculty/advisor/mentor through conversations about graduate school, editing her personal statement, and writing her letters of recommendations. Because of the lack of support for the environmental science program at Du Bois University, Marie felt as though she was unprepared in certain areas when entering graduate school. Marie explained how she struggled a lot during her first year of graduate school. The biology curriculum at Du Bois was not flexible enough to expose Marie to subject such as statistics and physics.

Marie could not express how valuable her advisor and faculty member were to her personal development, and as an environmental scientist. "They were a tremendous source of support and I think they often bolstered my confidence a lot. They made me

feel like I had someone who understood my field and understood what I was dealing

with, who could be an advocate for me… they're like my career parents."

Resistant Capital

The support Marie received to counter any form of resistance entering a STEM

field was unique in a number of ways. Marie's advisor and faculty of the program were

not minorities in terms of race. Marie defined them as "grown up hippies." However,

Marie felt as though they did the best they could. Her advisor was especially candid and

up front about problems she may encounter as a Black woman in STEM. He told her,

"(explicit) those people… There's nothing wrong with you. You're a great student." The

faculty in her program even went out of their way to seek out minority supporters for the

students, considering they themselves were not minorities. They also encouraged Marie

and her classmates to participate in programs that would exposure them to similar peers

in the field. Marie believed, " they tried very hard to prepare us for a culture in our field

that is often not maliciously, but ignorantly prejudiced."

The support and assistance with resisting in an unwelcoming field continued even

after Marie left Du Bois University. Marie recalled a really bad incident in graduate

school;

> I got locked out of my office one time. I just locked my keys in there and I
> went upstairs to ask the facilities lady to just let me in. She told me that she didn't
> want to let me in because she didn't think I belonged there and all this other stuff.
> This was the same lady who told everybody to put their purses away because
> there was a little Mexican boy coming in and all this stuff. She was a hot mess.
> That incident was really upsetting for me.

Even though Marie was not long at Du Bois one of the first people she called for

some kind of comfort was her old advisor. It was the level of comfort and support Marie

established with her old advisor that made her secure enough to contact him in the time of resistance.

More importantly Du Bois provided Marie with the space she need to become the environmental scientist that she is today. The faculty and students at Du Bois help create a space where Marie and her classmates could make mistakes and learn. Marie explain how important this space was for her:

> But that being in an environment where there is a lot of support and where there is a pre-established understanding that this is a learning environment this is for training it felt a lot more comfortable to make mistakes. I think you can also say that because it is a HBCU those mistakes did not feel as though they were representative of the ability of Black students overall. Like if I messed up an experiment I don't feel like anyone would assume that "oh that's because Black students can't do experiments." So I think that those things in combination probably made it a lot easier to feel like I could learn and grow.

Marie partially attributed the supportive environment to being at an HBCU. It was at her HBCU where she felt the least amount of resistance, which in return developed her into a scholarship and prepared her for research outside of Du Bois University.

Experience at Du Bois University

When I asked Marie to share an important aspect of her experience at Du Bois University that impacted her decision to enroll into a doctoral program, she sent me a picture of her, her faculty member, and cohort on their research trip to Mountain Lake. This picture represented a number of factors that impacted Marie's decision to enroll into a doctoral program; (1) being a part of the Environmental Biology scholars; (2) exposure to research; and (3) the faculty and peer relationships that were developed while at Du Bois University.

Although the environmental biology scholars program was not Marie's determining factor for enrolling into graduate school, it definitely help guide her to what she wanted to do and what she ended up doing. The program gave Marie along with her classmates the "opportunity to learn, to do research, and to experiment a little bit and to mess up. And it was having that early space to make mistakes that helped all of us to become more confident later on as researchers."

This particular picture that Marie shared was taken during her junior year at Du Bois University. It is a picture of Marie, her cohort, and faculty from the program at Mountain Lake for the summer to conduct research on plants. The trip to Mountain Lake was the first of many research trips for Marie. After that trip, Marie spent a summer in Hawaii taking classes, and she went to Cape Coast Ghana to conduct a research. The trip to Mountain Lake was the starting point for Marie in conducting research. Marie said, "This was the first point in college for my particular interest where I got to do anything cool. Where I really got to specialize. I got to be around other people who were specializing in the same things that I was."

Outside of the environmental science and environmental biology program there was not much support from the university. Therefore, the faculty of the program worked hard to create a really tight knit group of environmental biology scholars. This tight knit group formed a peer-to-peer mentoring group, causing the cohort of students to become good friends. With such a small cohort and the number of trips everyone took together, brought the students closer together. Lastly, the relationship with Marie's faculty was extremely important, especially with the lack of support from the university. It was

through her relationship with the faculty that she was able to gain her first exposure to research in environmental science and to be a part of programs such as environmental biology scholars. The bond Marie formed with her faculty at Du Bois University is so strong that not only does she remains in contact with them, but it has encouraged her to continue to give back to the environmental science progam at Du Bois anyway she can.

Factors that impacted enrollment into a Doctoral Program

When I asked Marie what factors/incentives where important when choosing a doctoral program, she gave me three specific things she looked for wherever she applied; (a) trusting faculty; (b) Financial security; (c) Climate.

Marie was looking for a program where she would have a safe place. Luckily for Marie, her advisor had a good friend that was a professor in an environmental science program, that they trusted would provide her with that safe space. Marie felt secure in choosing the institution she did, because of the recommendation her advisor made about a faculty member and she trusted his judgment. It also helped that the faculty member at the graduate school was a Black women. Marie knew she would have at least one minority faculty whom she felt she could form a great relationship with.

Security of funds was the second factor Marie found to be important. Marie wanted to know she would have funding to support her throughout the duration of her program. One of the institutions that accepted her put her on a year-to-year contract. "The way they do their funding is they renew it every year, so there is a possibility, although it's very slim, that you wouldn't get renewed in a year," opposed to the institution she chose to enroll, which guaranteed funding for five years.

The third factor Marie considered when choosing a doctoral program was the weather. Marie was accepted into another institution in the northern region of the United States but decided not to attend because it was not to her liking. "I don't know if you've been to North-state, but it's freezing cold."

Marie's situation is unique by the fact that she has attending three different graduate schools. Although the she followed her professor from the first program to the second, by the time Marie applied to her third program what she wanted out of graduate school had somewhat changed. The third time around Marie was only interested in two factors. The first was ensuring she enrolled in a quality program, most specifically a high-ranking program in environmental engineering. The second factor was having a better fit with her advisor. Marie explains how her approach was different this time around,

> So I think before when I first started looking at programs, I was really looking at does the program at large do environmental science? I think I learned to be more specific. I clarified a lot of what my own research interests were. I learned to be more specific and clear about what those research interests were. I learn to meet with an advisor and build a relationship with them. So that I was looking for not just what research interest, but also larger than that personality set and goal fit.

This time Marie was more specific in her search, basing her decision on her own research interests and making sure there were faculty who would match well with those interest as well as her personality.

CHAPTER FIVE

DOROTHY (DRED SCOTT UNIVERSITY)

Dorothy is current in her third year doctoral student in cancer and cell biology at a large research one institution in the Midwest region of the U.S. Her current research interest involves understanding fatty liver disease development and liver cancer progression, chronic liver disease progression and eventually hepatocellular carcinoma, which is liver cancer. She graduated from Dred Scott University, a small private HBCU, in 2013 with a Bachelors of Science in biochemistry. While attending Dred Scott University Dorothy was active in the Dread Scott Biomedical Association, Minority Association of Pre-Medical Students, the Science, Technology, Engineering, and Research (STEMR) (student researcher); and the Chemistry club (Vice-President). Dorothy is unique within the context of this study, in that she transferred from a predominantly white institution to attend Dred Scott, a HBCU.

After graduating from high school Dorothy planned to attend an institution in her home state of New York. Unfortunately financial aid fell through at the last minute, and Dorothy had to attend another institution. The institution Dorothy attended her first year of college was extremely large, and she did not feel as though she was being developed or poured into the way she wanted, so she decided to transfer. Although, Dorothy wanted to transfer, she was not sure where she wanted to attend. Providentially, one of Dorothy's family members attended Dred Scott, and invited her to visit the institution to gain a feel for campus life. Uncertain of where she wanted to be, Dorothy prayed on it. The doors to other institutions were closed, and it so happened that only opportunity available was

attending Dred Scott. At the end of her freshman year in college, Dorothy transferred to Dred Scott University.

Interest in the field

Dorothy had a desire to attend medical school since the 9th grade, however, while at Dred Scott she was part of Dred Scott University's HBCU-UP program known as Science, Technology, Engineering, and Mathematics Education through Research (STEMER). This program is a federally funded program through the National Science Foundation, to increase the number of minority graduates who pursue Masters or Ph.D. degrees in STEM disciplines. Dorothy served as a researcher in the STEMER program for two in a half years with her mentor and really enjoyed her research experience and decided not to apply to medical school, but applied to graduate school to do research.

Dorothy's interest in medicine came at a young age when one of her favorite cousins died from cancer. From this great loss, Dorothy gained an interest in becoming an oncologist, eventually she realized that doctors don't have all the answers nor do they have time to find them unless they are conducting research. Dorothy realized,

> most of the people that do research and look into how these diseases work are people who have PhDs or people who do medical related research…. even if I went to medical school, I still wouldn't want to work with patients too much, but I would still want to do something more research focused.

Dorothy decided becoming a science researcher was something she wanted to do rather than enrolling into medical school.

What solidified Dorothy's decision to enroll into a doctoral program was after she spoke in great lengths with her mentor/professor from the STEMER program. He was able to provide Dorothy with information about obtaining a PhD and the graduate school

process. Dorothy's mentor was very encouraging about her desire to pursue a PhD. This encouragement would prove to be beneficial when Dorothy was not accepted into graduate school right after graduating from Dred Scott. However, Dorothy did get accepted into a NIH post-bac program, which served as a mock graduate program for a year. During this year, Dorothy gained the same benefits as a graduate student and conducted research in a lab. After the year in the post-bac program, Dorothy reapplied to graduate school and was much more successful the next time around.

Community Cultural Wealth at Dred Scott University

<u>Aspirational Capital</u>

Within in the science department at Dred Scott there is a culture that encourages students to enroll into professional schools such as dental or medical school. Fortunately, in the chemistry department, the faculty were more open about their students going to graduate school if they showed interest. Dorothy recalled,

They would support you if you were going to medical school or whatever, but they were open, and definitely I feel like they talked about their experiences in graduate school more than teachers that I had that were in the biology department.

The Chemistry department at Dred Scott made sure to provide the opportunity for students to consider graduate school. The opportunity to consider graduate school was instrumental in Dorothy's aspirations to enroll in graduate school. The change was developed through the support Dorothy received from the faculty in the Chemistry department. Dorothy spoke with them one on one to ask question about no longer attending medical school or attending medical school after completing graduate school. Many of the faculty Dorothy spoke with encouraged her to attend graduate school, telling

her, "You have the mindset and mentality for graduate school, because you are very inquisitive, and ask a lot of question, which are great characteristics for someone who wants to do research." The encouragement Dorothy received from her faculty was helpful in her new desire to attend graduate school.

The encouragement from Dred Scott faculty was important to Dorothy, after dealing with her previous experience. Dorothy recalled a time at her previous institution before transferring to Dred Scott,

> My personal advisor and all of the students were assigned to speak to the science chair, like the chair of the math and science program at our school, so we would have to see our personal advisor and then her, and she would always discourage me about medical school. She would just be like, "I don't think you really have what it takes to go to medical school. I don't think you're going to do as well. Yeah, this is your first year, but these are still important times where you need to be excellent. You need to be above average for the class for them to consider you. "The same thing for my direct advisor, would be discouragement. "Maybe you should consider a different route or different career choice or different career opportunity.

The experience at Dorothy's first institution was offensive and discouraging. The faculty made extreme generalizations about Dorothy and her future based off of one meeting. Conversely, Dorothy's experience at Dred Scott was drastically different. Coming in as a transfer student, she automatically assumed she could reach her goals. Although coming in Dorothy did not know any of the faculty at Dred Scott, they were very encouraging and made an attempt to get to know Dorothy personally.

Linguistic Capital

As a student of color in a STEM discipline, the ability to be comfortable in the learning environment proved to be extremely helpful and impactful in Dorothy's success. It was not until Dorothy entered into her first year of graduate school, that she realized

these benefits. Without the support and relationships Dorothy established at Dred Scott, she felt as though those in her class were judging her. She didn't feel like it was an open opportunity for her to be completely vulnerable as she was at Dred Scott. To succeed and thrive in her current doctoral program, Dorothy had to build a network of black women who were also in STEM, where she could be herself. This network allowed Dorothy to properly prepare for papers, class discussions, and presentations. Dorothy felt more comfortable preparing and gaining feedback from those we look like her. She, explained, "when meeting with my girls, I had to be on my A game, because they were going to tell me about myself in a way that I could handle, or even if I couldn't handle it, but at the end of the day, they were going to make sure that I wasn't going to misrepresent myself when I got in from of everybody."

While the faculty in Chemistry department at Dred Scott was not majority African American when Dorothy was a student, the faculty was extreme diverse in race and ethnicity. However, they understood the institutional mission Dred Scott has in education African American students. They were supportive and understanding of their students. Dorothy exclaimed, " I didn't feel like I ever had to be someone else. I could always be myself around students, around faculty members, etc. I didn't have to watch the way I speak or something…. masking my ethnic identity, I never had to do that." The ability to be herself and not mask any par of her identity proved to be beneficial to Dorothy and has played a major role in where she is today.

<u>Familial Capital</u>

Even, with the diverse representation amongst the faculty, Dorothy considers the

Chemistry department, along with the students to be like a family. In the Chemistry

department at Dred Scott once students become upper classmen they take the majority of

their classes together, and those are who Dorothy considers to be her family. Dorothy and

her classmates would study together for nearly every exam. This actually made graduate

school a little difficult, because she had to learn how to study independently. Dorothy

explained,

I still am in touch with them via social media or sometimes through text or whatever. Sometimes I'll see them, but to this day these people are still encouraging me. We have a group chat and everyone now then we'll update each other, request prayers, etc.

However, the bond did not stop with the upperclassmen, even the underclassmen

were seen as extended family memebers to Dorothy. Many of the underclass looked up to

Dorothy, which provided her the opportunity to serve as a mentor to those who worked in

her lab. They would seek council from Dorothy once they made the decision to enroll

into graduate school rather than medical school.

The faculty at Dred Scott were extremely important to Dorothy during her time

there. The faculty from the Chemistry department showed their support when Dorothy

had to reapply to graduate school. It was not a problem for Dorothy to reach out to those

faculty members to update them about her life, or request their assistance. To this day,

Dorothy reaches out to the faculty in the Chemistry department, especially her mentor at

least twice a year to update him on her graduate school experience. Dorothy gains

affirmation and encouragement from faculty at Dred Scott, reminding her that although it

will not be easy, she is more than capable of successful completing her program. Dorothy summed up her relationship with the faculty by saying, "I definitely feel like I made lifelong friends going to Dred Scott, and I made lifelong colleagues in my professors."

Dorothy also had the opportunity to form a family like atmosphere with a group of people who were not in her department. During her second year at Dred Scott, Dorothy served as a residence assistant, where she formed a relationship with many of the staff at Dred Scott. Dorothy felt as those they were really supportive of her, especially academically. Dorothy recalled, "during my first year the dean pulled me aside and was like, "if you don't want to do this for a second year we will completely understand because we know you are trying to go to medical school." The dean went on to tell her, "You are trying to go to medical school. Being a residence assistant is not going to get you into medical school. If you need to focus, focus." This was important to Dorothy as she found people who genuinely care about her and her dreams.

Social Capital

One of the professors at Dred Scott and the graduate program director at Dorothy's graduate school, have a close relationship. The graduate program director, along with former students of Dred Scott, typically schedule a recruitment trip to Dred Scott for their graduate program and summer research program for undergraduate. Interesting, Dorothy's current graduate school had come to visit the Biology department at Dred Scott, while she was a student there. Unfortunately, many graduate programs did not come to visit the Chemistry department, so Dorothy did not know when graduate

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schools would come to visit Dred Scott unless a friend within the Biology department would tell her.

Dorothy was an active member of the Dred Scott Biomedical Association. The biomedical association would have someone come to speak to the students about various schools and program, typically about medical school. They would also have guest come to speak about conducting research. Eventually the research guest would serve as an inspiration to Dorothy, once she realized she wanted to do research. It encouraging for Dorothy to see other Black people conducting research, especially translational medically related research. Dorothy was also able to participate in mock interviews, in preparation for graduate school. The mock interviews were helpful for Dorothy, because she was able to interview with professors who really did not know her, providing a real life atmosphere.

The STEMER program also served as a major form of social capital for Dorothy while at Dred Scott. This program allowed Dorothy to conduct research during the academic year and summer. The program also came with various incentives such as a stipend of up to $3000, a GRE preparation workshop, presentations by visiting scientists, visits to graduate schools, and the opportunity to attend various scientific conferences to present research.

Navigational Capital

Unfortunately, Dorothy believes Dred Scott could have done a better job in preparing her for graduate school. Part of the reason Dorothy felt unprepared has to do with the fact that she switched focus once enrolling into graduate school. She also

mentioned Dred Scott needing to update their curriculum. Nevertheless, Dred Scott did provide Dorothy with various tools which she would need before and after enrolling into her doctoral program.

