ABSTRACT

Black women majoring in Science, Technology, Engineering and Math (STEM) fields at predominantly White institutions (PWIs) experience a number of emotions as they navigate spaces and seek their identity. Black women experience greater challenges when striving for their sense of belonging while at PWIs than at Historically Black Colleges and Universities (HBCUs) (Shavers & Moore, 2014). Precollege factors such as the middle school experience (King & Pringle, 2019), the high school experience (McGee & Bentley, 2017), family (Hannon, Woodside, Pollard, & Roman, 2016), and religion (Patton & McClure, 2009) contribute to Black women’s mentality and overall sense of belonging. Subsequently, the campus climate, peers, and faculty influence the level of engagement and adjustment, ultimately aiding in students’ persistence or causing them to mask their identities and identify alternative ways to cope. Invoked by Critical Race Feminist, the Anti-Deficit Achievement Framework was utilized to explore the experiences of this group of students. Through semi-structured interviews of twenty-three Black female undergraduate STEM students, experiences that contribute to success and hinder progress were examined. The themes that emerged from this qualitative study were decision to pursue a STEM major, method to thrive, big picture mentality, and simply surviving. Salient findings include the importance of social interactions both inside and outside of the classroom with peers, faculty, and advisors to cultivate belonging. This study will promote efforts to improve outcomes of the whole Black female student through consideration of influences on STEM persistence rates.
DEDICATION

I dedicate this dissertation to my wonderful family and the two people that are the wind beneath my wings.

To my amazing husband, Karl:

There is no way I could have accomplished this without your tremendous love and support. For every late night I spent studying with you providing me an endless supply of coffee to every time you encouraged me to keep working hard even when I was overwhelmed. You have always been my constant support, my best friend, and my biggest cheerleader, and for that I will always be eternally grateful. I love you more than words can say.

To my precious son, Dylan:

I never imagined that you would be such a source of strength and dedication for me. Because of your love and constant encouragement, no matter how hard it got, I knew that I could accomplish my goals. Every single night, you would ask me what I will work on while you were sleeping and that question of accountability resonated with me and made me want to make you proud each morning you confirmed what I had worked on. When you were born, I knew you were destined for greatness, and each day you remind me of that. I love you my sweet sunshine.
ACKNOWLEDGEMENTS

For I know the plans I have for you,” declares the LORD, “plans to prosper you and not to harm you, plans to give you hope and a future. Jeremiah 29:11 NIV

I have to begin by acknowledging my Lord and Savior Jesus Christ who truly has a plan for my life. Without God I am nothing, but with God, I can accomplish all things. My faith has sustained me on this journey. I would like to thank my chair, Dr. Laanan, for your guidance, support, and encouragement. I would like to thank my committee members for your invaluable feedback, insight, and direction throughout this process. Because of the investment of your time and dedication, I was allowed to accomplish my dreams. I have to thank my tribe of family and friends as they are small yet mighty prayer warriors who stood in the gap and prayed for me throughout this process. To my niece, Madison, and the reason behind so much of what I have done, you are a true inspiration. My husband, son, and mother-in-law have been a constant source of strength and determination, I could not have accomplished this without you. To my Cohort 13 family, I am so grateful for our journey together and I pray that we have created bonds that will last a lifetime. To Dr. Breaux and Sheryl, the sails that keep this ship afloat, thank you for your guidance, support, and assistance. To Julianna Proctor, I greatly appreciate your time, dedication and efforts to ensure I received informative data. I would like to extend a very special thank you to Tanta Myles, Dr. Monica Davis, and Dr. Amy Bickel, who all graciously provided guidance, insight, and encouragement along my journey. I would also like to thank Dr. Fifolt for your superb editing expertise. Finally, to my grandmother who is smiling down from heaven, I
hope that I have made you proud, I know this accomplishment is simply your wildest dream, I love you.
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CHAPTER 1
INTRODUCTION

I examined the sense of belonging of Black women who have chosen the Science, Technology, Engineering, or Math (STEM) track while attending a predominantly White institution (PWI). Sidney Poitier, a noble and prolific Black actor of his time, took encouraging advice from his mother who counseled him in 1967 as he took on the leading role in *Guess Who’s Coming to Dinner?* opposite his White counterpart and love interest during the height of the Civil Rights Movement. While the eyes of the nation were on him, he grappled with fulfilling the predetermined stereotypes and expectations or being successful far beyond a White actor in this same role. Poitier’s mother told him to “charm them into neutral” (Poitier, 2000, p.98), an expression that transcends decades and also speaks to the sentiment of many Black women attempting to effectively navigate White spaces. The objective of achieving consideration apart from any biases and being evaluated on one’s own merit is an attainable goal for some and a challenge for others as Black women operate in predominantly White spaces in pursuit of STEM majors. Students have to think and feel like they belong before they can act or engage with others like they belong (Strayhorn, 2012).

According to 2017 data from the National Center for Science and Engineering Statistics, the percentage of Black women graduating with bachelor’s degrees in Engineering increased by only 7% compared to 10 years ago. The statistic is even more dire when one considers that of the 22,794 total female graduates, only 1,054 or 4.85% are Black. The numbers do not improve when considering other STEM degrees. Based on data from U.S. Department of Education,
National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS), during 2015-2016, a higher percentage of Black females (64%) conferred degrees across all disciplines; however, the percentage dropped considerably (45%) among Black females granted STEM degrees (Musu-Gillette et al., 2016). Furthermore, even though there were over 2.2 million Black females between the ages of 18-24 enrolled in 2017, only 41% were undergraduates. Equally disturbing is the fact that the number of Black female undergraduates has consecutively decreased year after year between 2012 and 2016 (National Center for Science and Engineering Statistics, 2017). Data from IPEDS also revealed that of the bachelor’s degrees conferred between 2017 and 2019, specifically in Computer and Information Sciences, Engineering, Biological and Biomedical Sciences, Mathematics, and Physical Sciences, only 6% were to Black women.

As McGee and Bentley (2017) described, the presumed inferiority of Black women in STEM as they navigate highly competitive White spaces at a PWI can contribute to stress, ultimately influencing persistence rates. When these students allow the pressures of being the minority in both race and gender to overshadow their innate strength, they become overwhelmed with stress. While this presumption negatively impacts some students, others are capable of drowning out the negative noise and remaining focused on their studies (Porter et al., 2020). The stress that manifests as a result of the experiences has the potential to influence Black women’s ability to succeed.

**Background**

Born into slavery, Frances Jackson Coppin was the first Black student to teach at Oberlin College preparatory school and the first Black woman to lead an institution of higher learning. Regarding the pressure and anxiety, she felt to perform well particularly in rigorous “gentlemen
courses”, she acknowledged that her actions would be considered a reflection of the African race (Evans, 2008, p. 23). While Coppin’s experience is from the 1860s, the relevance of her tenacity as well as mental distress remains present today among Black female STEM students. Black women scholars have managed to thrive over the years despite their education being considered an insignificant element of the higher education academic foundation. As Evans (2008) highlighted, educational history has revealed the ways in which Black women declared intellectual spaces and engaged socially in the midst of oppression and outside influences from family responsibilities to societal pressures. This unwavering strength is present among many Black women pursuing STEM majors today.

Furthermore, Black women have historically faced significant challenges and struggles as they attempted to navigate White academic spaces. Black women at PWIs have faced racial opposition as well as sexism from Black male scholars who resented their academic advancement (Evans, 2008). The basis of this educational foundation helped to shape Black women’s outlook on higher education with some accepting the invisible characteristics defined for them while others resisted and created their own narratives. As Evans (2008) noted, women such as Anna Julia Cooper and Mary McLeod Bethune highlighted the aptitude of Black women.

Present throughout the trajectory of Black women scholars is racism and sexism, with racism being more prevalent in predominantly White spaces (Robinson et al., 2013). Referred to as double-jeopardy, being Black and female positions these scholars to contend with oppressive stereotypes regarding their race and sex (Brown et al., 2017; Lewis et al., 2013). As McGee and Bentley (2017) pointed out, in these academic spaces, racism is manifest through microaggressions and in more covert ways instead of the blatant forms of the past.
Microaggressions can come in multiple forms, including racial jokes, social avoidance and exclusion, expectations that one person can represent the perspectives of his or her whole social group, minimization of racists’ experiences, or assumptions about an individual’s academic skills and abilities based on group membership. (Griffin, 2017, p. 80)

Sexism has also been amplified in high-pressured fields such as STEM which further makes this research germane to improving outcomes for Black women in STEM. Johnson (2012) cited the need for a sense of belonging to increase the likelihood of persistence.

Data from the National Science Foundation (2017) reveal that Black women are entering STEM majors at one of the fastest rates, however, they continue to comprise less than 10% of the bachelor’s degrees awarded. Researchers have highlighted the need to better understand Black women’s lived experiences given their complex gender and racial identities that influence their academic trajectories (Brown et al., 2017; Lewis et al., 2013). As Dortch and Patel (2017) described, microaggressions directed towards Black female students result in feelings of isolation and marginalization, influencing their sense of belonging. This study will provide a deeper understanding of these students’ lived experiences, including the ways in which they successfully persist.

While negative influences such as racism, sexism, and classism directly affect Black women’s sense of belonging at a PWI, ultimately, causing some to drop out (Strayhorn, 2012), influences such as resiliency, grit, and self-efficacy positively contribute to matriculation (McGee & Bentley, 2017). It is vital to understand both. Included with resiliency of Black women in STEM is the presence of high self-esteem, family support systems, and an awareness of gender- and race-related obstacles (McGee & Bentley, 2017). Persisting at a PWI takes different forms for Black women. Further evidence of the issue that students are struggling with their sense of belonging and mental stability is the increased incidence of antidepressants being
prescribed on college campuses (Jackson, 2019). Often the overly positive imagery of PWIs overshadow the negative social and academic individual experiences sustained by Blacks attempting to navigate these spaces (Williams et al., 2019).

For Black communities, where aspects related to mental health have historically carried a stigma, the increased attention to this topic that can potentially influence overall mentality but will likely require more deliberate systematic efforts to reach college students, especially Black women. As described in The Chronicle of Higher Education (Williams-Hunt, 2017), factors such as belonging have a direct influence on student retention and are particularly meaningful for Black students with challenging majors such as STEM. Of significant importance is the definition Black women ascribed to themselves, which serves as their foundational agency and catalyst for educational development (Robinson et al., 2013).

Current Events

It is important to acknowledge the events that have transpired this year (2020) that have the potential to influence persistence and the academic outcomes of this group. The Novel Coronavirus 2019 (Covid-19) wreaked havoc on the United States, resulting in a significant loss of life, jobs, and overall opportunities. Given that higher education has felt the crushing impact of each blow of this virus, it is logical to conceive that there will be some ramifications as a result of this pandemic.

As the nation struggled for a sense of normalcy, another national uprising occurred. The murder of George Floyd by a White Minneapolis police officer during an arrest was watched by millions on May 25, 2020 and ignited a national outcry against police brutality aimed at Blacks. The killings of Floyd, Breonna Taylor, who was killed in her home by officers, and Ahmaud Arbery, who was gunned down by a group of White men, has caused higher education
administrators to speak out denouncing these acts and pledge their commitments to supporting Black lives (McKenzie, 2020). The consequences of these unfortunate events included protests in each of the 50 states, looting, violence in the streets, and overall unrest as people found their own ways of reacting to the situation.

Additionally, as a show of solidarity, *NBC News* reported over 40 countries and every continent, with the exception of Antarctica, joined the protests in their respective areas (Smith et al., 2020). These events have created space to engage in diverse, uncomfortable conversations in higher education, corporate America, and many other industries, as people strive to show their support of Black lives harmed by injustices with the ultimate goal of dismantling racism in all of its forms. The culmination of these events could potentially have an influence on Black women in STEM particularly at PWIs.

**Coronavirus Impact**

Black women are now placed at an even greater risk of failing to persist as a result of the pressures experienced from an unprecedented global pandemic. Novel Coronavirus 2019 (Covid-19), which has disproportionately impacted Blacks, is placing a spotlight on the disparities that exist among underserved populations (Millet et al., 2020). The Centers for Disease Control and Prevention (2020) identified social and health inequities, which have existed systemically for many years, have increased the risk and likelihood that people of color from various backgrounds are more likely to contract and die from Covid-19.