Dred Scott placed Dorothy in a position where she was able to gain networking skills. She credits this skill for allowing her to make it this far academically. Dred Scott put her in a place where she did plenty of networking, whether it's networking with people in her class, "like, hey do you have an old exam so I can see how this teacher is? To working with people to complete difficult homework assignment." These skills were even used a various conferences in order to meet different people and find out about different programs. The skill of networking built a strong foundation for Dorothy to succeed in her field.

Dorothy's networking skills would eventually translate into her learning to ask for help. She was not afraid to ask for help from classmates, upperclassmen, or professors. Dorothy recalls, "One thing I was never shameful in doing while at Dred Scott was seeking out help, asking my professors for advice or speaking to my program director, and my program coordinator." Dorothy made all attempts to be proactive and not reactive in terms of grades and fall behind in her schoolwork. This was a major contrast from Dorothy's first institutions, as she explained,

> That's something I really learned how to do at Dred Scott, which was like opening up my mouth and seeking out help because that wasn't something that I felt comfortable doing in my first institution, my undergrad institution because mainly it was an incredibly large institution.

Dred Scott also prepared Dorothy to think more like a scientist, in terms of research and disseminating her work. In the research lab at Dred Scott, Dorothy was able

to write collaboratively on some publications for scientific journals. Collaborating on the publications taught her how to write, prepare manuscripts, and to gain an understanding of how true scientists write. During this time Dorothy was treated as a colleague, as her mentor would prompt her for ideas of the next experiment they should conduct. Not only did this build Dorothy's confidence as a scientist, but it prepared her for graduate level research, where although she might be a graduate student or PhD candidate, she is still a colleague to her professors.

<u>Resistant Capital</u>

While studying in the biochemistry program at Dred Scott, Dorothy did not have many African American faculty advisors, her mentor was actually Russian. The conversations surrounding the opposition she might face as a Black researcher in a STEM discipline was few and far in between, because they did not understand what Dorothy would be up against. There were two instances which really stood out to Dorothy during her time at Dred Scott that really help put things in perspective.

Dorothy recalled one professor that was African American imparting words of wisdom to her and her classmates after not doing so well on an exam.

> He was really frustrated with us. We had failed a quiz or did horribly on an exam and he just really came down on us and was just like, "You guys have all these dreams and you guys want to do this and that and the third. You guys are Black. You guys need to work harder. You have to put in much more work to get to where it is that you are trying to go, and you guys are lazy. You guys are not putting in as much work that you need to do, and it's only going to be detrimental for you in the long run.

He went on talking about his experience as the only black man in his program and how that experience was difficult for him because he had never been the only black

person in an institution that he attended. He said, "Those are things that you guys may have to consider. Culturally you'll be out of place. You don't want to also academically feel out of place because you don't have your stuff together and stuff like that." Him saying that to Dorothy really woke her up and made her realize she has to prepare herself for what was ahead.

This African American faculty member had a major effect on Dorothy in more than one way. While Dorothy was attending a research conference she met an African American woman who was classmates with her faculty member that shared his experience as the only Black man in the program. She told Dorothy, "it's difficult to be a woman of color in STEM, especially a black woman, especially being the only black woman." However, this conversation did not become meaningful to Dorothy until she enrolled into her current doctoral program. Now Dorothy is the only Black person in the entire building besides the technician or the cleaning crew. Dorothy is the only Black person conducting research in preparation to receive her doctorate degree. It is now that Dorothy understands the difficulties with being the only person of color in a program.

Experience at Dred Scott University

Dorothy provided me with a picture of her and her professor/research mentor from Dred Scott University as a representation of her experience there and what impacted her decision to enroll into a doctoral program. The picture was taken a year after Dorothy had graduated from Dred Scott, when she had come back for a weekend to visit. This picture was important because he was Dorothy's first real research mentor and provided her with the encouragement to apply to a doctoral program. Although the picture does not

take place at the time Dorothy was attending Dred Scott, the picture sums up what she experienced while there and even when she graduated that influenced her decision to enroll into a doctoral program.

The picture is important to Dorothy because she considered this mentor to be, "hands down the best research mentor that I have had." He really pushed Dorothy in terms of expanding her research. He was the person who taught her to think and write like a scientist. Many of the publications Dorothy has written were because of her mentor. He would be sure to involve her in writing and editing the manuscript. So that was really good practice for what was ahead in her doctoral program.

The relationship between Dorothy and her mentor had a strong impact on her educational experience. Her mentor displayed a lot of faith in her. He trusted her as an individual and saw her as a colleague opposed to someone just working in the lab. Dorothy believed

> He valued my opinion and my advice in terms of different methods we would try for our projects. He valued my criticism in writing our manuscript. It made me feel like I can actually do this stuff, because I was writing with him the manuscript, thinking like a scientist all of those things that are so important.

Treating Dorothy as a colleague allowed for her mentor to be open and honest with her. He was able to tell her the good and the bad. He would provide constructive criticism, informing her of her shortcoming, but with tact, which was very important to her. Even toward the end of Dorothy's time at Dred Scott when she became a bit lazy, he informed her she was slacking. This was to make sure Dorothy did not get distracted, and

to remind her not to lose focus. He continuously motivated Dorothy and reminded her to "keep her head in the game."

Another reason this mentor was so important to Dorothy was because he was the first one to give her the idea about attending graduate school. He would ask Dorothy questions about her desire for medical school. When she told him some of the reasons she wanted to attended medical school, he replied by saying, "you want to go to medical school to eventually do research. So what is the point really of going to medical school, when you want to do research, when you can go to graduate school and do more research." Although Dorothy thought of the idea, she never truly saw it as an option. It was not until Dorothy's mentor encouraged her to apply to go to graduate school. He told her, "You have what it takes. You are inquisitive enough to pursue a graduate degree."

What made this experience so unique for Dorothy is that when she started to face the reality that she was not going to medical school, someone else (her mentor) noticed it before she verbally expressed it to anyone. When this happened Dorothy responded, "Wow! What are you doing in my head type of thing?" This interaction was important to Dorothy's because;

> For someone who I've worked with and someone who had learned me as a person, plus I was in his class, so I was one of his students also. It wasn't just coming form nowhere. It wasn't like you weren't good enough to go to medical school, just apply to grad school. It was like think about what you want and can medical school really do that for you? Or more of a why not graduate school? I think we did have that conversation where it was like why medical school versus graduate school.

Dorothy and her mentor had several conversations about medical school versus graduate school, and she couldn't really answer many questions about why she wanted to

go to medical school. This was extremely odd and challenging for Dorothy considering she had been planning to attend medical school since the ninth grade. However, Dorothy could answer numerous questions about why she wanted to continue research.

One of the most significant aspects of the picture Dorothy shared was that, it was taken while she was in her post-bac program after she graduated from Dred Scott, and she had officially got accepted into different graduate schools. Dorothy decided to come back to Dred Scott to talk with her mentor to receive guidance about her graduate school options. Dorthoy's visit was right before the time she had to make a decision about graduate school, and she thought it was important for her to get his opinion. He was someone Dorothy trusted and knew he had her best interest at heart. She knew he would not lead her astray in any way or try to convince her to make a decision that would benefit him. Dorothy said,

> he was just very not partial at all and was very straightforward, told me about things that were very important like identifying faculty members that I can actually work with, knowing the attitude and structure of the department etc., like how all of that works.

He constantly reminded Dorothy that this would not be three or two years of her life, but five to seven years, and that it is important for her to find a good institutional fit. Although he did not necessarily point out what school Dorothy should attend, he made sure to inform her of the important characteristics within a program that really matter. The skills and advice, Dorothy's mentor bestowed up her were insightful and impactful, but what proved to be of most importance to Dorothy is the encouragement and support she received from him.

He really expressed how proud he was of me and that really meant a lot to me because it made me feel… So a lot of times I just felt discouraged or like I was letting myself down, letting other people down and for him to say he was very proud of me and what I've been doing really help me continue, because I wasn't finish my post-bac.

During Dorothy's post-bac program she experienced some difficulties and struggles as she transitioned from more of a hard science to a biology type science. Many times she felt discourage or like she was letting herself down and the people around her. So for him to express how proud he was of her really helped her continue on into a graduate program. The experience with her mentor was inspiring and was just what Dorothy needed before she decided which school she would attend to further her education.

Factors that impacted enrollment into a Doctoral Program

When choosing a graduate program, Dorothy took three main things into consideration when determining where she would attend graduate school, (a) location; (b) the faculty she worked with; and (c) what were the students like.

When determining the location of her graduate school, Dorothy wanted to make sure she was close enough to family to be around them and get their support but far enough from her family to focus on school. Unfortunately, the institution in the Midwest where Dorothy is currently attending did not meeting her expectations for location, but the other incentives from the institution outweighed the location.

During the search for the graduate school of her choice, Dorothy wanted to ensure she could work with faculty on her research. As she went on graduate visits for interviews, she would speak to various faculty members to determine if they were

personable and that she could envision herself working with them. In addition to their mentality and mindset, Dorothy was interested in faculty with similar research interests. Dorothy said, "I think it was five faculty members. That was my rule, either four or five faculty members that I could see myself doing research with. They had interesting research topics that I was passionate about.".

One of the key factors in Dorothy's decision to attend her current graduate school was after she gained her acceptance. The institution decided to fly her to their campus, so she could gain a feel for the campus environment. Once Dorothy arrived to the campus she discovered a number of former Dred Scott students were enrolled at this institution. For Dorothy it is like having a mini family support group. Even though she did not attend Dred Scott with some of the students, the fact that the institution had the group of students that had the common bond and supported each other was very attractive to Dorothy. Even though Dorothy's current institution is not in the perfect location, where she can be close to family, she was willing to compromise, because of the Dred Scott community that was present on her current campus. Dorothy explained in reference to her Dred Scott family, "it made me feel like even though I was going to be far away form home again, I would still find my own mini family here."

CHAPTER SIX

KATHERINE (IDA B. WELLS STATE UNIVERSITY)

Katherine is a Ph.D. candidate in materials science and engineering at a large

public Research One institution in the midwestern part of the U.S., where she is studying

nuclear materials and surface characterization. She attended Ida B. Wells State

University; a large public HBCU in the southern part of the U.S. Katherine received her

Bachelors of Science in Physics and Chemistry from Ida B. Wells State University in

2010. While at Ida B. Wells State University Katherine was active in the Math & Physics

club, Honda Campus All-Star Challenge, Phi Eta Sigma, Beta Kappa Chi, Golden, Louis

Stokes Alliance for Minority Participation (LSAMP), and the Honors program.

Interest in the field

Katherine always had a desire to obtain a PhD, but was not sure of what her focus

would be. This desire came from being the only person in her family to have an

opportunity to pursue a terminal degree. Katherine's grandparents did not have the

opportunity to pursue a doctorate degree. Unfortunately, for lack of opportunity they

stopped at the master's level. At the time in which they were in school, doctorate degrees

were not being offered to African Americans. Her grandfather was a physical therapist

and at the time he could not get a PhD nor an M.D. Her grandmother was a nurse and

there were no doctoral programs for African Americans in nursing. Along with their

master's degrees, the most Katherine's grandparents could get was a certification.

Katherine believes it was her destiny to pursue a PhD, because her grandparents paved

the way for her to do so.

Since second grade Katherine has looked up to Mae Jimmerson, the first African

American female astronaut. She had a PhD in chemical engineering. This sparked

Katherine's interest. She began to research what engineering was all about. In addition to her love for engineering, Katherine has always had a desire to teach, thus leading to her decision to major in chemical or nuclear engineering once she was admitted into college. Katherine decided to attend Ida B. Wells State University after receiving a full ride. One of her professors convinced her to major in physics and minor in chemistry. During her junior year at Ida B. Wells Katherine decided to take his advice a step further and declared a double major in physics and chemistry. These two majors developed Katherine's interest in material and nuclear engineering.

Community Cultural Wealth at Ida B. Wells State University

Aspirational Capital

Katherine's physics advisor/mentor played a major role in shaping her aspirations. He really pushed her to pursue an advance degree, especially in physics. To do that he pushed Katherine to understand physics, teach it to other, and to form personal goals. In having a knowledge base of his personal goal, it steered Katherine's personal goals to publish, conduct cutting edge research, and to be a forward thinker in her field of study.

One of the ways Katherine's mentor helped to develop her goals and aspirations was through an internship at a research lab. The students at Ida B. Wells are required to secure an internship or work on a research project with a faculty member. During Katherine's first summer as a student at Ida B. Wells, she took an internship with her advisor at a prestigious national lab, exposing her to the world of programming and

research. The intersnship was an eye opener for Katherine, as she was not accustomed to this form of research.

His encouragement pushed Katherine to always stay active in the field and to not be afraid of trying new projects. With his support and encouragement Katherine explored the field of chemistry during her sophomore through an internship, which she eventually picked up as a second major.

As Katherine developed more into a scholar, she discovered a way to combine her love for science with her love for education. With the aid of her advisor/mentor and one of her classmates, Katherine put together a two-week summer program conducting science education outreach. During the two weeks, Katherine and her colleagues had high school students, guidance counselors, and high school teachers come to the national lab to learn about physics and nuclear physics. They would expose the students to this particular field of science. Also, they taught guidance counselors how to prepare students who want to major in science and equipped high school science teachers with ways to implement nuclear physics into their curriculum. The exposure from the three consecutive summers of working the science program is when Katherine found how she could apply science and education. It was also through these programs she that solidified her decision to pursue a doctorate in a STEM field.

Linguistic Capital

The faculty in the chemistry department was very diverse but only the African American faculty members took it upon themselves to infuse culture into the curriculum. They would make sure that you knew what black scholar did what. What Black scholar

contributed to what invention? Who was doing research in the country at the time and so forth. Katherine found this to be helpful in establishing her own identity. In a sense it proved to her that she can be a scientist, because of the successful African American scientists that have come before her. Katherine was able to establish a "there is nothing I cannot do" mentality.

In addition to the conversations Katherine had in the classroom setting concerning Black scientists, she also expressed the ability to converse with faculty and students outside of the classroom. Katherine credits her ability to communicate freely to the comfort level she had within her environment.

> I mean it gives you like a comfort that in your learning environment whether you were right or wrong, people wouldn't look at you if you were wrong and place an attack against your entire race. Because everybody in the classroom looked like you, so it really wasn't about you, it was only about your ability. So it means you are able to express yourself without being concerned that doing so was going to be on behalf of your entire racial background, instead it was just a reflection of your family, upbringing.

The simple fact that everyone looked like Katherine made it easier for her to communicate without fear of being attack. By attending an HBCU the way one communicated no longer was a reflection of an entire race, but more so on how students were raised.

Familial Capital

When I asked Katherine about the relationships she formed at Ida B. Well State University among students and faculty she responded by saying,

> We formed a family bond in my major, not only in my year, but the entire major. We became brothers and sisters and our professors, became our aunts and uncles,

our mothers and fathers. Whether they were in the physics department, math department, chemistry or whatever. We became like a family unit, especially the students.

Katharine mentioned having a few friends outside of the department who she would hang out with, but, she was not as close with the students outside of her department nor did she socialize with them as much. This had more to do with the fact that she and her classmates spent so much of their time together studying that there was no time to mingle with other majors. The tight bond between Katherine and her classmates did not stop at taking classes and studying together. These students would hang out on the weekends with one another, lean on each other for personal and private needs. Katherine said, "it was truly like having an extended family at school."

As far as faculty were concerned, she best explained them as parents away from home. If students did not go home over the break, for various reasons, faculty would take those students into their homes for the break. Faculty at Ida B. Wells even went as far as allowing students to borrow cars and even helped raise the children of some of their students. Faculty were sure to be there to help students not just academically but in personal matters as well.

The family bond between Katherine and the Ida B. Wells community did not stop at this institution, but they also made sure to instill in their students a sense of pride and acceptance as African American and a student at an HBCU. It did not matter what HBCU, the student's at Ida B. Wells were taught that they should be proud of attending an HBCU and that it is a privilege to be a part of that family. Katherine recalled being told about HBCUs, "that our education is no different from anywhere else, that we are

still getting the best and because we are with our people now we will never lose our identity later." This type of institutional and cultural pride was instilled in the students campus wide, whether in the classroom, in assembly, the programs students were apart of, clubs, the various department, all the way to the professor students were constantly gaining positive reinforcement about who they were and where they come from.

<u>Social Capital</u>

Ida B. Wells has many programs that expose their students to graduate school in the STEM fields. Like many HBCUs Ida B. Wells is an active institution in the Louis Stokes Alliance for Minority Participation (LSAMP). This program is design to provide funding and access to research. The program also allows students to present at various conferences. By being apart of LSAMP, Katherine gained full exposure to a path in the STEM fields. Katherine was exposed to how to properly conduct research and how to stay up to date with research in her field.

There were also the programs solely sponsored by Ida B. Wells that provided a form of social capital for Katherine as she navigated through the STEM pipeline. The honors program made sure Katherine remained a high performing student and that she would receive proper training, etiquette training, training for the life after college, how to live, how to manage money, and how to steer students on the right career path. The honors program also provided support for the GRE and other major exams students had to take in order to graduate. There was also the scientific honor society that Katherine had the opportunity join. Here, students would gather as scholars to present their research. Once you became a junior and senior at Ida B. Wells the physics and chemistry

department would allow students to gain teaching and instructing opportunities. Katherine, along with her classmates was allowed to serve as a teacher's assistant (TA) in certain labs and courses in the lower levels. The department also exposed students to research, conferences, and throughout their undergraduate career. Through those conferences and conducting research Katherine was able to build her network in solicitation for grants, postdoctoral positions, and scientist positions.