This virus has upended higher education and is positioned to influence the persistence of Black women in STEM, particularly at PWIs. As described by a sophomore STEM student attending Stanford University, she now has to contend with her financial aid being threatened along with housing concerns and an overall despondent outlook given the school offerings as a
result of the virus (Whitford, 2020). Based on the degree to which the virus is spreading, this student has concluded that she will very likely contract Covid-19. While some students may be experiencing isolation, stress, anxiety, and depression for the first time as they are removed from their campus communities and are forced to study at home or in hybrid environments, some Black women in STEM are having their previous experiences exacerbated. Given the number of infections that continue to rise daily, the overall impact remains to be seen.

**Black Lives Matter Movement**

Fueled by many people’s frustration with police brutality and injustices against Blacks, the death of George Floyd, Breonna Taylor, and Ahmaud Arbery reignited the Black Lives Matter movement. While there have been many references to the Civil Rights Movement and peaceful protests of that time in rally speeches, this current movement has included violence and destruction of property, which diminishes the message of the movement. Adding to the visibility of the movement, there have been countless celebrities speaking out against injustices for people of color in pursuit of fairness. Grassroots efforts appear to be more calculated as social media has created an outlet to easily organize thousands of protesters to meet for a common interest.

There have also been reports of anarchists in the crowds with a different agenda of destroying as much property as possible. As proponents of this movement seek to change views regarding systemic racism throughout the nation, the question remains as to whether this will have any influence on Black women, particularly as Black women seek to integrate into White spaces. From the spirit of being *woke* or keenly aware, many non-Blacks are going above and beyond to right their perceived sins of the past in an effort to make current conditions better. With the increased attention on improving conditions for Black people in all settings, will these
knee-jerk reactions result in increased opportunities and improved outcomes for Black women in STEM?

#SayHerName. The death of Breonna Taylor also renewed interest and attention surrounding this social media hashtag which focuses on the injustices specifically impacting Black women (Williams & Toldson, 2020). This movement, which provoked a national outcry in support of Black women, developed following the questionable 2015 death of an African American woman, Sandra Bland, while in police custody (Reed, 2020). As Crenshaw and Ritchie (2015) described, this organized campaign has created a platform to highlight the unique experiences of Black women and capture the ways in which their sex and gender influence interactions both in society as well as in settings such as higher education. Movements such as these have the potential to transcend digital spaces resulting in effective community engagement (Reed, 2020); however, the extent of successfully identifying parallels with marginalization of Black women in higher education is ongoing. While these present events are worthy of note, the outcomes remain to be seen.

Statement of the Problem

Despite the focus and attention on increasing the number of Black women in STEM in recent years (Morton & Parsons, 2018), data results from the National Center for Education Statistics (2018) revealed that the number of bachelor’s degrees earned by Black women have decreased. Increased enrollment rates of Black women in STEM have continued to result in low graduation rates for this group. The underrepresentation of Black women in STEM, and concerns regarding their lack of belonging which prevents persistence have not been explored. The influences that prevent these women from persisting should be examined. There is a need to study and understand the unique status and experiences of Black women in STEM, particularly
at PWIs (Johnson et al., 2019; Leath & Chavous, 2018). Their individual experiences are complex. Black women entering PWIs potentially face significant challenges as they pursue fields of study in STEM (Beasley & Fischer, 2012; Reilly et al., 2019; Smith et al., 2014). As Shahid and colleagues (2018) described, these challenges have been comparatively disregarded. Thus, there is a need to understand the specific challenges of this group.

The college success of Black women requires an examination of the whole student, both mentally and academically. These areas have historically been underexplored due to aggregate research trends that focus primarily on students of color (Dortch & Patel, 2017; Winkle-Wagner, 2015). The aggregate data lack indication of Black women’s experiences specifically as they search for belonging while contending with their race and gender. The research on Black women’s experiences at a PWI is limited (Shavers & Moore, 2014; Starobin et al., 2016) and further warrants the need for this research. Additionally, insufficient attention has been paid to the psychologically taxing experiences of Black women in STEM at PWIs that manifest as a result of failed attempts at managing microaggressions and racial stereotypes (McGee & Bentley, 2017).

Consequently, implicit bias and stereotypes surrounding women in STEM fields are magnified for Black women who must also contend with issues regarding their race. These students often enter PWIs at a disadvantage because the expectations of their academic performance are already low (Shahid et al., 2018). The strong, resilient persona of Black women both at home and in their community have caused them to suppress their feelings of vulnerability, anxiety, and depression which are more likely to surface when pursuing STEM subjects (Hooks, 1988; Shahid et al., 2018). As described by the National Academies of Sciences, Engineering, and Medicine (2017), more targeted research designed to examine the
experiences of diverse populations, such as Black women in STEM, is warranted in order to increase the diversity in STEM graduates and improve outcomes.

This study seeks to address the gap in the literature identified by Russell and Russell (2015) who cited the need for further research to understand the experiences of Black women in STEM. As Gummadam et al. (2016) noted, more research is needed to understand the sense of belonging of Black college women and the influence on psychological outcomes. Specific focus has to be placed on the experiences of Black women in STEM in order to improve institutional practices (Leath & Chavous, 2018). Furthermore, in an effort to understand the sense of belonging among these women, this study will also examine influences such as discrimination, structural racism, and sexism accounting for the diverse ways in which Black women interpret, cope, and respond. This study is a broader examination of research conducted by McGee and Bentley (2017) who studied these factors among a small number of Black female STEM students.
Purpose

The purpose of this study is to explore the sense of belonging of Black women in STEM at a PWI, considering the intersection of race and gender. The objective is to contribute to the literature, specifically regarding the experiences of Black women pursuing majors within STEM disciplines, specifically Computer and Information Sciences, Engineering, Biological and Biomedical Sciences, Mathematics, and Physical Sciences. This objective will be achieved by studying this specific group’s individual experiences before and during college. Examining undergraduate women to gain a deeper understanding is justified due to the literature that supports greater cognitive difficulties and stress of Black underclassmen (Dortch & Patel, 2017). Previous research findings revealed that Black women in non-STEM majors experienced greater levels of academic satisfaction and positivity than STEM majors (Leath & Chavous, 2018), and it is important to understand the reasons for this difference.

Most noticeably, the research that has been done with regard to the topic of belonging has primarily focused on all minority students (Smith et al., 2014) or all Black students in aggregate (Hannon et al., 2016; Thomas et al., 2009) without any specific focus on Black women, particularly those experiencing challenges while pursuing STEM subjects at a PWI. Research that has focused on Black women in STEM has grouped them with women of color (Ong et al., 2018; White et al., 2020), still failing to capture their individual experiences. This research will seek to gain a deeper understanding of the feelings of belongingness and connectedness of Black women in STEM by examining their level of engagement and interactions both academically and socially at a PWI. To this point, Hausmann et al. (2009) highlighted the connection between having the feeling of belonging and college persistence levels.
Additionally, students are more likely to experience heightened levels of anxiety and depression when first entering and adjusting to college; this is more prevalent for Black women at PWIs than at Historically Black Colleges and Universities (HBCUs) given that African American students were found to express greater levels of happiness at HBCUs (Shavers & Moore, 2014) and have a stronger sense of belonging and connection with the campus (White et al., 2020). In addition to disposition, Black first-year college students who attended HBCUs had higher grades than students who attended PWIs (Shahid et al., 2018). It is worth noting the positive influences at HBCUs that contribute to persistence to seek out opportunities to replicate those experiences. As Leath and Chavous (2018) observed, the unique intersection that involves the marginalization of race and gender among Black women and their experiences at a PWI are rarely studied. These previous research limitations result in deficiencies in knowledge to address this demographic, warranting further investigation.

The following research questions were asked to aid in determining what factors shape the academic trajectory of Black women in STEM during their undergraduate years at a PWI:

1. How do Black undergraduate women describe the early influences regarding people, places, and experiences that influence their early interest in STEM majors?
2. How do Black undergraduate women describe their sense of belonging at a PWI?
3. How do Black undergraduate women majoring in STEM cope or persist at a PWI?
4. How do Black undergraduate women describe their experiences with faculty, academic advisors and peers that cultivate their sense of belonging in a STEM major at a PWI?

**Significance**

While Black women are improving in their rate of degree attainment beyond other ethnic groups, they continue to be extremely underrepresented in STEM majors, and the mechanisms
influencing these outcomes are underexplored (Hill et al., 2010; Leath & Chavous, 2018). This study examined the strategies Black women in STEM utilized to navigate White spaces and effectively cope and remain resilient at a PWI. This study also examined Black women’s experiences and responses to stereotype threats using an antideficit approach which will inform policy and practice. Finding a sense of belonging in STEM at a PWI is a key contributor to persistence (Basile & Black, 2019; Johnson, 2012). Policy implications have to include an account of the barriers that exist and prevent the persistence of Black women in STEM. Given the lack of previous research regarding the sense of belonging of Black women in STEM, particularly at PWIs (Dortch & Patel, 2017; Leath & Chavous, 2018), this study will be important to policymakers and higher education administrators with a genuine interest in improving outcomes for this group of students.

As McGee and Bentley (2017) highlighted, the existing research in STEM has focused significantly on resiliency and grit. However, there has been an omission of the influences that produce anxiety as a result of the high-pressured, racist climate. Through this study, resources and services will be identified that PWIs can implement and further assess to allow Black women to feel more welcomed, and better able to cope as they pursue STEM subjects. As Johnson (2012) described, through the utilization of Astin’s (1991) Input-Environment-Output (IEO) model, inputs such as background characteristics and the campus environment, including policies, programs, and people, can influence Black women’s outcomes. Knowledge gained regarding the educational environment will be beneficial to higher education administrators in developing skills and addressing needs to shape the outcomes of this particular student group.

Consequently, there is a need to understand the academic and psychological needs of Black women in order to inform policy and research efforts (Iruka et al., 2020). Studying this
problem will benefit higher education administrators, educators, and peers of all races at PWIs.
A critical aspect of improving outcomes for Black women in STEM at PWIs involves the
customization of approaches designed to meet their specific needs, and not a one-size method,
assuming their experiences are all the same (Winkle-Wagner et al., 2019). There is increasing
evidence to support the belief that Black women are switching their majors from STEM majors
at a disproportionate rate at PWIs (Russell & Russell, 2015). It is important to understand their
experiences and the reasons for the change. Additionally, there is research to support the idea
that Black women in STEM have been more motivated to excel in STEM at HBCUs than PWIs
(Shahid et al., 2018; White et al., 2020), and understanding the environment at a PWI will
contribute to improving outcomes for these students.

The results of this study will also be beneficial to policymakers who will be better
equipped to implement programs and resources as early as middle school to allow Black women
to be better mentally prepared for college. A thorough examination of the literature reveals that
there are limited findings that are race- and gender-specific (Leath & Chavous, 2018; Thomas et
al., 2009; Winkle-Wagner et al., 2019). Understanding the intersection of race and gender is
germane to examining the experiences of this group. There is a void in the literature regarding
the impact and influences on Black women in college when race is also a factor (Hannon et al.,
2016). To challenge the existing work that has been previously conducted regarding Black
student experiences, this research will more closely examine the influences on Black women and
critically consider the experiences that exist particularly for this group.
Definitions of Key Terms

The terms used throughout this study are defined as follows:

Black. Black is broadly defined to include women of African descent who are native to Africa, Latin America, and the Caribbean in addition to the United States. The terms Black and African American will be used interchangeably, contingent upon the source.

Female. Is defined as the biological status assigned at birth or the sex with which the individual currently identifies.

Student. Reference to students is defined as full-time college freshmen, sophomores, juniors, and seniors, excluding graduate students.

STEM. For this study, I will refer to a narrower scope within Science, Technology, Engineering, and Math, specifically the following STEM disciplines as defined by the National Science Foundation: Computer and Information Sciences, Engineering, Biological and Biomedical Sciences, Mathematics, and Physical Sciences which includes the following majors: Marine Science, Microbiology, Operations Management, Computer Science, Aerospace Engineering, Architectural Engineering, Chemical Engineering, Civil Engineering, Computer Engineering, Construction Engineering, Electrical Engineering, Environmental Engineering, Mechanical Engineering, Musical Audio Engineering, Mathematics, Environmental Science, Chemistry, Geology, and Physics.