Katherine was exposed to the practice of research and their benefits during her first year at Ida B. Wells. Her advisor/mentor was working on a project examining how people perceive themselves freshman year versus sophomore year after taking physics courses and how their perceptions change through the course. The project was to help determine if the course made students want to take up science or run away. The project never died down and provided Katherine the opportunities to not only work in a national science laboratory, but it also exposed her to the grant writing process.

By attending Ida B. Wells, Katherine was not only exposed to what a true scientist is but she was also gained a network that would assist with her enrollment into graduate school. Ida B. Wells has a few bridge programs for doctorate students but Katherine was not able to take advantage of them. At Katherine's current institution, there were a few alumni from Ida B. Wells within her program that served as an information bridge for her to be admitted into the program. Katherine applied to a recruitment program put on by her current institution for three days. Some alumni from Ida B. Wells and other HBCUs saw her name, saw she was from Ida B. Wells and really advocated to get her accepted into the visitation program. What Katherine received from the visitation program was the

chance to talk with faulty and a fee wavier for the application. If it were not for other people from Ida B. Wells and other HBCUs, Katherine is not sure she would have been accepted into the program or not.

Navigational Capital

Katherine was able to take advantage of several opportunities that would prepare her for enrolling into graduate school. As a member of the honors program as Ida B. Wells State University, Katherine was exposed to preparation for graduate school and the world outside of college. With this training she was given the proper etiquette training, business training, and skills to manage lift after college. More importantly, the exposure gave her to mindset to continue on to graduate school.

Katherine also gained assistance from faculty members in the physics department. A junior faculty in the department helped Katherine prepare for the physics GRE. Her advisor/mentor assisted in filling out the applications as well as helped Katherine figure out where she should apply for graduate school, what type of programs she should look for, and what professors she might be interested in. He also wrote Katherine a number of letters of recommendation and helped her tailor her personal statements to each institution she applied.

Along with assisting Katherine with professional development and navigating the graduate school application process, Ida B. Wells also prepared her academically. Katherine said,

> The physics and chemistry departments were very rigorous. They were very adamant on passing their classes, passing them fairly, and learning the materials, so you couldn't move on in the program unless you were mastering things. But they made sure that you were mastering things all along the way.

Although the faculty provided a rigorous curriculum, they also provided their services to ensure students were successful. Katherine recalled faculty, "helping with extra sessions after classes or homework help, and questions to be answered. The faculty really took a one-on-one approach with each student to make sure we were all prepared before we left. So wherever we went we could still be a star students."

The culture of assisting Katherine at Ida B. Wells does not stop with the faculty, and did not stop once she graduated. Katherine and her classmates still are in constant contact with one another as a form of encouragement as they did when they attended Ida B. Wells together. Along with the her classmates, Katherine's former professors at Ida B. Wells check up on her to make sure she is doing well and is going to graduate on time.

Resistant Capital

Katherine remembers when she and her classmates would have late night study sessions, or filling out graduate school applications, her professors would stop to talk. He would tell them about the different schools they were applying to, how their experience might be if they attended there. He even shared his own personal experiences as a person of color in a STEM Ph. program and some of the barriers he had to deal with.

Most of the conversations surrounding the opposition Katherine might face as an African American in STEM came from her faculty advisor/mentor. He would caution her as graduation drew near about what to look for, how she should conduct herself, and to be mindful of the transition from attending school where she is a part of the majority to where she would now be in the minority and how that feels. He also wanted to remind her

that she wasn't accepted into graduate school because of the color of her skin, but because of the knowledge and skill set she possesses.

Katherine also gained a reality check and encouragement through the honors program. They would let her know, "that there is a bigger world out there than just you and there is a lot going on, and things are not always fair in the world and you will have to live through that." Even though they were sure to prepare their students for the harsh realities outside of Ida B. Wells, the honors programs also provided reinforcement through their encouragement. Katherine talked about how they would tell her and her classmates " hey you guys have to go to graduate school, because you are smart, you can do research and you need to continue on. Go as high as you can go." She said, "they didn't care what you did, they just wanted you to continue on. So that's how they would phrase it, they don't care what you take up in graduate school, but you need to get a PhD"

Experience at Ida B. Wells State University

Katherine provided a picture of herself, her classmates, and advisor/mentor at her graduation. This picture was the only picture Katherine had of her, all most everyone she graduated with in her department, and her advisor. The picture is important because it was her physics advisor/mentor that encouraged her to go into physics and pushed her to pursue a doctorate in the field. Katherine's classmates were equally as important as she said, "everybody worked together toward a common goal that pushed us all to graduate school. It was not an individual effort and it was not an individual decision either."

Katherine and her classmates didn't necessarily follow after one another, but they were most certainly on the same page. Without their encouragement and support, the

success they experienced together would not have happened. Katherine said, " A lot of times you don't have enough within yourself to pursue everything that you want to do, because it's hard work. So having a cohort of students who are liked minded prove to be beneficial." Katherine went on to describe her cohort of like-minded students: "for instance, when someone is down and a person says, "'hey you can do this' or 'hey I am working on this right now, you should work on it with me.'" Those were the type of interactions with her classmates that really helped and drove her to achieve her goals of enrolling into graduate school.

Katherine's advisor served her in a number of capacities she considered him to be her teacher, her mentor, and as another family member. As a teacher/professor, he made sure to be of assistance when every she needed help, clarification, or a better understanding of a concept taught in class. He made sure to provide extra assistance no matter the subject. Katherine described him by saying, "He was always there. So it gave us a sense of "he knows everything." It made us realize this is what a scholar is, somebody who may not always know everything, but is willing to help in some way." As a mentor he showed Katherine what it took him to gain his success as a professor. He helped her to understand that there are other things she can do with her PhD other than teach. Although he desired for her to teach, he exposed her to various industries she could work for. He introduced her to a diverse group of scientists and engineers at conferences. No matter Katherine's interest her mentor made sure during her time at Ida B. Wells State University that she knew how to properly conduct and disseminate her research. Most importantly during her tenure at Ida B. Wells her advisor made sure she knew what it

meant to be a scientist. Last but not least he served as another family member by making sure she was doing well and had everything she needed. He would even invite Katherine and her classmates over his house through out the year. They would use that time to celebrate joyous occasions and get to know one another. Spending time at her professor's house allowed Katherine and her classmates to get to know his wife. She would become as involve as Katherine's mentor. The two of them together- her mentor and his wife would serve as another mother and father figure to Katherine and her cohort.

Katherine is more than confident that "without each other, none of this would happened." She felt this way because graduating and going on to graduate school was something she did with the help of others. Katherine's picture is a reminder that she didn't get to where she is today alone, but it was through the help of her friends and advisor. It was through thei assistance that she applied to the program to visit the institution she is currently attending. This picture serves as an important chapter in her life, and a reminder of the experiences Katherine had while attending Ida B. Wells that would assist her in the start a new chapter by way of graduate school.

Factors that impacted enrollment into a Doctoral Program

When looking to enroll into graduate program there were only three factors that Katherine considered, funding, research/program alignment, and a supportive community. Of the three factors only two weighed heavily on her decision, funding and a supportive community.

In choosing a PhD program, Katherine was well aware she would not be able to financially support herself through this journey. Therefore, she was looking for a program that was willing to fund her PhD goals. When it comes to the program Katherine is currently in that is exactly what she was able to secure. Through a minority fellowship, Katherine was able to secure guaranteed funding as long as she was in the program. Although the graduate program was important to Katherine, the funding was of greater importance. Katherine wasn't as concerned about the engineering programs, mainly because she had done her research when applying and knew the programs where she applied would support her research agenda.

Along with the funding, what stood out most to Katherine through the minority fellowship at her current institution is how the minority students formed their own community. Unlike many fellowships that simply offer a financial break, this particular fellowship offered a support system for Katherine. Her current institution not only focused on money, but they were also concerned about her well-being as a graduate student. What stood out about this community of support is the fact that it was made up of minorities pursuing a PhD in engineering. The community brought comfort to Katherine and affirmed her that she would have a group of like-minded people who would support her through this rigorous process. The community of support was just as equally important to Katherine when looking for a graduate program as funding. Without one or the other, the graduate program was not as enticing.

CHAPTER SEVEN

MARY (UNIVERSITY)

Mary completed her first year of her joint Master's/PhD in biomedical engineering program at large public Research One institution in the Midwest region of the U.S., where she is studying how to use computer vision and microscopy to differentiate between diseased and non-diseased tissues. She graduated from Nat Turner State University, a small public HBCU in 2015 with a bachelor's degree in nuclear engineering. While attending Nat Turner State University Mary was active in the National Society of Black Engineering, American Nuclear Society, Alpha Nu Sigma Nuclear Honor Society, Nat Turner State Honors College, Delta Sigma Theta Sorority Inc., Golden Key International Honors Society, and Louis Stokes Alliances for Minority Participation (LSAMP).

Interest in the field

Mary grew up in the same town as Nat Turner State and even went to elementary and middle school on the university's campus, which is why she chose to attend there. Mary said, "I felt a sense of home there (Nat Turner State)." Mary wanted to be sure to build a strong foundation and to network as much as possible during her undergraduate experience, then branch out once she graduated.

Mary has always had a thirst for knowledge. Through her undergraduate program and a number of internship experiences Mary realized the only way to fulfill her thirst for knowledge was by pursing a PhD. Mary would not have been able to quench her thirst for knowledge and would eventually make her stagnant to a certain extent if she did not

pursue a PhD. Mary said, "I wanted to learn how to think deeper than surface level questions and to use those questions to develop research projects and proposals. Mary could have stopped at the Master's level, but she realized the only way to learn and explore as much as she could was to earn a PhD.

In addition to her thirst for knowledge, in 2013, during Mary's sophomore year at Nat Turner State University, one of her closest friends was diagnosed with bone cancer. Although deeply sadden by the experience, Mary wanted to find a way to help. Along with raising money, and being a support system for her friend Mary wanted to discover a way to bridge the gap between nuclear and images in cancer. This curiosity is what led Mary to the field of biomedical engineering for her doctoral program. She said when discussing her friend's illness, "it made me wonder about cancer and other disease progression and treatment methods. I too wanted to be a part of the ongoing efforts to conduct research in a field that impacts the lives of so many."

Along with the influence of Mary's friend being diagnosed with cancer, Nat Turner State and the state's flagship university are the only institutions of higher education in the state that offer nuclear engineering. With Nat Turner State being the only HBCU in the state to offer nuclear engineering, Mary was able to see a number of Blacks who graduated from the program who went on to do different things whether it was graduate school, working in industry, or working for a regulatory commission. Mary had a couple of friends who made the transition to graduate school. It was an eye opener for Mary to witness her friends navigate the educational pipeline and to see how much growth transpired over just a couple of months. Lastly, Mary received an abundance of

encouragement from her advisor, as well as the interim president of Nat Turner State at the time. The encouragement served as a strong motivation for Mary to enroll into a doctoral program.

Community Cultural Wealth at Nat Turner State University

<u>Aspirational Capital</u>

The best thing Nat Turner State did for Mary as far as the goals she set for herself was to provide her with the knowledge of what opportunities are out there, then encourage and motivate her to go after those opportunities. Mary knows she always has some type of support system coming form Nat Turner State. Any goals she sets, she knows she can reach out to the people at Nat Turner state whether it's help with work, or assistance with implementing a new program. Mary described the support system by saying,

> Whenever I need help in something I'm able to ask for help. Also, it works the other way around or it works vive versa. In the event they need help, I have goals set where I reach out to others, where I reach back and make sure that I am being a service to others who have helped me along the way.

Mary considers Nat Turner State as a "springboard" for her dreams and aspirations.

In conjunction with the encouragement and motivation, Nat Turner State informed Mary of various opportunities. " I think lot of underrepresented minorities don't know the opportunities that are out there… I think a lot of it is not knowing what's out there." For Mary, going to Nat Turner State placed her in a network work that would continuously inform her of all possibilities after graduation. Mary explained the impact of the network at Nat Turner: "The class right above me, those who were enrolled in a doctoral program, they did come back to speak about their experiences. It was very

touching. Faculty talked about their graduate school experience and how it changed their lives for the better. I just wanted to follow in their footsteps." It was experiences such as this that not only provided Mary with the knowledge of the benefits of graduate school, but also the motivation to apply.

Linguistic Capital

Being in a STEM program limited the opportunity for Mary to experience culturally relevant conversations in the classroom, but, her professors made sure to use moments before and after class to discuss culturally relevant topics with Mary and her classmates, which will be discussed in the resistance portion of this research. More important than those conversations was the comfort level of communication Mary had with her professors and classmates. Mary said,

> I felt very comfortable talking to my professors while at Nat Turner State. Our advisor, in fact, had an open door policy. We would talk to him about personal things. We weren't afraid to go in his office to ask for help on work. The open line of communication was extremely helpful.

Some faculty preferred e-mails, but the majority of the faculty at Nat Turner were there to speak with students whether it was about school or personal issues. Even the students were there to lean a listening ear. When describing the open lines of communication Mary said, "Everybody was just very friendly, very understanding. I had not experienced, anyone who was about making you feel less than if you needed help on anything. It was all about making sure we lift each other up."

Without the comfort level at Nat Turner State, Mary believes it would be more difficult to maneuver at her current institution. At Nat Turner State there were about 15 students in her class once she got into her major classes. Currently, Mary is in class with

about 100 people and there is only one or two people that look like her in the class. It's more difficult to find that support system now that she is no longer at Nat Turner State. When talking about her current institution, Mary said, "It's much more difficult to communicate with people who don't identify with you or who don't really understand culture, don't really understand your walk of life or your experience." Mary was able to relate to those faculty she was closest with in multiple ways. Whether that was the thirst for knowledge, whether that was an interest in nuclear engineering, whether that was sharing the same ethnic background, whether that was their faith and religion. For Mary being able to relate in some way was very meaningful. Fortunately for Mary, this is the experience she gained at Nat Turner State, and because of her experience believe she is better equipped to be successful in graduate school.

Familial Capital

Nat Turner State has approximately 2,500 students. With such a small student population, Mary had a diverse group of friends who majored in various fields. The small student population also fostered a close relationship with faculty, staff, and administration at Nat Turner State. The interim president and former provost actually wrote one of her letters of recommendation for graduate school. More than anything the closest relationships Mary formed was in her engineering department.

Mary's advisor was all about teamwork, learning concepts, and making sure the class, as a whole understood those concepts. Mary described her advisor this way, "He believes that everyone should help each other." This created a tight bond among the students in the department. Mary went on to explain the bond, "We walk to classes

together. We ate lunch together. We went out together." The tight bond among student was extremely important for the students in the nuclear engineering department. During the last semester of students' senior year, they are to choose between two Predominantly White Institutions, one in the South and the other in the Midwest to complete their engineering degree. The strong relationship between students proved to be beneficial as these students would depend on one other to succeed. The relationship among these students still exists today. Mary described current relationships between her former classmates,

> That relationship was super strong. We still have a group today that we speak to each other in, that we encourage each other. We propose things about jobs, about graduate schools. It's a very, very strong support system.

The strong bond remains between Mary and the faculty within her department. They still communicate regularly and when she is back in town she is sure to visit him. If Mary happens to be on campus, her advisor even makes sure that he allows Mary time during his class period to speak about her experience with current students. The relationships formed among former and current students, faculty, staff, and administration makes her feel as though she is apart of a rich legacy.

Social Capital

Mary joined the National Society of Black Engineers (NSBE) her first year at Nat Turner State. Unfortunately, it wasn't the best experience. The organization was not going to conferences, there were only a few members, and very few people knew of the organization's existence. It was the mission of Mary along with a few of her classmates to revitalize NSBE. They were able to increase the number of members, and eventually

were able to go to conferences and NCBE's national convention. This provided opportunities for Mary like none other. Through having an active NSBE organization Mary was able to secure an internship with General Electric.

Nat Tuner as an institution also provided Mary with a number of career development opportunities such as an internship with the Lawrence Livermore National Laboratory in California, and an internship with United Research Services (URS) Corporation. As a member of the Honors College, Nat Turner State offered etiquette courses to their students. The etiquette courses were helpful for when Mary had an interview and they may have taken her to dinner, or just understanding how to present herself to others. The Honors College also had business series, engineering seminars, and a plethora of different professional development programs that were very meaningful to Mary.

Nat Turner States' nuclear engineering program is fairly new, and they do not have a nuclear reactor on campus. Therefore, the students in the nuclear engineering program, had to attend another institution to gain that experience. Nat Turner developed a partnership with two highly Research One institutions, one in the Southern region of the United States, and the other in the Midwestern region of the United States. Mary chose to attend the institution in the Midwest, which would eventually become her school of choice for her graduate studies. Mary would spend the last semester of her senior year at the institution in the Midwest. There she took between three to five courses and then returned back to Nat Turner State for Graduation. Not only did this experience broaden

her knowledge of nuclear engineering, but it broadened her network, which would play a major part in her acceptance into graduate school.

The partnership between Nat Turner State and the institution in the Midwest has been in existence for about four to five years. One of the main reasons the partnership exists is due to the relationship the chair of the nuclear engineering program at the institution in the Midwest has with a professor at Nat Turner State. Mary found not only the program to be friendly and helpful, but the faculty was also helpful during her semester there. The experience at this institution had a lasting impression on Mary and impacted her decision to enroll into her doctoral program there, and helped her to build a relationship with the institution.