Predominantly White Institution (PWI). In its simplest form, PWI is defined as a college or university in which the majority of the students are White/Caucasian, non-Hispanic. As Bourke (2016) described, PWIs can be much more complex when considering the influence of race on the campus climate and institutional practices. This research explored some of these complexities.
**Sense of Belonging.** The expanded definition of sense of belonging, described by Strayhorn (2012), in which the need to belong gratifies the physiological needs and influences the student’s behavior and perceptions was utilized for this study due to the significance of connectedness of Black women in STEM at a PWI.

**Racial Microaggressions.** The subtle, indirect persistent forms of racism (McGee & Bentley, 2017).

**Anti-Deficit Achievement Framework.** The Anti-Deficit Achievement Framework (Harper, 2010) allows focus on the achievement of students of color in STEM and creates a conduit to gain an understanding of the positive and negative experiences of Black women, particularly at a PWI. This anti-deficit approach is the genesis of this research.

**Critical Race Feminism.** While a formal definition has not been determined for Critical Race Feminism (CRF), it originated from critical race theory (Anfara & Mertz, 2014), and is defined as a framework that will address issues facing Black women.

**Racial Battle Fatigue.** A phenomenon described as internal emotional exhaustion as a result of being worn down from operating as a strong or angry Black woman while traversing predominantly White spaces (Corbin et al., 2018).

**Chapter Summary**

In this chapter, I provided evidence for the need to conduct this study along with background information that supports need for examining the topic of the ways in which Black women in STEM at a PWI define their sense of belonging. This chapter included a historical journey of Black women in STEM that led to the present day, along with the current state of affairs. The purpose provided supports what this research hopes to accomplish including identification of policies and institutional practices through improved outcomes for Black
women. The significance of this study will be beneficial to higher education administrators and policymakers and provide greater understanding of Black undergraduate women as they navigate challenging STEM majors in predominantly White spaces.

To conclude this chapter, key terms have been defined. Chapter 2 has been thematically organized to present four key areas that emerged from the literature, the precollege experience, the role of the campus climate, the role of the campus culture, and student involvement. This body of literature will fill a gap and advance scholarly pedagogy in this area. Chapter 2 concludes with the theoretical framework which guided this study’s design.

Chapter 3 will present the rationale for the chosen research method. Also, the reasoning for the proposed design and framework will be explained. The rationale for the selected site will be discussed. Data collection and analysis techniques will be presented. The chapter will conclude with the ethical considerations of this study.

Chapter 4 is dedicated to presenting the profiles of the twenty-three women who participated in this study. These profiles will provide a deeper understanding of each of the participants. The chapter will also highlight the precollege and college influences that contributed and hindered their sense of belonging and academic trajectories.

The findings from this study are provided in Chapter 5. Four themes emerged, with associated findings, as having played a significant role in these students’ establishment of a sense of belonging: decision to pursue a STEM major, method to thrive, big picture mentality, and simply surviving. Each theme will be discussed in depth, illustrating the relationship with the research questions and will be presented under the guise of the anti-deficit achievement framework and include the perspective of CRF, which guided this study.
In Chapter 6, the findings will be presented in relation to the research questions. The literature relationships to the findings will be provided. The discussion is centered on the four themes that emerged from this study along with the connections to the framework. Implications for policy and practice of higher education administrators will be provided. The chapter concludes with recommendations for future research followed by my final thoughts regarding this research journey.
CHAPTER 2

LITERATURE REVIEW

In this chapter, the current state of Black women pursuing STEM at a PWI is synthesized. The research illuminates the need to focus on Black women in STEM at PWIs. Given that less research has been conducted regarding the unique experiences of Black women at PWIs as compared to African American men (Shahid et al., 2018), this research is valuable and significant. It will provide insights in terms of experiences and mental pressures Black women present with and encounter, particularly when pursuing STEM subjects. The limitations of previous research have prevented a deeper examination of the mental psyche, particularly of Black women at PWIs who are pursuing the demanding field of STEM. As the literature map illustrates (see Appendix A), existing literature regarding the problem includes the emergence of themes, such as the precollegiate experience, role of campus climate, role of campus culture, and student involvement. These key areas emerged as consistent themes seen throughout the literature regarding this topic.

The chapter begins with an examination of the racial issues and biases occurring in the United States, which have been amplified as a result of the disparities highlighted during the current pandemic and the social unrest ignited by police brutality against Blacks. The literature includes challenges as well as contributing benefits to the success of Black women in STEM warranting the necessity to understand these students further from an anti-deficit perspective through the framing of the questions.
Racial Biases in America

Black women in the United States have been publicly working for deep social change since before the end of legalized slavery in 1863 (James, 2002). Not surprisingly, as soon as Black women had access to higher education in the late 19th century, they also began working from within educational institutions. (Bell et al., 2020, p. 4)

Research demonstrates that universities are microcosms of the larger, racially-motivated unrest happening throughout society and have the capacity to mirror recent events (Thelamour et al., 2019) such as systematic racism revealed through the pandemic and national protest. These harsh realities contribute to the marginalization students feel on college campuses, especially predominantly White campuses. However, despite differences in ethnicities, when there is a sense of belonging and connection present, students are still able to thrive (Thelamour et al., 2019).

Epidemics and pandemics like Covid-19 are known to expose fundamental racial and socio-economic inequities (Link & Phelan, 1995). As protests against anti-black racial violence and extrajudicial killings continue, the connection between these two pandemics becomes clearer. (Gibson et al., 2020, p. 5)

The most recent events have brought a number of long-standing issues regarding racial injustices to the forefront creating the space for critical conversations within higher education. In addition to ending violence against Blacks, the Black Lives Matter movement was formed in order to “eradicate White supremacy and violence perpetrated in other settings, including in academic settings” (Bell et al., 2020, p. 4). It remains to be seen whether these recent events will have any impact on the sense of belonging and persistence of Black women in STEM at PWIs. The existing social injustices are perceived as a collective problem and therefore will require collective actions of all of those within the context of the campus community (Bell et al., 2020).
Precollege Experience

The precollegiate experiences, including family dynamics, religious backgrounds, college exposure, and academic support systems contribute to the sense of belonging of Black women pursuing STEM majors. The ways in which these factors influence the overall well-being of Black women pursuing STEM majors will be explored. As Morton and Parsons (2018) noted, more qualitative research is needed that accounts for the influence of the precollege engagement with STEM by Black women in order to fully capture their full experience. Engagement during the precollegiate years contributes in both positive and negative ways towards Black women persistence in STEM. The ways in which Black women are nurtured and taught to be Black during their precollege years influences their level of persistence and engagement in college (Porter et al., 2020).

Moreover, teacher perceptions of Black girls as more mature than they are during their precollege years results in less nurturing and mentoring. When bias is present and Black girls are viewed as more adult-like than their peers, they are often overlooked for engagement and academic opportunities to connect with their teacher. Furthermore, as Johnson (2015) described, proficiency in subjects such as math decreases as Black girls progress through school instead of improving due in part to exclusionary discipline that results in disproportionate occurrences of punishment and removal from the classroom. The teacher-to-student mentor relationship is jeopardized negatively influencing future outcomes (Epstein et al., 2017).

Hence, Reilly et al. (2019) cited the need to better understand these influential factors in an effort to support and contribute to the success of Black women in STEM. For instance, summer bridge programs with a STEM focus can increase student interest in math and science and prepare them for the rigor of college by exposing them to the college experience (Raines,
It is possible that these early encounters influence the importance of their identity which influences future college engagement. Lack of participation and encouragement from teachers to engage in STEM-related courses coupled with the lack of course offerings and consistent preparation during precollege years creates barriers to persistence for Black STEM students (Russell & Russell, 2015). Additionally, as Tan and colleagues (2013) described, science classrooms and clubs as early as middle school shape Black women’s complex view of their postsecondary capabilities in STEM.

**Family**

As Stage et al. (2014) described, the influence of family support for underrepresented students, such as Black women, extends beyond the parental unit and may include non-biological relatives. While family income and parent college exposure had no significant influence on students who chose the STEM track (Beasley & Fischer, 2012), social and emotional support plays a role in the stability, focus, and matriculation of students. Families that consider opportunities for their children foster home environments that allow these students to thrive. Furthermore, Shahid et al. (2018) explained the positive influence of family support which directly affects the emotional well-being of Black women, regardless of whether familial support included past college experience. Exposure to extracurricular activities and programs with a STEM focus allows these students to envision themselves in college.

While a large number of Black families have no prior academic experience in STEM, most families still see the significant benefits for their daughters to pursue STEM majors (White, 2020). Nevertheless, parents were concerned that their children successfully advanced through college, even if they were first-generation students. Parents working in STEM careers further aided students’ decisions, motivated them, and increased their interest in science discovery.
(Moakler & Kim, 2014). Seeing family members thrive in those areas creates motivation for these students to pursue similar interests. Family support also contributed to confidence in Black women’s ability to successfully persist in a mostly homogeneous culture such as a PWI (Iruka et al., 2020).

Furthermore, family, including extended relatives such as aunts and cousins’ college experiences and STEM careers, positively influenced student motivation to attend college in pursuit of STEM majors (Moakler & Kim, 2014). These family members serve as an encouraging resource through each step of the college admissions process. Additionally, Black women continued to rely on the strength of those family members who had college exposure to assist them with navigating through their college experiences (Strayhorn, 2012). Conversely, the lack of role models within the family and immediate community, made opportunities in STEM seem impossible for Black women and resulted in families suggesting other majors while still encouraging exposure to the college experience (Shahid et al., 2018).

**Faith and Religion**

Spirituality and religion, defined as a divine relationship with God, positively connect to Black women persistence at PWIs and is a more significant coping mechanism for those students with more challenging majors such as STEM (Patton & McClure, 2009). Paramount to the family dynamics is the deeply rooted layers of faith and religion present in most Black families. Intertwined with spirituality and religion for these women is a commitment to their faith which involves a renewed hope and unwavering belief despite the unknown (Patton & McClure, 2009).

Positive academic performance was associated with increased levels of spirituality among Black female students, and findings suggested no distinction between religion and spirituality, with a focus on gaining inner peace and acquiring strength (Patton & McClure, 2009). As
Graham (2016) described, religion is the essential coping construct that is expected to bring divine healing to Black women. This notion influences students’ approaches to stability and resiliency. This self-regulating behavior is reinforced through individual and collective prayer, involvement, and relationships with the church family.

Fundamentally, the family coupled with the support of the Black church has replaced the seeking of mental wellness, and therapy visits are replaced with laying of hands, fasting, and praying (Graham, 2016). Being raised in this environment naturally shapes the overall psyche of these students. Spirituality is considered a key dimension to identity development of Black women, and manifests more significantly when faced with challenging STEM majors (Morton & Parsons, 2018). Faith and spirituality that is strengthened through a relationship with God translates to increased confidence and self-awareness in homogeneous spaces such as a PWI. In essence, as Patton and McClure (2009) noted, spirituality contributes to healthy lifestyles and stability in marginalized climates in addition to serving as a coping mechanism.

Middle School Experience

While family and faith leaves a lasting impression on young Black girls, their decisions regarding STEM often begin as early as middle school. As King and Pringle (2019) described, some Black girls abandon their interest in STEM once they arrive in middle school. Establishing a sense of belonging and connection contributes to STEM persistence in middle school, which is the foundation for college. Positive STEM experiences are critical during the middle school years because these students begin to make decisions regarding their long-term interest in this path of study (Barton, 2007). In some cases, the marginalization and stereotypes they experience occur prior to them entering a school building, which influences their self-esteem. This requires Black girls with an interest in STEM to either conform to the societal and social pressures
established for them or rise above them potentially risking further judgment and criticism (King & Pringle, 2019).

Those students who are driven enough to continue to persist in STEM face additional challenges and educational opportunities because of choosing this path. Placement in predominantly White advanced STEM classes introduces the PWI experience. The nurturing of interest and skills in STEM has to begin during the middle school years to create a foundational platform that later supports their feelings of belonging once they reach college (Collins et al., 2020). Teachers play an important role in motivating Black girls to think critically and pursue STEM opportunities both inside and outside of the classroom. Additionally, Black girls in both middle school and high school who had been exposed to afterschool tutoring, enrichment programs, and assigned mentors shifted their attitudes in favor of pursuing STEM academic opportunities (Ferreira & Patterson, 2011).