Navigational Capital

Nat Turner State sharpened Mary's ability to manage time wisely, to think critically, and to think beyond an engineer's mindset. Mary explained, "going to Nat Turner State, they talked about being able to multitask and being able to look at the bigger picture and break it down into different areas and see how you can accomplish the goal." Mary also mentioned how Nat Turner honed her networking skills, and taught her not to be afraid to ask for help. Mary has found all of these aspects to be import in her ability to access, thrive, and survive in graduate school.

The faculty and administration at Nat Turner State played a major role in assisting Mary as she navigated the education pipeline. Many faculty members would forward her e-mails from universities that were looking for students to come visit their graduate program. Mary found this to be very helpful because there were institutions she was

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interested in, but after the visit realized they were not a good fit for her. Had Mary not

gone on the visit weekend, she would not have been able to make a conscientious

decision about what graduate school to attend. During the application process, those same

faculty members and administrators were willing to write letters of recommendations.

Once Mary began to receive her letters of acceptance, she would send out emails

and even called those who assisted with the graduate school application process. The

faculty and administrators were willing to discuss with Mary the details of the program

and funding that was being offered to her. They wanted to be certain Mary took into

account all the important financial details. Mary said, "they were making sure I looked

into what's the cost of living where you're selecting to go to graduate school, and making

sure that my stipend was enough to cover that…. They wanted to be sure I was making

the right decision."

Most importantly, Nat Turner State served as a form of encouragement for Mary

as she navigated and continues to navigate through the STEM pipeline. Throughout the

application process faculty would be sure to send encouraging messages along the way.

Mary explained just how encouraging the faculty were,

> We see them in the hallways. I might not have had a smile in my face just for a
> second. It could've been for any reason. They're like, "Is the application process
> stressful? Is there any way I can help you?" They were always willing to just
> bring a smile to my face. Even now, they're still sending encouraging words or
> ensuring that my experience here is as enjoyable as my undergrad experience.

That source of encouragement did not go away just because Mary graduated

either. The faculty and students still serve as a listening ear, whether she just wants to

vent or to talk about her experience, they have always been there and they still are. Mary expressed how helpful this is for her experience,

> Whenever I call, I don't feel like an intruder. I still feel like I'm a part of the family. They always answer. If they don't know the answer, they'll reach out to someone else who might have an answer. Just being willing to still help me. That has been really humbling and really exciting for me.

Resistant Capital

Often times Mary and her professors would have conversations about institutional racism and gender bias that she may experience in the STEM field. There was also discussions about the importance of doing well as a minority. "When we go to Predominantly White Institutions or predominantly White conferences and things of that sort, that we were able to excel and achieve no matter what."

These conversations proved to be beneficial for Mary as they instilled confidence that is extremely helpful today. "I use that every day just thinking about coming to an engineering campus and being a female. There are two African Americans in the biomedical engineering graduate program here. Those conversations helped me get through it."

Mary was also meet with encouragement in order to combat the resistance she would face as a raising Black school in engineering. Nat Turner, especially Mary's advisor instilled in her the mentality to work hard. This gave Mary the confidence she needed to apply for internships and even graduate school. With this mentality she knew she could compete with anyone from any university.

Experience at Nat Turner State University

When I asked Mary to provide a picture of something that represented her time at Nat Turner State that was influential in her decision to enroll into a doctoral program, she sent me a picture of her and her friend who was diagnosed with bone cancer. The picture was taking at her friend's graduation, which was the end of Mary's first year in her doctoral program. This picture represented two main factors that were impactful in Mary's decision to enroll into a doctoral program: (a) Nat Turner State University and (b) Mary's friend who was diagnosed with bone cancer.

Although Mary considered her attire to be subpar for graduation, she did not feel out of place, because she was sporting her Nat Turner State sweatshirt. Wearing Nat Turner State paraphilia is really important to Mary, as she likes to show her support for the faculty, staff, students, and anyone else she might have encountered during her time at Nat Turner State. Nat Turner State played a major role in Mary's life, she said, "it is bigger than some place I attended school for four years…. I've basically been here from 2 to 22." Though the crew neck in the picture may seem like a regular article of clothing, every time Mary looks at the crew neck she thinks about her experience at Nat Turner, the people who helped her along the way, even the negative situations, which served as building blocks all played a role in Mary's decision to enroll into a doctoral program.

Mary and her friend actually graduated from high school together. Their friendship blossomed during the summer going into their first year at Nat Turner State, where they both participated in the Louis Stokes Alliance for Minority Participation Program (LSAMP). The friendship between Mary and her friend grew so much that

people on campus referred to them as "Fric and Frat," because they were always together. However, Mary's friend had to miss a semester once she was diagnosed with cancer. At Nat Turner, like many institutions, if a student misses a semester they will miss an important class that is offered once a year. Therefore, Mary's friend was not able to graduate until the year after her. Mary was devastated when her friend was diagnosed with bone cancer. However, she held it together to be there for her friend. Mary even started a GoFundMe account and was able to raise thousands of dollars to assist with her friend's doctor bills.

Once Mary's friend went into full remission, they were able to see each other more and more on campus. They even became roommates during the end of Mary's junior year and senior year. Now Mary and her friend are both in engineering doctoral programs and are able to share this experience together as well. The friendship between Mary and her friend was very impactful to her as they went on to graduate school visits together, and shared their love for learning and research.

Factors that impacted enrollment into a Doctoral Program

For Mary one of the main factors in choosing a doctoral program was the environment and culture of the program. Mary was seeking a program that was more collaborative as opposed to a competitive program. Mary said, "I wanted to be sure that I could fit in, that I didn't feel like an outcast." Although she had chosen to attend a predominantly white institution for graduate school, Mary still wanted to be sure she would fit in. She wanted to find a support group, to have a family like environment, while in graduate school.

Another important aspect that impacted Mary's choice was two-fold. Once Mary applied into the School of Engineering, because she is a minority, she was automatically selected to participate in the graduate engineering research program. Therefore, Mary's financial concerns were taken care of.

The financial aspect was very important to Mary, but what really captured her attention was when the chair of the department at Mary's current institution, an African American man, came to Nat Turner State to an event to talk to perspective students. If he had not come Mary said, "I would not have come to the graduate visit at my current institution in the fall of my senior year which wouldn't have put me into the feeder program for that diverse group of people who can get the fellowship." The program and the African American chair also showed Mary the institution's commitment to diversity. For Mary, that was very important as she wanted to attend an institution that was open to diversifying their graduate program. Mary summed it up this way, "I just wanted to make sure I went to the university that was down for the cause.

CHAPTER EIGHT

CROSS CASE ANALYSIS

Although HBCUs share the mission of educating African Americans, these institutions are not monolithic. HBCUs vary in size, Carnegie Classification, location, students' demographic, etc. Therefore, the participants' in this study had varied undergraduate experiences. Nevertheless, there are a number of commonalities that the participants shared throughout their educational journey. This chapter attempts to answer the guided research questions: (a) What aspects of CCW do African American students at HBCUs believe influence and assist them in enrolling in STEM doctoral programs? (b) How do the experiences of African Americans at an HBCU affect their decision to enroll in a doctoral program? and (c) What factors impacted African American students from HBCUs' decisions to enroll into a doctoral program? The questions were answered by integrating the common experiences identified by of the participants' cases as well as some of the participants' differences. Table 3 provides a brief overview of the themes that were discovered through the cross case analysis. Each type of capital provided a theme(s), which answered the first guided research question. Other emergent themes were identified, which answered the second and third research questions, based on participants' experience during the undergraduate experience and factors that contributed to their enrollment into a STEM doctoral program.

Table 3 Summary of Themes

Research Question	Major Themes	Description
Q1. What aspects of CCW do African American students at HBCUs believe influence and assist them in enrolling in STEM doctoral programs?	Aspirational Capital	Help developed the goals of pursuing a PhD.
	Linguistic Capital	Had conversations about the struggles that might occur as a Black researcher in STEM.
	Familial Capital	Participants were a part of intimate and cohesive cohorts of students, who worked closely together to reach graduation.
	Social Capital	HBCUs provided students support from various grants, research projects, and programs. Initiatives ranged from graduate school visits, graduate school rep visits, and providing various forms of professional development.
	Navigational Capital	Faculty from the STEM departments wrote letters of recommendations, prepared students for standardize tests, and assisted with the application process. Faculty were also helpful in helping students select the graduate school of their choice.
	Resistance Capital	Participants were encouraged throughout their program and even graduate school. The lack of resistance to pursue a PhD in STEM proved to be extremely beneficial.
Q2. How do the experiences of African Americans at a HBCU affect their decision to enroll in a doctoral program?	Faculty engagement	Professors and mentors created a welcoming environment that allowed for students to make mistakes and learn.
	Peer to Peer engagement	Peers work collaboratively

		to succeed in the program and beyond as opposed to working competitively against each other.
	Exposure to Research	Conducting research at a HBCU provided an opportunity for participants to gain insight into what a career in the STEM field is like.
Q3. What factors impacted African Americans from HBCUs decision to enroll into a particular doctoral program?	Supportive Research	Faculty within the doctoral program must share a research interest with participants.
	Supportive Environment	Participants were looking for an institution that embraced diversity and had a support system for students of color.
	Financial Assistance	Funding was a non-negotiable. Participants expected some form of assistantship and/or fellowship to defray the cost of graduate school.

The first set of themes, which derived from the main research question surrounded the characteristics of participants' HBCUs are identified through the context of Community Cultural Wealth (Yosso, 2005). With there being several components to Community Cultural Wealth, each form of capital had findings that were identified as to how their HBCU experience was impactful towards them enrolling into a doctoral program. The findings associated with aspirational capital addressed how HBCUs help form an idea of how participants could further their education in STEM and what the possible outcomes of them furthering their education in STEM could be. Relative to linguistic capital participants' discussed what it means to be a Black scientist/engineering

and the ability for participants to be able to communicate among peers and faculty without losing their sense of identity. For the familial capital participants expressed how they viewed those in their department (e.g. faculty, staff, and students) as a family of some sort. Due to the small class sizes it was easy for participants to form strong relationships with those in the department in and out of the classroom that still exist today. Participants were exposed to social capital through conducting research, attending conferences, various programs, and graduate school recruitment efforts. Navigational capital is how faculty assisted in the application process, and helped students decide the right fit for their doctoral program. Resistance capital emerged through encouraging participants to continue in the STEM education pipeline. Within the HBCU environment, participants had the support of their peers and faculty to succeed in their STEM program.

Additional themes were developed using the pictures each participant provided to answer the second research question. I identified three themes surrounding the undergraduate HBCU experience that impacted participants to enroll into a STEM doctoral program. The three major themes that emerged through the pictures provided by participants are their (a) opportunity to conduct research, (b) the relationships formed between their peers and faculty, and (c) exposing student to the career advantages once earning a Ph.D.

The final set of themes were established based on the third guided research question, which provided insight into factors participants' found most influential for their choice of a STEM doctoral program. Those themes consisted of the graduated institution

having faculty that shared common research interest and a supportive community inside

and outside the classroom.

Community Cultural Wealth at HBCUs

<u>Aspirational Capital</u>

All participants in this study discussed the desire to pursue an advanced degree of

some sort before enrolling into any institution of higher education but their HBCUs

assisted in developing the goal of pursing a PhD. For example, Katherine had decided to

pursue a Ph.D. since before she could remember, based on the lack of opportunities her

grandparents had growing up. She went on to explain, "I've always wanted to get a Ph.D.

I wasn't sure what I was going to get it in. So as a child I wanted to go to Harvard and get

a Ph.D." By attending Ida B. Wells State University Katherine had the opportunity to

gain exposure to research that she never knew existed, which ultimately led her to pursue

a Ph.D. in material science and engineering. Marie has always had a desire and love for

learning, which motivated her to further her education. Meanwhile, Mary along with her

parents, established early on that she would earn a terminal degree. When asked about her

plans to get a doctoral degree, Marie responded by saying,

> I was gonna do a terminal degree, but I think at that point I was still deciding
> between whether I wanted to do environmental law and go to law school, whether
> I wanted to try and do veterinarian school, or whether I wanted to do a Ph.D. in
> environmental science…. I already decided. I already knew, my parents made it
> very clear that we had to, I was gonna get a terminal degree.

Dorothy on the other hand always had a desire to attended medical school. Dorothy

recalled,

> I wanted to study medicine since I was younger, mainly because I lost one of my
> favorite cousins to cancer, so I was really interested in becoming an oncologist, a

cancer doctor, and eventually I realized that doctors, physicians, I should say, don't always necessarily have all of the answers and they don't really have the time.

The participants experienced early interventions within their lives that influenced their decision to further their education past an undergraduate degree. Nevertheless, the HBCUs that the participants attended had a major impact on how their aspirations would be fulfilled. HBCUs were instrumental in further developing and shaping the goals of the participants to attend a STEM doctoral program. Participants were able to gain access to aspirational capital, as HBCU faculty and peers served as a support system to pursue their doctoral degree. The findings for aspirational capital are consisten with literature that states that HBCUs significantly influence African American students' aspirations to pursue a graduate degree (Pascarella, et al., 2004). Hence, the influences of the HBCUs lead the participants to enroll into a STEM doctoral program.

Linguistic Capital

The recurring theme that came up from each participant was the lack conversation about their African American culture within the STEM curriculum. Participants mentioned there were not many African American professors in their department and the topic of race never really came up during class. Fortunately, participants did mention conversations with the few African American faculty surrounding struggles they might experience as a Black scholar studying in STEM. Dorothy talked about an incident in class when the professor spoke about what it meant be Black scholars in the STEM field.

> He was really frustrated with us. We had failed a quiz or did horribly on an exam and he just really came down on us and was just like, "You guys have all these dreams and you guys want to do this and that and the third. You guys are black. You guys need to work harder. You have to put in much more work to get to

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where it is that you are trying to go, and you guys are lazy. You guys are not putting in as much work that you need to do, and it's only going to be detrimental for you in the long run." He just started going into his experience being the only black man in his program at Michigan State and how that experience was difficult for him because he had never been the only black person in an institution that he's been at. He said, "Those are things that you guys may have to consider. Culturally you'll be out of place. You don't want to also academically feel out of place because you don't have your stuff together and stuff like that"…. I don't think any of my STEM professors were African American besides him.

More importantly, participants expressed the ability to converse with faculty and peers without feeling as though they had to mask their identity. Participants expressed how there was never a need to code switch. Meaning that did not have to hide their identity when in the presence of faculty or students at their institutions. They were even able to go as far as discussing personal issues with not only their peers but with faculty as well. Mary had a similar experience as she expressed,

> I felt very comfortable talking to my professors while at Nat Turner State. Our adviser, in fact, had an opened door policy. We would talk to him about personal things. We weren't afraid to go in his office to ask for help on work. The open line of communication was extremely helpful…... I think that if I didn't have the comfort level I had at Nat Turner State, then it will be more difficult for me to maneuver at a Predominantly White Institution.

Katherine then discussed how she was able to always be herself while attend Ida B. Wells State.

> Everybody looks like you, so you are comfortable being yourself, you are comfortable with your own performance, because you can look around and everyone is performing the same as well. So you feel included.

While classes were in session or just around campus Dorothy talked about how she could always be her self.

> I didn't feel like I ever had to be someone else. I could always be myself around students, around faculty members, et cetera. I didn't have to watch the way I speak

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or something. Of course in professional settings when preparing for talks or presentations or et cetera, of course, I would be professional, but as far as just, I don't know, masking my ethnic identity, I never had to do that.

The majority of the participants expressed that there was minimum discussion surrounding race within the curriculum. Paricipants explained the curriculum allowed very little room for race and cultural discussion since their focus was STEM. Although there was a lack of discussion around race and cultural within the curriculum participants had the ability to communicate with faculty and peers without code switching or the sense of losing their identity. Participants had a sense of security within their HBCU, which allowed them to communicate and perform in the classroom without feeling scrutinized. The experience of the participants is consistent with literature that expands linguistic capital from words or symbols, but allows students to gain knowledge while maintaining their social, occupational, economic, or individual identity (Collier, 2004).

Familial Capital

Each participant expressed how they felt like a part of a big family, in reference to the faculty and students within their departments. Participants expressed typically being a part of a small cohort, which created a more intimate and cohesive unit which even allowed students to become close with cohorts before and after them. Dorothy spoke of the benefits of a small cohort saying,

> I think that's the benefit of going to a smaller college, being able to actually speak to your professors and those relationships with them. They have had me as a student for at least two years. They knew me. They knew my grades, et cetera, and how I worked.

The smaller unit also allowed participants to work together, study together, and work on projects with one another. The participants were also able to become close on a more

personal level. Participants would hang out with their cohort on the weekends and for

social gatherings, and would eventual lean on them when personal issues would come up

in their life. The bond between the participants and their cohort still exists today. Mary

went as far to say,

> That relationship was super strong. We still have a group today that we speak to each other in, that we encourage each other. We propose things about jobs, about graduate schools. It's a very very strong support system and work of individuals.

> Some participants referred to their faculty, administration, and/or staff as an aunt

and uncle or mother and father figure, as well as their classmates as brothers and sister.

Katherine explained the family bond like this:

> We formed a family bond in my major, not only in my year, but the entire major. We became brothers and sisters and our professors, became our aunts and uncles, our mothers and fathers. Whether they were in the physics department, math department, chemistry or whatever. We became like a family unit, especially the students.

> These figures became the adult figures that students could confide in and lean on

in the absence of their parents. Because of this bond, the participants were able to have

more open and honest dialogue with the faculty at their HBCU. The faculty who were

instrumental in each participants' life showed how much they cared for them as people

and as scholars. Katherine spoke on how faculty went out of their way to meet students'

academic and personal needs.