**High School Experience**

Many Black women’s undergraduate years are a product of their high school experiences. Due to the secondary schooling structure, resources are often limited or non-existent to assist students in need of psychological tools and resources. Furthermore, as McGee and Bentley (2017) described, Black women in STEM are influenced by their high school experiences, particularly when they are steered away from the more rigorous STEM courses, which further places them at a disadvantage when they reach college.

The separation that takes place during high school as a result of some students being placed in advanced placement courses negatively influences Black female students’ perceived proficiencies in STEM and causes them to doubt their capabilities (Joseph et al., 2016). Another issue is the limited availability of resources which hinders their exposure to academic STEM
opportunities. Guidance counselors who are willing to assist Black girls with understanding STEM college curriculum, the overall college admissions process, and potential STEM career opportunities play a key role in students’ considerations and feelings of belonging (Russell & Russell, 2015). Additionally, proactive academic advisors who identify deficiencies are able to recommend summer programs and resources better equipping these students for college (Marbley et al., 2013). Moreover, research findings revealed that high school grade point average was a predictor of persistence in STEM (Espinosa, 2011; Gayles & Ampaw, 2014). This further implies the significance of the high school experience.

In addition to academic performance and mental stamina, Koenig et al. (2012) discovered that students who were not able to effectively manage their time were at increased risk of not persisting. Despite being dissuaded from advanced STEM courses, some persistent Black women do not allow it to prevent them from pursuing STEM majors once they reach college. As Zirkel and Johnson (2016) pointed out, efforts to teach resiliency and grit prior to college do not account for the campus climate and potential racism that exists.

Although these elements are lacking from some secondary administrators’ efforts, some Black women have the innate ability to persevere (Abrams et al., 2014). As Stitt and Happel-Parkins (2019) described, there is limited information regarding the factors that influence Black women in their pursuit of STEM subjects, including their sense of belonging. The topic of Black women’s sense of belonging, particularly at a PWI, is important because this group, by virtue of its unique historical legacy, manages significant responsibilities, while identifying as unequivocally strong (Abrams et al., 2014).
Role of Campus Climate

The role of the campus climate, including peers, faculty interactions, and overall culture contribute to the behavior and success or failure of Black women. The campus climate at a PWI influences the manner in which Black female STEM students establish their sense of belonging. As Esposito (2011) described:

Although researchers have explored campus climate and student experiences, they have not specifically focused on the hidden curriculum of diversity within a higher education setting. By this I mean, what students learn about race, class, and gender through the informal interactions they have with professors and students. (p. 145)

These informal interactions shape Black females’ overall perception of the campus climate. As Strayhorn (2012) described, the curriculum should be designed to condition students to work in diverse teams both in and outside of the classroom, which further normalizes belonging.

Competing ideologies around diversity and media interpretations also contribute to overall perceptions (Thelamour et al., 2019). Given that STEM educational environments are dominated by White males, it makes it challenging for Black females to develop a sense of belonging (Johnson, 2012). The limited number of Black women presents a constant struggle to establish their position. Higher education scholars have long recognized the influence of campus climate on the experiences and outcomes of STEM students (Griffin, 2017). When a negative racial climate exists, there is limited psychological protection the campus can provide (Thelamour et al., 2019). Adjustments can be made to make the campus climate more inviting. While Black female STEM students are not explicitly reviewed when campus climates are examined (Leath & Chavous, 2018), there is a need to understand this specific groups’ interaction with the campus climate. High-level institutional speeches on campus inclusion activities have to translate to actions. Integrating the needs of these students has to extend beyond ceremonial actions of
diversity initiatives in order to shift the climate at PWIs to be more welcoming (Patton et al., 2019).

As described by Dortch and Patel (2017), a strong social identity contributes significantly to Black women persistence in STEM. This identity is developed through their feelings of belonging. The campus climate can set the tone and create feelings of belonging when a welcoming inclusive environment is present. Feeling ostracized or berated within the context of the classroom has a negative influence on Black women development of a sense of belonging (Leath & Chavous, 2018). In essence, an inclusive campus climate involves students maintaining a sense of belonging in every aspect of their college experience, including academically and socially.

Accordingly, a positive racial climate contributes to a positive academic performance for Black women in STEM at a PWI (Leath & Chavous, 2018). Alternatively, a lack of institutional support contributes to isolation among Black male and female students further hindering Black women in STEM experiences (Dortch & Patel, 2017). Support within the institution has to be communicated at all levels. Racial climates at PWIs that are hostile or unwelcoming, negatively influence motivation and result in academic and social disconnections (Leath & Chavous, 2018). Black women are forced to seek out opportunities to connect on their own or remain isolated from the majority of students. Assessing how diverse groups, such as Black women, perceive campus climate is complex, but it may provide insights into the overall campus culture (Henning & Roberts, 2016).

To an extent, learning communities specifically designed for women in STEM have proven effective but rarely are designed for Black women in STEM (Johnson, 2012). Many institutional efforts do not extend beyond the creation of the learning community, omitting a
specific focus on marginalized groups such as Black women. As Shavers and Moore (2014) described, the unsupportive environment found at PWIs and the ways in which it negatively contributes to the level of engagement of African American students has a direct influence on persistence. In an effort to fit in with the campus environment, Black women have attempted to change who they are in the hopes of increasing their feeling of belonging (Leath & Chavous, 2018). Conversely, when there are positive perceptions of the broader campus climate, the negative impact felt by Black women in STEM is ameliorated (Johnson, 2012).

Furthermore, Black women with a strong sense of pride in their race and history experience less occurrences of depression despite being in a predominantly White campus climate (Morton & Parsons, 2018). Black women who are confident in their academic capabilities have also excelled in STEM in predominantly White spaces. Consequently, as McGee and Bentley (2017) described, some resilient Black women in STEM who are referred to as strong see it as a way of being berated and inundated with tasks unfairly because they are considered capable of enduring it because of their strength. Promoting a campus climate that attempts to encourage Black women in this way will likely have mixed results.