> Many of time if a student didn't go home over break because they lived too far, they took them into their home for the break. If students needed to borrow cars or need help personally in some manner, many people had children, we took turns watching them even the professors would help with raising children within the department of students. It was really a family.

Due to the bond participants were able to establish during their time at their HBCUs, they all spoke about how they remained in contact with the faculty, to update them on what is going on in their lives. Marie elaborated on the current relationship between her and her faculty.

> I still talk to the faculty a lot. I visit whenever I'm back in town and I have a day or something, I stop by Du Bois and visit them. I meet up with my old advisor and I'll take him out to dinner or something like that.

Through the series of interviews participants identified the faculty and peers from their HBCU as family. Participants were part of a small cohort, which allowed for students to form a strong bond with their peers and faculty. Researchers have acknowledged the ability of HBCUs to create an inclusive environment through meaningful and lasting relationships between students and faculty, which provides an enriching experience for their students (Fries-Britt & Turner, 2002; Guiffrida, 2005). Paritipants expressed how meaningful the relationships are with their peers, as they studied, ate lunch, hung out, and encouraged one another to pursue their dreams. The relationship with faculty was just as meaningful as particpants were able to learn from faculty what it is like to be a scientist or engineer and what it takes to obtain a PhD in those areas.

Social Capital

Although participants did not access their current institution through a partnership with their HBCU, professors and/or former students helped participants gain access in a variety of other ways. Katherine's graduate school visit proved to be extremely beneficial and assisted her in the admissions process.

> I applied to the informational conference. It's a three day conference, the alum saw my name, saw my university and really pushed to get me accepted into the conference. What the conference guarantees is that you get to talk to faculty, but you also get a fee waiver to the application fee. So if it wasn't for other people form other HBCUs, not just alum from Ida B. Wells State, but other students from HBCUs I am not sure I would've been accepted into the program or not.

In Katherine's case, not only were the alum from her institution helpful, but so were the students who were a part of the HBCU community.

HBCUs also provided a way for students to gain additional support from various initiatives developed or supported by their institutions (Toldson, 2012). The initiatives ranged from graduate student campus visits, institutional representatives coming to visit, research programs, being active in professional organizations, programs to prepare students for after graduation and any other opportunities that would help in their profession development. Mary talked about being an active member of National Society of Black Engineers. "We were able to go to the conference or the national convention. That provided opportunities like no other. I was able to get an internship with General Electric through the NSBE convention." For example Dorothy talked about the STEMER program sponsored by NSF's HBCU-UP and the many opportunities while attending Dred Scott.

> That did help in terms of thinking like a scientist, both in terms of doing research and in terms of writing. In my research lab at Dred Scott, I helped a lot with the writing of our publications that we did for scientific journals. That helped me a lot with learning how to write and prepare a manuscript and paying attention to how I should write as a scientist and familiarize myself with the terms. My research mentor would prompt me for ideas of the next experiment that we should do, like "Why should we do this?" Asking me different questions that helped me build, I guess, my scientific confidence because it made me realize I was his colleague.

Marie talked about a national program she was member of called Research Experience

Undergraduate and it's impact.

> The National Science Foundation funds these Research Experiences for Undergraduates and they take place all across the world, usually at universities. A professor has to apply and say, "Hey, I want to create an REU experience," and then they come up with little summer research projects and they take maybe ten to twelve undergraduate students who will come and work for the duration of the summer on this research project. It's like a trading opportunity…. In my case it was also an opportunity to spend the summer in Africa and hang out in Ghana. That was hugely influential in who I became.

In addition, participants talked about the role of national and federally supported

programs played in their undergraduate experience. These initiatives developed by their

institution and supported by the federal government provided a means of social capital

for the participants. Dorothy spoke about a program developed at Dred Scott.

> I was part of this association called Dred Scott Biomedical Association, and they used to have someone come in on Fridays and give a talk either about a school and a program, usually a medical school, or they would have someone who was doing research come in and give a talk. That was pretty inspiring because it became more inspiring when I realized I really did love research and I really wanted to do research, so seeing other individuals who were black and doing research or just people who were doing research that was pretty interesting, especially translational medically related research, that was very interesting to me.

Mary went on to talk about some of the initiatives right there at Nat Turner State:

> Nat Turner State also has a career development center. I was able to intern with Lawrence Livermore National Laboratory. I also interned with URS Corporation….. In the Honors College, we had things like etiquette courses that were very helpful. Because when you go on job interviews and they take you to dinner, you need to understand how you should present yourself at these dinners. We had business series. We had engineering seminars. It was a plethora of different things that, I guess, I was able to experience while I was there that were so meaningful.

<u>Distributing social capital</u>

The final theme for social capital is unique in that participants expressed how they became a form of social capital for their HBCU after graduation. Participants talked about how they still go back to their institution to recruit students for graduate school, summer programs, and internships, and various programs. They also return just to talk with current students and inform them about life as a graduate student and opportunities that come with obtaining a PhD Katherine exclaimed, "I go back to visit at least once a year and talk to faculty, past faculty that I had for different classes, catch them up on what I am doing, recruit for my graduate program. Not only recruit for the graduate program, but the fellowship program that I am in and that's about it." Mary talked about her current set-up with one of her former professors, saying, "he makes sure that if we're in town, we come back. If we're on campus, he makes sure that he makes time during his class period for us to just come and speak about our experiences."

Marie even went further by serving as a mentor and recruit students for her former program.

> Also I mentor a lot of undergraduate or early graduate students. I'll send them to former faculty. I'll be like, "Hey, could you talk to this student about this, so forth." They send me students. Sometimes they have me come back and speak to the Environmental Science group. We exchange opportunities. If I see really good REUs that will be great for their Environmental Science students, I send them to them right away and I'm like, "Get some undergrads on this. This is a great opportunity. They don't have any black applicants here. Get them there.

Dorothy similarly serves as a mentor for student who decide to take the graduate school route as opposed to medical school.

> I was able to mentor a few of them that worked in my lab in undergrad, and as far as applying to graduate school, a lot of them were applying to graduate school

rather than medical school and reached out to me and stuff. It's very inspiring to have people who believe in you and look up to you, et cetera.

All four participants were active in a research project during their undergraduate experience. The research projects particpants worked on were made available through faculty securing grants, contracts, or partnerships. By conducting research students were able to attend conferences to present their work and network. Partipcipants were also able to a visit or connect with protential graduate schools through their faculty and alumni. Many successful alumni would visit to speak with participants about their graduate experiences, and now participants serve in the same capacity, serving as a mentors to many of the students at their HBCUs. The experience of these participants aligns with Stanton-Salazar's (1997) claim that the reputation of Black intellectuals and professionals within the HBCU network (alumni, faculty, and staff) serves as a form of social capital for Black students.

Navigational Capital

The participants spoke on how their department or faculty assisted them through letters of recommendations, preparation for standardized tests, and any assistance with the application process. Although Dorothy had graduated from Dred Scott, she talked about how the faculty were instrumental in her pursuit of graduate school.

> The chemistry department was the department I was in, and they were very supportive because I reapplied to a graduate school a year after not being at Dred Scott for me to still be able to reach out to them and update them about my life, request recommendations from them and everything was no problem at all.

When talking about the role of her advisor in the application process Katherine said,

> He helped me fill out applications. He helped me figure out what school to apply to, what programs, what professors I might be interested in. He wrote letters of

recommendations for me, helped me form my personal statements, and things like that.

Another emergent theme through navigational capital was how instrumental faculty were in helping the participants select a graduate school. After spending four years with faculty, participants expressed developing a bond and trust, where they knew the faculty had the participants best interest at heart. Therefore, participants would sit down with faculty to discuss the pros and cons of attending the various schools that accepted them. Mary talked about the input of her faculty when deciding what institution to attend.

> I definitely called everyone else. I sent an e-mail. Of course, they wanted to know the details as far as what fellowship I'm on, will I be funded for all 5 years. I guess making sure that I took into account the important details, making sure I looked into what's the cost of living, where you're selecting to go to graduate school, and making sure that my stipend was enough to cover that. I think they were excited for me. They also wanted to be sure that I made the right decision for me.

Before completing her post-back program, Dorothy talked about how she visited Dred Scott to get some advice from her mentor as to what school she should choose.

> He didn't necessarily point out the different schools. Like I told him, I sent him a list of all the schools I had gotten into, I think maybe even before that meeting that we had. I sent him a list of all the schools I had gotten into….. it was very inspiring to me and also just seeking council from someone I trusted was exactly what I needed right before I decided on which school I went to. I didn't necessarily, I told him all of the pros of the different schools when I went to go visit and stuff. I didn't put the pros to the name of the school. He like the you know go for the bigger names type thing. I know he is like that so I did not want to put the characteristic of the schools to the name of the schools so that he could give me an unbiased opinion. That was pretty helpful for me honestly.

From these experiences, participants proved that faculty had a major impact on the graduate school students chose.

More important than assisting with the graduate school application, participants expressed how the faculty within their department introduced the idea of pursuing a doctoral degree in the field. Faculty were instrumental in developing the participants' minds to think like a scientist and/or engineer, and displaying what their life could be like. Participants also mentioned how their HBCU introduced them to their field and the opportunities that come with advancing in their various fields. For example, Marie said, "My advisor helped me develop my goals in the sense of being a model for what an academic researcher in ecology looked like, what that lifestyle was."

Marie spoke about how her faculty encouraged her to apply for the Ecological Society of America's SEEDS program and how it opened up her eyes.

> Wow, this is where I want to be. It's so cool, all these people working on such interesting things, on like, wolves and caribou and lions and deer," and you know, et cetera. That opportunity, I don't think I would have found on my own. I think it's only that I applied for it because my faculty told me to basically.

Katherine spoke about her experience with her professor/mentor and how he opened her eyes to various possibilities.

> He showed us the path to where he got to. In terms of how he ended up being a professor. Then helped us understand that there are other things that you can do, you don't have to teach. He would like for you to teach, but you don't have to. There are so many other industries you can work for. He would introduce that to us by introducing us to people that he knew while we were at conferences and stuff like that.

It is clear through the experiences of the four participants that their HBCU played a major role in helping them navigate through the STEM pipeline. Faculty at HBCUs tend to engage with studetns personally, instill a sense of institutional pride, and provide them with tools needed to succed (Berger & Milem, 2000). Participants expressed how

faculty were instrumental in helping particpiants choose the graduate school that would serve as the best fit. Faculty also ensured that particpants were exposed to research and had the opportunity to gain experience outside of their institution. Although the particpants have graduated from their HBCUs and are enroll in their doctoral program they still have access to navigational capital, whether it be professional or personal from their HBCU peers and faculty.

<u>Resistant Capital</u>

Resistance capital manifested itself through encouragement and lack of resistance to go into the STEM fields. In fields that often look to weed students out, the participants experienced the exact opposite (Gasman & Nguyen, 2014; Seymour & Hewitt, 1997). Faculty found ways to expose students to research through research grants and over prepare them academically for graduate school. Participants felt less pressure within their STEM programs while attending their HBCU. They did not feel marginalized, isolated, the pressures of representing an entire race, and/or pressure to prove if they belong. When talking about her experience at Du Bois University Marie said,

> Everyone was black so it didn't really matter and you didn't feel like you had to perform in some way or be super, super good at something because you were the only black kid in your class and you had to represent.

Katherine talked the importance of the lack of resistance that exists at an HBCU.

> Probably because I am in the majority. Everybody looks like you, so you are comfortable being yourself, you are comfortable with your own performance, because you can look around and everyone is performing the same as well. So you feel included…. I think most of that has to do with the fact that your faculty members also look like you. Even at your HBCU if you faculty does not look like you, you wouldn't have that feeling.

Mary echoed those sentiments when she explained the culture on campus.

Everybody was just very friendly, very understanding. I had an experience, anyone who was about making you feel less than if you needed help on anything. It was all about making sure we lift each other up.

The resistance factor became even more prevalent once the student enrolled into their doctoral program. When students would experience the resistance that exists from being a Black student in a STEM doctoral program, the faculty from their HBCU provided them with encouragement and guidance. Marie expressed how valuable her faculty are to her personal development, "Even now, honestly probably if my advisor did something crazy tomorrow, I would still call my former advisor and be like, "I don't know what to do!" You know." She went on talk about an incident that happened after she graduated from Du Bois University.

> There was a really bad incident when I was at my first graduate school where I got locked out of my office one time. I just locked my keys in there and I went upstairs to ask the facilities lady to just let me in. She told me that she didn't want to let me in because she didn't think I belonged there and all this other stuff. This was the same lady who told everybody to put their purses away because there was a little Mexican boy coming in and all this stuff. She was a hot mess. That incident was really upsetting for me. One of the people who I called kind of for comfort was my old advisor/mentor.

Most importantly, resistance was met with encouragement, whether the participants were still students at their HBCU or had graduated and enrolled in their doctoral program. Marie spoke of the affirmation provided by her faculty, "My advisor especially is very candid and very up front being like, "You know, you could encounter problems. [explicit] those people, basically. There's nothing wrong with you. You're a great student," et cetera, et cetera." Dorothy even spoke about the importance of her mentor encouraging her during her time of transition.

He really expressed how proud he was of me and that really meant a lot to me. My post-bac program was pretty difficult and I had gone through quite a few struggles with transitioning from more hard science to like biology type science and all that was new. It was just a lot to take in. So a lot of times I just felt discouraged or like I was letting myself down, letting other people down and for him to say he was very proud of me and what I've been doing really helped me continue.

Katherine talked about how her advisor warned her about many of the oppositions she would face, but coupled it with encouraging words.

So mostly it was my faculty advisor who would warn us as we were graduating about what to look out for, how to conduct ourselves, to be mindful that we were going from being majority to minority and how that feels. To remind us that we are not just where we are because of the color of our skins….you guys have to go to graduate school, because you are smart, you can do research and you need to continue on. Go as high as you can go. They didn't care what you did, they just wanted you to continue on. So that's how they would phrase it, they don't care what you take up in graduate school, but you need to get a PhD.

The encouragement seem to be one of the most important forms of resistance capital as students had to deal with the various barriers to be successful. The encouragement received by participants was reaffirming for students and provided the confidence they needed to succeed in fields that proved to be difficult for minorities to navigate within. Through their experience participants saw first-hand how HBCUs dispel the belief that higher education is reserved for a particular race and/or social class (Brown et al., 2001). With such an environment participants felt comfortable to ask questions, to make mistakes, and to pursue their dreams of obtaining a PhD. The experience of the participants are consistent with research that found HBCUs to promote educational attainment and advancement thorough a safe space in an otherwise racially demoralizing society (Brown et al., 2001).

How HBCUs affect the decision to enroll in doctoral programs

When participants provided a picture of something from their HBCU experience that was most impactful towards their decision to enroll into a doctoral program, there were three major themes that consistently emerged: (a) the people they were exposed to, (b) the exposure to research during undergraduate, and (c) informing students of the opportunities that come with a Ph.D.

Exposure to positive people

Every participant in this study provided a picture with people from their HBCU who were influential in their decision to enroll into a doctoral program. Although Dorothy provided a picture of her professor/mentor, the participants did not limit their influence to a professor. Dorothy stated the important role her mentor played in her decision to enroll in a doctoral program by saying,

> He really pushed me in terms of like expanding my research, like my research mindset. Basically in a sense, he was the person who taught me to think like a scientist. He was the one that kinda helped me learn how to write like a scientist.

> Mary and Katherine provided a picture of their cohort and professor.

Katherine acknowledged that "my professor who was there all along was the one who encouraged me to go to physics for undergrad and he is the one who pushed me to go to graduate school. You know pushed me to stay in physics and do everything else." However, she did not stop there. She went on to explain the importance of her classmates by saying,

> Without the encouragement of each other a lot of things wouldn't have happened. A lot of times you don't have enough within yourself to pursue everything that you want to do, because it's hard work. So having a cohort of students who are like minded. When everyone, when someone is down and a person says, "hey you

can do this" or "hey I am working on this right now, you should work on it with me." That really helps, drives us to complete applications to take the GRE, to study for the GRE, without each other none of this would happen……, it was something I did in collaboration with others. So I didn't do it by myself which is significant to me. I didn't get here alone and my advisor and friends who are in the picture actually helped a lot. They are the ones that helped me apply for the program to visit the university I am at now

Conversely, Mary provided a picture of a classmate that played a major role in her enrollment into a doctoral program. Participants were aware that this was not a decision that could be made without the support and assistance of others. Mary was quick to acknowledge, "the faculty, staff, student, everyone who I've encountered played a role in me choosing to pursue a PhD in some way, shape, or form." She went on to credit her friend for her field of study,

> her diagnosis was the spark for my interest in the program that I am currently pursuing. It made me wonder about cancer and other diseases progression and treatment methods. I too wanted to be a part of the ongoing efforts to conduct research in a field that impacts the lives of so many.

The people in the picture provided by the participants were not only in the picture because of their support, but also how they played a role in the participant gaining exposure to research whether they were over the research project (e.g. professor, mentor) or they were colleagues conducting research alongside them. By attending their HBCU these participants were able to gain first-hand experience within small cohorts of how to conduct proper research. Marie talked about her research experience at Du Bois University by saying,

> I think what it was, it definitely gave us an opportunity to learn to do research and to experiment a little bit and to mess up. And it was a little bit having that early space to make mistakes that helped all of us to become more confident later on as researchers.

The safe space for Marie was important because it was through the environment created by their professors and mentors that allowed them to make mistakes and grow as scientists and engineers. Participants also had classmates who cared about their success as much as them, which opened up the possibility for them to study together, research together, and form a bond that still exists today.

Exposure to research

By conducting research at an HBCU, this opened the opportunity for students to gain insight into the life of a scientist/engineer. In addition to conducting research, participants took part in writing, finding, and presenting their research at conferences, and helping to secure grants for future research projects. Throughout the research process participants gained insight to what can be achieved through receiving a PhD Katherine talked about the insight her advisor/mentor provided her with,

> Making sure that whatever research we were interested in, he would show us exactly what it meant to be a scientist, how to research a method, how to report it, so forth… He went a step beyond and showed us, what it looks like, to keep a research journal, what it looks like to be building evidence to report something to the world.

Dorothy talked how her mentor made her realize her enjoyment of research and helped her face the realties of attending graduate school as opposed to medical school.

> He was the one that first gave me the idea of going to graduate school. He asked me why do I really want to go to medical school. I told him like some of the reason why I thought I wanted to go to medical school. He said, "you want to go to medical school to eventually do research. So what is the point really of going to medical school, when you want to do research, when you can go to graduate school and do more research." I did think of the idea but never saw that was kinda an option I had. But he was the one who encourage me to apply to go to graduate school. He told me he thinks I have what it takes. I am inquisitive enough to pursue a graduate degree. So that was helpful to me, because he was the one that

kinda first brought up the idea. I guess I had been thinking about it, but I never really want to admit it.

By HBCUs training and exposing students to a career path in the STEM fields, faculty broadened participants' view for their future careers. Even more so, their department was able to tailor the experience to the interest of the participants. Once students discovered they could earn a PhD in their particular STEM field while focusing on something they were extremely passionate about, the decision to enroll in graduate school was easy.

Factors that impacted enrollment into a Doctoral Program

As it pertains to incentives that were provided by HBCUs and institutions that impacted students' decision to enroll into a particular STEM doctoral program, it was very consistent among all participants. The major incentive offered by the HBCUs that each participant experienced was programs that exposed the students to what a scientist or engineer looks like. Students were then able to take the research they conducted and present them at various STEM conferences, giving them exposure to graduate institutions and other like-minded scholars. Whether sponsored by the HBCU or encouraged by their faculty, during their last year at their chosen HBCU each participant was able to make multiple graduate school visits. The graduate school visits not only provided an insight into what graduate school life was like, but it better informed the participants about the climate of the institution and department they were applying to. Also, the HBCUs exposed the participants to graduate students and connected them with established scholars in their field that students identified with (e.g. African American, female,

alumni, graduates of HBCUs). For example, Dorothy spoke of her visit, which allowed

her to see the type of environment she would have by attending their graduate school.

> They flew me out after I was accepted to help me make my decision, so that was the first, "Okay, cool point for that." Second was that they had a bunch of former Dred Scott students who were current student there, who were either in doctoral programs, like graduate doctoral programs, or medical doctoral programs or did nursing or something here. They had me go to dinner with them the night before I left. It was a mini family of support. Even though I didn't go to Dred Scott with some of them, the fact that they all had this little group where they stuck together and supported each other, et cetera, was very attractive to me, and that's one of the reasons that I really decided it was the place for me.

Mary had the opportunity to visit four or five graduate school to learn what their graduate

school had to offer.

> All were engineering visits geared towards increasing their number of minority students in doctoral engineering programs. They all had similarities and were all extremely helpful. We had set schedules where we toured the campus, interviewed with faculty, attended professional development seminars, heard grad student testimonials, and asked questions about fellowships and so much more. I was able to get the answers to many of the questions I had about the university and my potential department and advisors. During the visits, I also was able to network and meet other minority students, some who attended HBCUs for their undergraduate degrees. Though we did not choose the same university to pursue a graduate degree, we remain good friends.

When it came to the incentives provided by the graduate school, there were two

major themes each participant identified. With the assistance of their faculty, one of the

first things students searched for were faculty with similar research interests. For

example, Dorothy used graduate school visits to identify faculty she could see herself

working with.

> That was my main key defining faculty members when I went on these interviews, and when I spoke to different people from the school, finding faculty ... At least I think said it was five faculty members. That was my rule. Either four or five faculty members that I could see myself doing research with. They had interesting research topics that I was passionate about, and if I got to meet them.

Dorothy went on talk about one visit in particular, and how that impacted her decision.

> Another school that I went to, one of the people that I really wanted to work with, they were actually very impersonal. They weren't personable at all and I could not see myself working with them as their student. It was, one, identifying faculty members with interesting research topics, two, meeting these faculty members and feeling them out and seeing if they were actually people I could see myself working with.

In addition to the faculty sharing a similar research interest, students chose their current graduate school based on if the institution had a community that would support them during their time there. Dorothy would consider "What are the students like? Are they happy? Are they supportive? Could I find a good support system amongst the students or amongst people in the area?" For example, Mary expressed going into go a graduate program that was more collaborative versus a competitive.

> I wanted to be sure that I could fit in, that I didn't feel like an outcast. Even though I was choosing between a lot of predominantly white institutions, I wanted to be sure that I could still fit in. I could find the support group while I was in graduate school at a predominantly white institution. For me, the biggest thing was being able to fit in, have a family, and to go into a collaborative environment versus a competitive environment.

Interestingly, each participant had funding to support them for up to five years of their program. However, financial support was not a serious topic of conversation throughout the interview. Mary did not really have to stress about funding, because if she was admitted she knew funding was coming.

> Once you apply to the College of Engineering, if you're a minority, you're automatically selected to participate in the graduate engineering research college program. They have a partnership with advisers in the different schools or different departments. Basically, I was already going to get that fellowship.

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Although, funding support did come up, it was short and to the point, as if funding was expected or a non-negotiable. When looking for schools as a minority Marie knew funding wouldn't be an issues. Going in, Marie thought: "They really need minority students so they'll likely offer you a good fellowship and so forth. That was actually what they did."

Unique experiences at HBCUs

The multiple case study approach allowed for participants to express their own personal experience at various HBCUs. Many of the characteristics of the HBCUs expressed by the participants were common across the board. Participants experiences seem to be similar, whether the institution was public or private was not a major factor, nor was the size of the institution.

The major factors that contributed to the difference in the student's experience were how well the institution developed their program and the notoriety that come with it. If the program was better developed students were exposed to more research and expressed being better prepared for the doctoral program. The notoriety brought more recruiters, but also gave their institutions the ability to access more grants to conduct research and strengthen the program.

Two participants felt as though they were not fully prepared for their program. When Marie was asked about her level of preparation at Du Bois University she responded by saying…

> To be honest I really actually struggled a lot my first year in graduate school, to
> the point where I was actually on academic probation one semester, which is very
> uncharacteristic of me. I struggled a lot. I didn't have a background in statistics

because that wasn't part of the biology curriculum and there wasn't enough flexibility in the biology curriculum.

The level of preparation may be a by-product of what Marie believes was her departments high focus on students getting into medical school. Dorothy expressed how the department at Dred Scott was highly focused on students going into medical school as well. With such a narrow focus on students getting into medical school, Dorothy expressed her difficulties academically in graduate school.

> Academically I felt like it did not really prepare me as much as I would've liked to. I know in some classes there was this one class, I think it was biochemistry, and it was like a little bit embarrassing for me to even ... At some point I started lying about being a biochemistry major because it was just like when I actually took this biochemistry class, I was like, "What in the hell? I never learned this," or some of these things I never even heard of. You know you hear of certain things and you're like, "Oh yeah, that sounds familiar….. Just some things are not a part of their curriculum and it needs to be updated, and that's one of my long-term goals, updating their curriculum because I don't want other people to come from Dred Scott and just be as unprepared as I felt.

Two of the four participants, believe their institution did a great job at preparing them for their doctoral program. When asked about how well Ida B. Wells prepared her for graduate school, Katherine expressed,

> The physics and chemistry department were very rigorous. They were very adamant on passing their classes, pass them fairly, and learn the materials and so you couldn't move on the program unless you were mastering things. But they made sure that you were mastering things all along the way. Helping with extra sessions after classes or homework help, and questions to be answered. The faculty really took a one-on-one approach with each student to make sure we were all prepared before we left. So wherever we went umm we could still be star students.

Although Mary didn't not explicitly speak on academics, she praised Nat Turner State for properly preparing her for graduate school.

I would say the ability to manage my time wisely, the ability to think critically, and to think beyond an engineer's mindset. Because a lot of the times, I think, engineers just look at one aspect of things at a time. Whereas, going to Nat Turner, they talked about being able to multitask and being able to look at the bigger picture and break it down into different areas and see how you can accomplish the goal.

It is clear through the experiences of these participants that size or institutional status is not true indicator of academic differences for participants. Although all participants took part in research projects in their program, most of the differences stemmed from the focus of the department. Participants who were apart of programs that focused on sending their students to professional school struggled more than participants who were in programs that focused on research and sending their students to graduate school.

Summary

This chapter illustrated how each participant was exposed to various forms of Community Cultural Wealth (CCW) during their tenure at their HBCU. Many of the themes overlapped, especially as it pertains to the various forms of capital HBCUs provided their students Although each student experienced some form of CCW, it manifested itself differently for each student, and various capitals seem to be more impactful for some participants than others. Many of the most impactful forms of capital were best demonstrated through the participants' pictures and what they perceived to be most impactful. Although all the participants selected pictures of people from their institution, each person served in a different capacity.

While finances are always an important aspect of furthering one's education, there are other components that must be considered when attempting to encourage Blacks to

enroll into STEM doctoral programs. Participants found campus visits, faculty with

similar research interest, and a positive and supportive campus environment to be of great

importance when considering to enrollment in a STEM doctoral program.

CHAPTER NINE

DISCUSSION, RECOMMENDATIONS, AND CONCLUSION

Introduction

The purpose of this multiple-case study was to gain a deeper knowledge of the unique experiences of students from different HBCUs to better understand the in impact these institutions have on African Americans enrolling in STEM doctoral programs. Contained in the following sections are the following: (a) discussion of the findings through the lenses of Community Cultural Wealth; (b) fit of the findings with existing literature; and (c) the implications for policy, practice, and future research.

Discussion of the Findings through the Lenses of the Conceptual Framework

Conceptually, Community Cultural Wealth guides this study, and under this framework there are six concepts; aspirational capital, familial capital, linguistic capital, social capital, navigational capital, and resistance capital (Yosso, 2005). The use of this conceptual framework was extremely helpful in understanding the impact HBCUs have on Black students to enroll into a STEM doctoral program. The conceptual interpretations of the six concepts of Community Cultural Wealth are discussed in detail below.

Aspirational Capital

Aspirational capital is the ability to maintain hopes and dreams for the future, even when facing barriers, whether real or perceived (Yosso, 2005). The results from this study provide that HBCUs serve as a form of aspiration during the students' time there and even after they graduate. Although all the participants entered into higher education with the desire to pursue a terminal degree, their HBCU played a role in helping them to

maintain and construct their goal to enter into a STEM doctoral program. Consistent with

the literature, HBCUs significantly influence African American students' aspirations for

a graduate degree (Pascarella, et al., 2004). The influence HBCUs have on African

Americans could be due to the fact of the environment fostered at HBCUs around the

belief that every student can succeed and the support system that students receive while

attending.

Also, this study found that students continue to utilize that support system to

encourage them to reach their goals after graduating from their HBCU. Unfortunately,

there is no research examining the role HBCUs play in the lives of graduate students after

leaving their institution. This process started close to graduation when students would

seek the input of their faculty for which graduate school to attend. Participants from the

study talked about how when dealing with perceived or real barriers, they would reach

out to former classmates and faculty from their HBCU for guidance and encouragement.

For Black students, it is important to have support and encouragement when studying in a

field that often causes many of them to feel isolated and as if they do not belong.

Linguistic Capital

Linguistic capital is the intellectual and social skills attained through

communication experiences in more than one language (Yosso, 2005). Participants

mentioned there was very little talk about race in their curriculum or even within the

classroom. Reason being, the subject matter had no room to incorporate race into the

curriculum and because the majority of their faculty did not identify as African

American. Only one participant acknowledges how the professor would provide facts

about Black scientist and engineers. Nevertheless, participants did express the ability to communicate and act in a manner of comfort around faculty and students without feeling as though they lost their Black identity. This finding is consistent without the other components of linguistic capital, which is not limited to words or symbols, but allows students to gain knowledge while maintaining their social, occupational, economic, or individual identity (Collier, 2004). Students were able to navigate in this space as themselves because often times their classmates had similar backgrounds or identified with the participants through race. For the faculty, although many did not identify as African American within the STEM fields, the faculty was extremely diverse. Participants believe faculty at no matter their race understand the cultural of student support at an HBCU and made an attempt to incorporate that cultural inside and outside the classroom.

Familial Capital

Familial capital refers to that cultural knowledge nurtured among family that carries a sense of history, memory and cultural intuition (Yosso, 2005). The participants acknowledged faculty, staff, and students within the program (those that preceded and followed their cohort) as family. HBCUs have been acknowledged for their ability to create an inclusive environment through meaningful and lasting relationship between students and faculty that enhances students' success and retention (Fries-Britt & Turner, 2002; Guiffrida, 2005). It was through the environment fostered by HBCUs that students were able to pursue their dreams. Students were able to develop a relationship with faculty to learn what the life of a scientist or engineer was like. They were also able to

learn of the opportunities that come with obtaining a PhD in a STEM field. The relationship with their peers also made the journey to graduate school less stressful. Opposed to competing with their peers, students at HBCUs are able to bond with their classmates and work together to ensure the success of everyone.

Social Capital

Social capital is a network of people and community resources (Yosso, 2005). All the participants were exposed to social capital in a number of areas. Their experience from these participants are consistent with Stanton-Salazar (1997) assertion of the reputation of Black intellectuals and professionals among HBCUs' alumni, faculty, and stuff, which serve as a form of social capital for Black students.

Based on the reputation built by HBCUs, participants were a part of research projects conducted by faculty. Many grants and contracts secured by faculty at HBCUs provide the opportunity for students to gain exposure to research. Along with the research exposure, students are able to attend national conferences to present their work. By attending these conferences, students were able to connect with researchers at other institutions. Students were also exposed to graduate programs as many representatives would come to their campus to recruit students. The visits from graduate schools gave students the opportunity to make connections with graduate schools and learn what graduate schools is all about. Lastly, institutions made sure to put students in contact with successful alumni. Meeting with alumni allowed for students to gain the perspective of someone who has been where they are. Like the participants in the study, many of the

alumni not only came back but also attempted to advocate for students who are trying to gain acceptance into a program.

<u>Navigational Capital</u>

Navigational capital refers to the ability to maneuver through social institutions (Yoss, 2005). The participants from this study expressed how their institution helped them to navigate the educational space to persist on to a graduate program. Faculty members at HBCUs also tend to engage with their students personally, instill a sense of institutional pride, and provide them with the proper tools required to succeed (Berger & Milem, 2000). Students expressed the various ways in which their faculty and classmates have assisted them and continue to assist them in navigating the educational pipeline. Through the relationships formed by faculty students are able to learn about various aspects of graduate school such as information to apply, what to look for in an institution, and what institution is the best fit for that particular student. Faculty went as far as helping students select their program after graduation.

Before the point of graduation, each HBCU represented in the study ensured that their students had what it took to gain access into a STEM graduate program. To ensure student preparation, programs made sure their students were prepared academically, conducted some form of research, had an opportunity to work outside of their institution, etc. These institutions went beyond simply preparing the students academically, but sought to prepare students emotionally and mentality for what was ahead.

Resistant Capital

Resistant capital refers to knowledge and skills fostered through oppositional behavior that challenges inequality (Freire,1970; Delgado Bernal, 1997). The participants talked about how they were not met with resistance while attending an HBCU. Instead, they were met with encouragement in order to combat the resistance they would be met with outside of their institution. The findings from this research are consistent with Brown et al. (2001) findings that these institutions promote educational attainment and advancement but also served as safe space in an otherwise racially demoralizing society. HBCUs dispelled the belief that higher education is only suitable for the rich or socially prestigious (Brown et al., 2001) With students feeling safe within their HBCU environment they are more comfortable to ask questions and make mistakes. There was not a pressure to prove if they belonged, were smart enough to do conduct research, or as if they had to represent an entire race. Conversely, they are met with encouragement and reassurance that they belong and are more than capable of being successful.

Fit of the Findings with Existing Literature

The study supports the findings that suggest that HBCUs and their culture, no matter the color of faculty, serve as a form of Community Cultural Wealth for Black students (Brown & Davis, 2001; Davis, 1998). In some aspect, the four participants were able to identify knowingly or unknowingly the ways in which HBCUs utilize Community Cultural Wealth to assist them in succeeded in the STEM field. It is important to know that it was difficult for students to identify the function of linguistic capital until they compared it to the PWI they were currently attending. Participants were not able to

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identify any culturally relevant conversations within their STEM classes. However, each participant noted they were comfortable in their level of communication with faculty and students, and did not have to experience any form of code switching until they enrolled in their doctoral programs. They were also able to be maintain their personal identity during their time at an HBCU. Through this study we were able to acknowledge various aspects that should be consider as additional forms of capital to Community Cultural Wealth such as encouragement, perseverance, and environmental.

Literature implies the role HBCUs play in influencing Black students to enroll into STEM doctoral programs (Gary, 2012; Gasman & Nguyen, 2014; Lewis et al., 2013). While this research does not dispute any of the previous literature on HBCUs, it does question how much of an impact faculty of color really have on Black students' choice to enroll into doctoral programs. Reported in the literature is the impact that seeing Black faculty had on students to enroll into a STEM doctoral program (Gary, 2012: Gasman & Nguyen, 2014); however, all four participants in the study claimed to have a diverse set of faculty and few African American faculty in their program. A matter of fact, three out of the four participants identified a non-African American faculty member as the most influential in their decision to enroll in STEM. All participants did encounter faculty of color and acknowledge seeing them as motivation to achieve their goals. Although the race of faculty and mentors was an important aspect for participants, more importantly was faculty willingness to encourage students to pursue a PhD, accept students' identity, expose students to research, and advise them on the opportunities that

come with obtaining a PhD. One may argue this is the culture of HBCUs, and if faculty are willing to engrain themselves in the culture they will be impactful.

Conversely, the research reports a collegiate and collaborative peer relationship among students at HBCUs (Gary, 2012; Gasman & Nguyen, 2014). This research is consistent with previous literature and proved to be extremely influential in the HBCU experience for all the participants. All the participants from this study identified their peers as family, whom they studied with and confided in. Participants partially contributed their desire and access into a doctoral program to their classmates, calling it a teamwork effort. Consistent with Gary (2012), participants identified their relationships with their peers from HBCUs to be long-lasting, as all participants claimed to still stay in constant contact with their peers; updating them on career and personal goals.

Literature from Gary (2012) regrettably reported a sense of inadequacy regarding academic preparation for graduate school. This topic in particular is inconsistent, as Gasman & Nguyen (2014) identified exposure to research as a key success for HBCUs graduating Black students in STEM. This research shares in the inconsistency within the literature. Two of the four participants felt as though their programs were somewhat underdeveloped, making their transition into graduate school very tough. They identified the program as underdeveloped or outdated. Juxtaposed, the other two participants found that their programs did more than enough to prepare them for graduate school. This preparation gave them the courage they would need when entering their doctoral program.

This research supports ensuring students are not being prevented or discouraged from pursuing STEM majors or careers (Gary, 2012; Gasman & Nguyen, 2014). Although this research did not explore other factors outside of HBCUs, participants expressed how important it was for faculty to not focus on weeding them out (Gasman & Nguyen, 2014) but to encourage them along the way. The encouragement from faculty seemed to be of great meaning as students valued the opinions of their faculty. Participants had an understanding that faculty knew what it would take to be successful in a STEM graduate program, so to hear encouraging words and affirmation that they can succeed in a STEM doctoral program only furthered their desire to enroll.

Implications for Policy and Practice

This study has provided insight into a number of potential practices and policies that can be implemented on the institutional level regarding strategies that will positively influence Black students in pursuit of a doctoral degree in STEM. These policies and strategies will assist in aiding more Black students to purse an advanced degree in STEM.

From a policy perspective, the federal government plays a pivotal role in supporting HBCUs' push for educating Black students in STEM. Each participant throughout the study mentioned taking part in a federally supported program or research lab. Federal programs such as the Louis Stokes Alliance for Minority Participation (LSAMP), Centers of Research Excellence in Science and Technology (CREST), HBCU Research Infrastructure for Science and Engineering (HBCU-Rise), Partnerships for Research and Education in Materials (PREM), and Partnerships in Astronomy and Astrophysics Research and Education (PAARE) along with Title III Part B are all

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programs that assist HBCUs in advancing their STEM programs (Toldson & Preston, 2015). It is imperative that the federal government and policy makers continue to acknowledge and support the work being done at HBCUs by continually financing and expanding these programs. It is equally important for the states where HBCUs are located to acknowledge and support the work being done at HBCUs. With this support financially, HBCUs will be able to expand their infrastructure and programs offered, as well as continue with strong contribution to diversifying the STEM field.

As practice is concerned there are a number of implications for HBCUs, other institutions of high education, and doctoral program looking to increase the number of African American students. HBCUs (especially those that focus on sending students to professional school) should expose their students to research and ensure that they highlight the possibilities and benefits of enrolling in a doctoral program to students in STEM disciplines. Participants seemed to have benefitied from their exposure to research and the benefits of graduate school. Expanding research opportunities can be done by taking advantage of federally funded programs such as CREST, HBCU-Rise, PREM, PAARE, and HBCU-Up. HBCUs can look to expose their students to graduate school through partnerships and graduate visits.

Other institutions of higher education should consider encouraging more Black students to major in STEM fields, but also provide a welcoming environment that will support and ensure the success of these students. Graduate programs that are looking to recruit more African American students should not only focus on providing funding, but should look to diversify their student body as well as their faculty. A supportive and

diverse cohort and faculty were of great concern for participants in their decisions to attend their particular graduate school.

Based on this study, there are a number of takeaways for HBCUs as they continue to advance Black students through the STEM pipeline. This research has shown how HBCUs have done an outstanding job at supporting Blacks student in STEM fields. Unfortunately, the participants who majored in a more concentrated area in STEM expressed a need for more capacity to support those programs. Researchers have even discovered HBCU numbers are lower in graduating Black students in certain concentrated fields (William & Preston, forthcoming). HBCUs are in need of more resources and financial support to expand programs offered and more exposure for their students. Student also noted just how important faculty at HBCUs are in their decision to enroll into a doctoral program.

Two of the four participants' main professors were White and students often mentioned a lack of African American faculty members. All participants did acknowledge having faculty of color and how that shaped their belief in knowing they obtain a PhD. Although race does play a factor, the relationship fostered between students and faculty is equally impactful. The close relationship developed between students and faculty provided a number of opportunities students might not get otherwise. Through a strong relationship with faculty students are able to gain the encouragement and support system needed to excel in STEM. These strong relationships provided students the opportunity to discover the possibility that come with obtaining a PhD. One

may argue that without a strong relationship with faculty it might be more difficult for Black students to navigate the STEM pipeline.

In addition to the relationship formed with faculty, it is equally as important for Black students to have a positive relationship with their peers. A cooperative environment as opposed to a competitive environment serves better for the success of Black students in STEM. Black students in such intensive fields of study show better progress and success when they are able to collaborate with students on research project, study together, encourage one another, and see their peers as people who are working with them to reach their goals.

As the country seeks to increase the representation of African American students in STEM fields (Campbell, Skvirsky, Wortis, Thomas, Kawachi, & Hohmann, 2014), it is imperative for them continue to experience some of the same elements of a positive environment once enrolling into their graduate programs. It is not enough for graduate programs to provide funding and state of the art facilities to Black students. Often times, Black students are admitted to programs where they experience isolation, which begins to negatively affect the student emotionally and academically. When students are in the state of isolation they feel the need to prove themselves and represent the entire Black community. Therefore, graduate schools must display a buy-in for creating an inclusive environment for all. Creating an inclusive environment, means ensuring there are diverse faculty within the programs and more students of color as they matriculate through graduate school.

Future Research

Although this study offered great insight into what factors influenced African Americans from HBCUs to enroll in a STEM doctoral program, additional research is needed to advance the work around the topic. First, expanding the scope of this research to more HBCU graduates with STEM doctoral degrees would further explain the primary research question guiding this study- what aspect of CCW do Black students at HBCUs believe influence and assist them to enroll in STEM doctoral programs. Although this multiple case study provided insight into the various HBCUs (i.e. Large public or private, and small public or private), it would be advantageous to increase the number of institutions and participants. Likewise, diversifying the participant pool to encompass more than one gender would also be advantageous. It would be advantageous to compare and contrast the experiences of male and female students at HBCUs.

Second, a deeper examination of the faculty at HBCUs may offer insight into the culture and practices of the institution. Since this study only takes into account the perspective of the student, it would more forth telling to gain the perspective of the faculty at HBCUs. The findings from this study exposes the lack of African Americans in STEM departments at HBCUs. Further examination into the make-up of STEM faculty at HBCUs will provide more insight into factors such as races and the environment that exist on these campuses that impacts students' decisions to enroll into doctoral programs.

The findings from this study highlight a third aspect of furture research, the importance of various enrichment programs offered at HBCUs. A deeper examination into various enrichment programs at HBCUs whether institutional, departmental, or

national programs, may provide insight into various components that may have a major impact on whether a student decides to pursue a STEM doctoral degree or not. Further insight into these programs may offer insight into best practices for encouraging African Americans to enroll in STEM doctoral programs.

This study focuses solely on students who pursue a STEM doctoral program, but, researchers have found that attending an HBCU may increase the likelihood of Black students to pursue a doctoral degree at some point (Joseph, 2013; King & Chepyator-Thomson, 1996;Lundy-Wagner et al., 2013; Perna, 2001). Any additional research should be conducted on the role HBCUs play in influencing Black students to enroll into any doctoral program. A further examination would provide a deeper insight into the culture of HBCUs, and provide successful strategies that exist across STEM, as well as in the arts and humanities that impact student's decision to enroll into doctoral programs.

More research should examine how HBCUs serve as form of Community Cultural Wealth to the Black community. This study was limited to students in STEM and those who were currently in a doctoral program. With there being multiple aspects of Community Cultural Wealth, more research should examine the various forms of capital and how HBCUs provide opportunities for Black students to succeed in all fields. Further research will allow for a better understanding of how HBCUs act as a form of Community Cultural Wealth for Black students in higher education.

Conclusion

HBCUs are not monolithic in their institutional structure. However, these institutions in some form or another provide their students with the Community Cultural
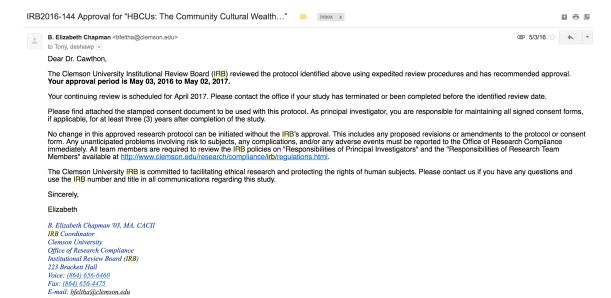
Wealth needed to succeed. Depending on the student, some various forms of Community Cultural Wealth are more impactful than others, but no matter what, students have access to Community Cultural Wealth during the time at an HBCU and even after they graduate. It is important to note that HBCUs cultivate this type of environment not simply through a number of initiatives, but through the interactions students have with faculty, staff, administration, and with their peers. Ultimately, it is the culture fostered by HBCUs that makes it easier for Black students to succeed, whether they are looking to enroll into a graduate program or go into the workforce. This culture provides a space for Black students to be their authentic selves, while learning and discovering who they are. It allows for students to grow and make mistakes without the pressure of representing an entire race or feeling isolated as they attempt to navigate the educational pipeline.

As the U.S. continues to encourage more Black students to obtain advanced degrees in the STEM fields, it is imperative that institutions, policymakers, and funders look to HBCUs for how to address this community of students. HBCUs are a great example for how institutions must invest in their students in order to get the greatest return. These institutions have created an environment that promotes student success in a more unconventional way within higher education. Often times, these unconventional methods that were discovered through the lens of Community Cultural Wealth go unnoticed and undervalued. While these methods are not quantifiable, the outcomes of these methods have shown through the data that this approach is most beneficial in helping Black students succeed.

APPENDICES

Appendix A

IRB Approval

Appendix B

Study Participant Consent Form

Information about Being in a Research Study
Clemson University

Historically Black Colleges Universities (HBCUs) serving as a Community Cultural Wealth for African Americans students who enroll in STEM doctoral program

Description of the Study and Your Part in It

Dr. Tony Cawthon and DeShawn Preston are inviting you to take part in a research study. Dr. Cawthon is an Alumni Distinguished Professor at Clemson University. DeShawn Preston is a student at Clemson University, running this study with the help of Dr. Cawthon. The purpose of this research is to examine the role HBCUs plays in aiding African American students to pursue a doctoral degree in STEM.

Your part in the study will be to participate in an interview. We want you to offer the perspective of a student who attended a HBCU and how this experience aided with your enrollment into a STEM doctoral program. With your permission, we would like to audio record the interview.

It will take you about 3 interviews ranging from about 30- 90 minutes.

Risks and Discomforts

There are certain risks or discomforts that you might expect if you take part in this research. They include divulging private information. Please do not share any information that may be sensitive or make you uncomfortable. You may refuse to answer or leave the interview at any time if you become uncomfortable.

Possible Benefits

We do not know of any way you would benefit directly from taking part in this study. However, this research may help us to understand methods, strategies, and possibly programs that one of the top ten baccalaureate-origin institutions of African American recipients. The findings from this study have the possibility of being transferable, providing strategies for faculty to aid student with enrolling into doctoral programs. With such result not only will this aid in helping more HBCUs assist students to enroll in doctoral programs, but some of the methods and strategies could be implemented at PWIs to increase the number of African Americans who graduate to pursue a doctoral degree.

Protection of Privacy and Confidentiality

We will do everything we can to protect your privacy and confidentiality. We will not tell anybody outside of the research team that you were in this study or what information we collected about your particular.

Participants will not be identifiable by names as pseudonyms will be assigned to both participants and colleges. Institution name and location will not be used in this study. The participants institution will be identifed as private or public, and student enrollment. Audio recordings will be kept on an Ipad with a security code.The two members of the research team will have access to the data. After the interviews have been transcribed, the participants interviews and information will be paired with their pseudonym and the audio recording of the interviews will be destroyed.

We might be required to share the information we collect from you with the Clemson University Office of Research Compliance and the federal Office for Human Research Protections. If this happens, the information would only be used to find out if we ran this study properly and protected your rights in the study.

Choosing to Be in the Study

You do not have to be in this study. You may choose not to take part and you may choose to stop taking part at any time. You will not be punished in any way if you decide not to be in the study or to stop taking part in the study.

If you choose to stop taking part in this study, the information you have already provided will be used in a confidential manner.

Contact Information

If you have any questions or concerns about this study or if any problems arise, please contact Dr. Tony Cawthon at Clemson University at **864-656-5100**.

If you have any questions or concerns about your rights in this research study, please contact the Clemson University Office of Research Compliance (ORC) at 864-656-6460 or irb@clemson.edu. If you are outside of the Upstate South Carolina area, please use the ORC's toll-free number, 866-297-3071.

Consent

I have read this form and have been allowed to ask any questions I might have. I agree to take part in this study.

Participant's signature: _____ Date: _____

A copy of this form will be given to you.

Participants Recruitment Letter

May 10, 2016

Dear Dr. XXXXX,

Hello. My name is **DeShawn Preston.** I am a doctoral student in Higher Education at the E.T. Moore School of Education. My professor, **Dr. Tony Cawthon**, Assistant Professor at Clemson University, and I would like **invite you to participate in a research project entitled "Historically Black Colleges Universities serving as a Community Cultural Wealth for African Americans students who enroll in STEM doctoral programs"**

This qualitative study will examine how and what assistance HBCUs provide students to matriculate into a doctoral program, using Yosso's (2005) Community Cultural Wealth framework. More specifically, this research will look to find out what Blacks from HBCUs believe influenced and assisted them with enrolling into a STEM doctoral program.

You have been identified as a potential participant because you are located in one of the major disciplines (the Sciences and the Humanities) in which we are focusing our efforts. In addition, your name may have been provided by an informant and/or based on a review of your website/curriculum vitae.

Please note that your participation is completely voluntary. The extent of your participation would include **three interviews**. The interview will take between **30-90 minutes**. With your permission, we would like to audio record the interviews. Following the interview, you **could** be contacted via e-mail with follow-up or clarifying questions. Such an exchange would require no more than ten minutes time.

The risks are minimal in that **you will be assigned a pseudonym** and the **university will be masked.** Audio recording will be kept on an Ipad with security code. The two members of the research team will have access to the data. After the interviews have been transcribed, the participant's interviews and information will be paired with their pseudonym and the audio recording of the interviews will be destroyed.

If you are willing to participate, please email **DeShawn Preston** at deshawp@clemson.edu. DeShawn Preston and Dr. Cawthon will interview transcription and data organization. If you should have any questions, please feel free to contact DeShawn Preston at deshawp@clemson.edu or at 404.625.6192.

Thank you for your time.

DeShawn Preston, Ph.D. Candidate
E.T. Moore School of Education
G19A Tillman Hall
deshawp@clemson.edu

Appendix D

Background Information questionnaire

1. Name_____
2. Phone _____Cell_____
3. School Email Address_____
4. Alternative Email Address_____
5. Hometown _____State_____

Academic Information
6. Current Doctoral Program_____
7. Year in Program _____First _____Second _____Third _____Fourth
   _____Fifth _____Sixth _____ Other
8. Research Interest_____
9. Current Cumulative GPA_____
10. Are you currently receiving funding assistance (indicate if full or partial)
    _____
11. Anticipated Graduation Year_____
12. Undergraduate Institution_____
13. Major(s)_____
14. Cognate/Minor_____
15. Final Cumulative GPA_____/4.00 Scale (please try to estimate)
16. Graduation Year_____
17. Master's Degree Institution_____
18. Major(s)_____
19. Cognate/Minor_____
20. Final Master's Cumulative GPA_____/4.00 Scale (please try and estimate)
21. Graduation Year_____
22. Do you have a mentor(s)? If so how many_____
Campus Involvement During *Education* Tenure
List all campus organizations in which you were involved with outside of classes.
Club/Organization Leadership Position (if any)

_____   _____
_____   _____
_____   _____
_____   _____

_____   _____
Community Involvement During *Education* Tenure
List all campus organizations in which you were involved with outside of classes.
Club/Organization Leadership Position (if any)

_____   _____
_____   _____
_____   _____

_____   _____

_____   _____

Programs

Were you involved in any programs that helped prepared you for your doctoral program? If so, please describe.

Interview Protocol

Opening Questions

1. Tell me a little about yourself
2. What developed your interest in your particular field
3. Why did you attend an HBCU for your baccalaureate degree
4. Tell me how you made the decision to enroll in a doctoral program
5. What factors were important when determining to enroll in the program

Community Cultural Wealth (Questions 1)
- Aspirational Capital
  - Did institutions help in the development of your goals? If so how?
  - Once your aspirations were developed did your institutions help you reach those aspirations? If so how?
  - Did your institution have anything to do with your aspirations to enroll in a doctoral program? If so how?
- Linguistic Capital
  - Did your professors make any of your lessons culturally relevant? If so was it helpful in the classroom?
  - Were you able to communicate in class or outside of class without feeling as though you loss your identity?
- Familial Capital
  - How would you describe the relationships you had with faculty, staff, and students on campus? Explain.
  - How would you describe your relationship with faculty and students within your department?
  - Was there a sense of cultural pride that was instilled in your while attending your institution?
- Social Capital
  - What opportunities for professional and career development did your institution provide?
  - Is there some type of pipeline program/agreement between you institutions and other doctoral programs?
  - Was there a relationship between your faculty and the doctoral institution where you are currently enrolled?
  - Were you able to use any connections from your undergraduate institution (alumni, faculty, institution reputation) that assisted in your enrollment into your doctoral program?
- Navigational Capital
  - Did your institution help you as navigated through the stem pipeline (selection of school, application process)? If so how?

        o How did your institutions prepare you for your doctoral program?

        o Did your institution/faculty assist you in your program after graduation? If so explain.

- Resistant Capital
    - Was there ever a discussion about the opposition you might face as a Black person in STEM? What would it like?
    - Did you anyone from your institution assist you whenever you felt like giving up or you felt as though you were performing poorly? If so explain.
    - In a field that is often known for weeding students out that are not prepared how did your institution assist you in enrolling into a doctoral program?

College Characteristics (Question 2)

1. Let's talk about undergrad. Describe for me experiences with people in undergrad that influenced your decision to enroll in a doctoral program.

      a. Probe: Tell me about your relationships with professors? How would you describe those relationships? How were they supportive or non-supportive of your decision?

      b. Probe: Tell me about your relationships with peers at college? How would you describe those relationships? How were they supportive or non-supportive of your decision?

      d. What qualities in those relationships seem meaningful?

2. In what ways do you feel your undergraduate experience prepared (or unprepared) you to pursue doctoral education?

3. If you could change anything about your undergraduate experience in relation to pursuing the doctorate what would it be? Why?

Special Program, Efforts, and Networking (Question 3)

1. Did your department provide you with opportunities or exposure to doctoral programs or work
2. What influence do you think the faculty at your institution had on you pursuing your degree
3. Did your HBCU have any programs that assist you with your enrollment into a doctoral program
4. Are there any strong relationship with outside institutions that recruit students into their doctoral program
5. Do you feel as though your alumni or faculty provided you with the network needed to enroll into a doctoral program

Appendix F

Photo Ellication Directions and questions

Instructions for Photo Ellication
Paritipants are asked to provide a photo of anything (people, paraphernalia, campus, document, etc.) from your HBCU experience that impacted your decision to enroll into a STEM doctoral program.

Second Interview
1. What are you sharing with us today?
2. Why is this so important to you?
3. How is this a representation of one of the many influence for your enrollment into a doctoral program?

REFERENCES

Albritton, T. J. (2012). Educating our own: The historical legacy of HBCUs and their relevance for educating a new generation of leaders. *The Urban Review*, *44*(3), 311-331.

Allen, W. (1992). The color of success: African-American college student outcomes at predominantly White and historically Black public colleges and universities. *Harvard Educational Review*, *62*(1), 26-45.

Allen, W. R., Epps, E. G., & Haniff, N. Z. (1991). *College in Black and White: African American students in predominantly White and in historically Black public universities*. New York: SUNY Press.

Allen, W. R., & Jewell, J. O. (2002). A backward glance forward: Past, present and future perspectives on historically Black colleges and universities. *The Review of Higher Education*, *25*(3), 241-261.

American Institutes for Research. (2012). *Broadening participation in STEM: A call to action.* Washington, DC: Author.

Armstrong, E. E., & Thompson, K. (2003). Strategies for increasing minorities in the sciences: A University of Maryland, College Park Model. *Journal of Women and Minorities in Science and Engineering*, *9*(2), 119-135. doi: 10.1615/JWomenMinorScienEng.v9.i2.30.

Auerbach, S. (2007). From moral supporters to struggling advocates: Reconceptualizing parent roles in education through the experience of working-class families of color. *Urban Education*, *42*(3), 250-283.

Baillie, C. (2006). Engineers within a local and global society. *Synthesis Lectures on Engineering, Technology and Society*, *1*(1), 1-76.

Berger, J. B., & Milem, J. F. (2000). Exploring the impact of historical- ly black colleges in promoting the development of undergraduate self-concept. *Journal of College Student Development, 41*(4), 381–394.

Boone, P. R. (2003). When the "amen corner" comes to class: An examination of the pedagogical and cultural impact of call–response communication in the Black college classroom. *Communication Education*, *52*(3-4), 212-229.

Bourdieu, P., & Passeron, J. (1990). *Reproduction in education, society and culture.* Beverly Hills, CA: Sage.

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Breiner, J. M., Harkness, S. S., Johnson, C. C., & Koehler, C. M. (2012). What is STEM? A discussion about conceptions of STEM in education and partnerships. *School Science and Mathematics*, *112*(1), 3-11.

Brown, M. C., & Davis, J. E. (2001). The historically Black college as social contract, social capital, and social equalizer. *Peabody journal of Education*, *76*(1), 31-49.

Brown, M. C., Donahoo, S., & Bertrand, R. D. (2001). The Black college and the quest for educational opportunity. *Urban Education*, *36*(5), 553-571.

Burrelli, J., & Rapoport, A. (2008). *Role of HBCUs as baccalaureate-origin institutions of Black S&E doctorate recipients* (NSF 08-319). Arlington, VA: National Science Foundation.

Campbell, A.D., Skvirsky, R., Wortis, H. , Thomas, S., Kawachi, I., and Hohmann, C. (2014). Nest 2014: Views from the trainees-talking about what matters in efforts to diversify the stem workforce. CBE Life Sci. Educ. 13, 587.

Catalano, G. D. (2007). Engineering, poverty, and the earth. *Synthesis Lectures on Engineering, Technology and Society*, *2*(1), 1-73.

Collier, M. J. (1994). Cultural identity and intercultural communication. In L. A. Samovar & R. E. Porter (Eds.), *Intercultural communication: A reader* (pp. 36–45). Belmont, CA: Wadsworth.

Collier, M. J. (1997). Cultural identity and intercultural communication. *Intercultural communication: A reader*, 36-44.

Davidson, M. N., & Foster-Johnson, L. (2001). Mentoring in the preparation of graduate researchers of color. *Review of Educational Research, 71*(4), 549-574.

Dawkins, M. P. (2006). The McKnight doctoral fellowship program: Toward a seamless approach to the production of african american doctorates. *Journal of Negro Education, 75*(3), 563-571.

Delgado Bernal, D. (2002). Critical race theory, LatCrit theory and critical raced gendered epistemologies: recognizing Students of Color as holders and creators of knowledge. *Qualitative Inquiry*, 8(1),105–126.

Delgado, Gaitan, C. (2001). *The power of community: mobilizing for family and schooling.* Boulder CO: Rowman and Littlefield Publishers.

Deloria, V. (1969) *Custer died for your sins: an Indian manifesto* New York Avon.

Fiegener, M. K., & Proudfoot, S. L. (2013). Baccalaureate origins of US-trained S&E

doctorate recipients. *Arlington, VA: National Science Foundation, http://www. nsf. gov/statistics/infbrief/nsfl3323/nsfl3323. pdf.*

Freire, P. (1970). *Education for critical consciousness.* New York Continuum Publishing Company.

Garcia, S. B., & Guerra, P. L. (2004). Deconstructing deficit thinking working with educators to create more equitable learning environments. *Education and Urban Society, 36*(2), 150-168.

Gary, S. (2010). *Four portraits: The role of historically Black colleges and universities in the development of Black science, technology, engineering and mathematics Ph. D. students.*

Gasman, M., & Tudico, C. L. (2008). Introduction. In M. Gasman & C. L. Tudico *Historically black colleges and universities: Triumphs, troubles, and taboos* (pp. 1–12). New York, NY: Palgrave MacMillan.

Glesne, C. (2006). *Becoming qualitative researchers: An introduction.* Boston, MA: Pearson.

Glesne, C. & Peshkin, A. (1992). *Becoming qualitative researchers: An introduction.* White Plains, NY: Longman.

Guest, Greg; Bunce, Arwen & Johnson, Laura (2006). "How many interviews are enough? *An experiment with data saturation and variability".* Field Methods, 18(1), 59-82.

Guiffrida, D. (2005). To break away or strengthen ties to home: A complex question for African American students attending a pre- dominantly white institution. *Equity and Excellence in Education, 38*(1), 49–60.

Frehill, L. M. (2004). The gendered construction of the engineering profession in the United States, 1893–1920. *Men and Masculinities*, *6*(4), 383-403.

Fries-Britt, S., & Turner, B. (2002). Uneven stories: Successful Black Collegians at a Black and White Campus. *The Review of Higher Education, 25*(3), 315–330.

Harper, B. E. (2007). African American access to higher education: the evolving role of historically black colleges and universities. *American Academic*, *3*(1), 109-127.

Harper, D. (2002). Talking about pictures: A case for photo elicitation. *Visual studies*, *17*(1), 13-26.

Harper, S. R. (2007). Using qualitative methods to assess student trajectories and college impact. *New Directions for Institutional Research*, 2007(136), 55-68.

Hebel, S. (2001). A New Push To Integrate Public Black Colleges. *Chronicle of Higher Education*, *47*(39).

Hirt, J. B., Amelink, C. T., McFeeters, B. B., & Strayhorn, T. L. (2008). A system of othermothering: Student affairs administrators' perceptions of relationships with students at Historically Black Colleges. *NASPA Journal*, *45*(2), 210-236.

Jackson, C. L., & Nunn, E. F. (2003). *Historically black colleges and universities: A reference handbook.* Santa Barbara, CA: Abc-clio.

Johnson, M. J., & Sheppard, S. D. (2004). Relationships Between Engineering Student and Faculty Demographics and Stakeholders Working to Affect Change*. *Journal of Engineering Education*, *93*(2), 139.

Joseph, J. (2013). The impact of historically black colleges and universities on doctoral students. *New Directions for Higher Education, 2013*(163), 67-76.

Kim, M. M. (2002). Historically Black vs. White institutions: Academic development among Black students. *The Review of Higher Education*, *25*(4), 385-407.

Kim, M. M., & Conrad, C. F. (2006). The impact of historically Black colleges and universities on the academic success of African-American students. *Research in Higher Education*, *47*(4), 399-427.

Knight, L., Davenport, E., Green-Powell, P., & Hilton, A. A. (2012). The Role of Historically Black Colleges or Universities in Today's Higher Education Landscape. *International Journal of Education*, *4*(2), 223-235.

López, G. R. (2003). Parent involvement as racialized performance. *Interrogating racism in qualitative research methodology.* New York, NY: Peter Lang. 71–95.

Lundy-Wagner, V., Vultaggio, J., & Gasman, M. (2013). Preparing underrepresented students of color for doctoral success: The role of undergraduate institutions. *International Journal of Doctoral Studies,* 8, 151-171.

Maton, K. I., & Hrabowski III, F. A. (2004). Increasing the Number of African American PhDs in the Sciences and Engineering A Strengths-Based Approach. *American Psychologist*, *59*(6), 547.

Merriam, S. B. (1998). *Qualitative research and case study applications in education.* San Francisco: Jossey-Bass.

National Science Foundation, National Center for Science and Engineering Statistics. (2015). *Women, Minorities, and Persons with Disabilities in Science and Engineering: 2015.* Special Report NSF 15-311. Arlington, VA. Available at

http://ww.nsf.gov/statistics/wmpd/.

Oliver, M. L., & Shapiro, T. M. (2006). *Black wealth, white wealth: A new perspective on racial inequality*. NewYork: Routledge.

Owens, E. W., Shelton, A. J., Bloom, C. M., & Cavil, J. K. (2012). The significance of HBCUs to the production of STEM graduates: Answering the call. *Educational Foundations, 26*, 33-47.

Palmer, R., & Gasman, M. (2008). " It Takes a Village to Raise a Child": The Role of Social Capital in Promoting Academic Success for African American Men at a Black College. *Journal of College Student Development*, *49*(1), 52-70.

Pascarella, E., Bohr, L., Nora, A., & Terenzini, P. (1995). Cognitive effects of 2-year and 4-year colleges: New evidence. *Educational Evaluation and Policy Analysis*, *17*(1), 83-96.

Pascarella, E. T., Wolniak, G. C., Pierson, C. T., & Flowers, L. A. (2004). The role of race in the development of plans for a graduate degree. *The Review of Higher Education, 27*(3), 299-320.

Pawley, A.L., (2012)What Counts as "Engineering": Towards a Redefinition. *Engineering and Social Justice: In the University and Beyond.* Purdue University Press:West Lafayette, IN. 59-85.

Perna, L., Lundy-Wagner, V., Drezner, N. D., Gasman, M., Yoon, S., Bose, E., & Gary, S. (2009). The contribution of HBCUs to the preparation of African American women for STEM careers: A case study. *Research in Higher Education*, *50*(1), 1-23.

Riley, D. (2008). Engineering and social justice. *Synthesis Lectures on Engineers, Technology, and Society*, *3*(1), 1-152.

Rovai, A. P., Gallien, L. B., & Stiff-Williams, H. R. (Eds.). (2007). *Closing the African American achievement gap in higher education*. New York: Teachers College Press.

Rovaris, D. J. (2005). *Mays and Morehouse: How Benjamin E. Mays Developed Morehouse College, 1940-1967*. Beckham Publications.

Seymour, E. & Hewitt, N. (1997). *Talking about leaving: Why undergraduates leave the sciences*. Boulder, CO: Westview Press.

Sibulkin, A. E., & Butler, J. (2011). Diverse colleges of origin of african american doctoral recipients, 2001–2005: Historically black colleges and universities and

beyond. *Research in Higher Education, 52*(8), 830-852.

Solorzano, D. G. (1995). The doctorate production and baccalaureate origins of african americans in the sciences and engineering. *Journal of Negro Education, ,* 15-32.

Stake, R. E. (1995). The art of case study research. Thousand Oaks, CA: Sage

Stanfield, J. H., II.(1994).Ethnic modeling in qualitative research. In N. K .Denzin & Y. S. Lincoln (Eds.), Handbook of qualitative inquiry (pp. 175-188). Newbury Park, CA:Sage.

Stanton-Salazar, R. (1997). A social capital framework for understanding the socialization of racial minority children and youths. *Harvard educational review, 67*(1), 1-41.

Stolle-McAllister, K. (2011). The case for summer bridge: Building social and cultural capital for talented black STEM students. *Science Educator, 20*(2), 12.

Strayhorn, T. L. (2010). Social barriers and supports to underrepresented minorities' success in STEM fields. In *Frontiers in Education (FIE) Conference, Washington, DC*.

Strayhorn, T. L., Long III, L. L., Kitchen, J. A., Williams, M. S., & Stentz, M. E. (2013). Academic and social barriers to Black and Latino male collegians' success in engineering and related STEM fields. In *American Society for Engineering Education Annual Conference and Exposition, Atlanta, GA*.

Strayhorn, T. L., Williams, M. S., Tillman-Kelly, D., & Suddeth, T. (2013). Sex differences in graduate school choice for Black HBCU bachelor's degree recipients: A national analysis. *Journal of African American Studies, 17*(2), 174-188.

Toldson, I. A. (2013). Historically Black Colleges and Universities Can Promote Leadership and Excellence in STEM (Editor's Commentary). *The Journal of Negro Education, 82*(4), 359-367.

Toldon, I. A. (2015). OpEd: Why Justice Scalia was wrong about black scientists - NBC News . Retrieved from http://www.nbcnews.com/news/nbcblk/oped-why-justice-scalia-was-wrong-about-black-scientists-n478476

Treisman, U. (1992). Studying students studying calculus: A look at the lives of minority mathematics students in college. *The College Mathematics Journal, 23*(5), 362-372. doi: 10.2307/2686410

Upton, R., & Tanenbaum, C. (2014). The Role of Historically Black Colleges and

Universities as Pathway Providers: Institutional Pathways to the STEM PhD. *American Institutes for Research*.

Wenglinsky, H. H. (1996). The educational justification of historically Black colleges and universities: A policy response to the US Supreme Court. *Educational Evaluation and Policy Analysis*, *18*(1), 91-103.

Williams P (1991) *The alchemy of race and rights: diary of a law professor* Cambridge MA Harvard University Press.

White House Initiative on Historically Black Colleges and Universities. (n.d.). *What is an HBCU?* Retrieved from http://sites.ed.gov/whhbcu/one-hundred-and-five-historically-black-colleges-and-universities/

Wolf-Wendel, L. E. (1998). Models of excellence: The baccalaureate origins of successful european american women, african american women, and latinas. *Journal of Higher Education, 69*(2), 141-186.

Yin, R. K. (2014). Case study research: Design and methods. Sage publications.

Yosso, T. J. (2005). Whose culture has capital? A critical race theory discussion of community cultural wealth. *Race Ethnicity and Education, 8*(1), 69-91.