**Peers**

Peers are in a unique position to influence students either positively by providing guidance, assistance, encouragement, and support or negatively by basing their actions on premature labeling and stereotyping. Shahid et al. (2018) ascribed a lack of support from peers to their unawareness and low expectations of Black women. This underestimation results in reduced engagement and development of friendships from peers at PWIs. Students are more likely to interact with those who look like them. Dortch and Patel (2017) revealed that microinvalidations can exist among peers of the same race due to the lack of acceptance for not
looking or acting a particular way or being a certain skin tone. This microinvalidation often manifests through isolation and alienation. In fact, embedded campus norms influence the progression of diversity in STEM (Patton et al., 2019).

Consequently, when social integration is lacking, stress levels are increased and motivation is decreased, ultimately affecting academic performance (Shahid et al., 2018). Stress is manifested in several different ways as Black women search for opportunities to connect and develop their own identities. Dortch and Patel (2017) highlighted the manner in which the lack of belonging is fueled, including the marginalization of Black women by both White women and White men. Not feeling included with any particular group contributes to isolation and feelings of social abandonment. Skepticism regarding Black women’s intellectual ability in STEM due in part to perceptions and judgment through a stereotypical lens has negatively influenced engagement with peers both in and outside of the classroom (Esposito, 2011).

Furthermore, racial battle fatigue as a result of systematic environmental microaggressions, such as unequitable university policies that promote racial segregation and lack of representation in prominent student areas (Mills, 2019), contribute to the lack of belonging of Black women at PWIs. Attempting to assimilate within these spaces can be burdensome. As Smith (2014) described,

Racialized students often feel bereft of dignity and self-respect as they try to find a sense of belonging and legitimacy in traditionally white spaces. In many cases for the sake of diplomacy, objectivity, professionalism, and even survival, these marginalized people remain silent and reserved, preferring to keep their heads down and find a way to cope. (p. 35)

Experiencing microaggressions from White peers is considered an inevitable occurrence for many high-achieving Black women who are determined to define their space at PWIs (Haynes, 2019). The action of peers are closely examined. Another contributing factor involves the
witnessing of Black peers dropping out of STEM majors due to the pressures associated with it, which negatively influences the psyche of remaining students (McGee & Bentley, 2017).

Alternatively, persistence in STEM for Black women has improved with positive peer engagement (Espinosa, 2011; Ong et al., 2018). Encouragement from peers has had a lasting impression. Black women in STEM at PWIs also look to other upper-class Black women as mentors and examples of what they can achieve (White et al., 2020). The overall comfort level with the existing surroundings appears to increase as these students advance through college. As described by Brittian et al. (2009), student involvement in campus activities with peers has resulted in increased levels of confidence and overall leadership capabilities, greatly reducing feelings of anxiety and depression. Black women who rely on their high levels of self-esteem and overall confidence have to counter the low expectations that some of their White peers may have for them by constantly proving their capabilities (Hannon et al., 2016). Black women with inner strength can more easily manage these experiences. Mills (2019) emphasized the pressure felt by students to conform to the climate of predominantly White campuses and the socialization of White dominance, which further forces Black women to mask their true identities.

**Faculty**

Faculty play an important role in fostering a sense of belonging for Black women in STEM at PWIs, and their contributions to persistence extend beyond competence and skills, traversing into meaningful understanding and invested student-to-faculty relationships. Faculty, regardless of race, who value Black women’s success in STEM and engage with them based on their own merits instead of stereotypical societal narratives are considered role models (Johnson et al., 2019). Black women appreciate being considered from a neutral perspective absent of any preconceived notions.
As McGee and Bentley (2017) acknowledged, while not the case for biology, tokenism and bias is more likely to occur in student-to-faculty relationships such as this due to less than 20% of Black women represented among faculty. Being included or acknowledged to fulfill an obligation is detrimental instead of beneficial to these students. Constant judgment by faculty based on stereotypical perceptions decreases the likelihood of Black women developing a sense of belonging and contributes to their isolation and alienation (Hannon et al., 2016). Faculty often serve in dual roles as both educator and advisor, both formally and informally.

**Academic Advisors**

The purpose of an advisor is: (a) to assist students in forming goals and devising plans for accomplishing those goals, and (b) to enable students to cope with any personal, intellectual, and institutional barriers that hinder the execution of that plan. (Sutton & Sankar, 2011, p. 73)

While there is limited literature on the influences of academic advisors on the persistence of STEM students (Sutton & Sankar, 2011), advisors are a key contributor to the overall experience and feelings of belonging of students. Black students have categorized their satisfaction and feelings of connection with faculty who required students to meet with them on a regular basis for advising, both academically and personally (Guiffrida, 2005). Many Black academic advisors are expected to serve as mentors and resources for Black students. Black faculty at PWIs are expected to be engaged advocates of Black students, especially as these students pursue challenging majors such as STEM (Guiffrida, 2005). When the faculty member and advisor are not synonymous, there are opportunities to combine efforts to meet the academic and social needs of STEM students, which has improved persistence rates and overall satisfaction (Sutton & Sankar, 2011). Advisors have to develop creative approaches to reach these students. Sutton and Sankar (2011) recommended surveying students to determine their desire for mentors and to ascertain the types of support they need.
Advising takes place informally when faculty engage with students regarding academic issues, personal problems, career aspirations, or any other concerns they may have (Guiffrida, 2005). Additionally, the opportunity to meet and build mentoring relationships with faculty during pre-college bridge programs provides a level of encouragement and necessary academic advising for STEM students (Raines, 2012). Advisors who were willing to discuss career opportunities during students’ freshmen and sophomore years further encouraged these students to create goals to aspire to, and further implied the advisors’ confidence in them that they could achieve those goals. Exposure through targeted programs such as these create opportunities that may not otherwise be available. Black women value the pedagogical approach of faculty who focus on engagement and cooperation viewing them as capable, competent students (White et al., 2020). This holistic approach provides guidance and builds trust when there is a consistent time commitment from the faculty. However, as Guiffrida (2005) described, the frequency of interactions does not predict the quality of the experiences.

**Positive faculty influences.** Johnson et al. (2019) revealed that Black women develop greater feelings of belonging at PWIs when faculty with whom they share racial identity is present. Student interactions with faculty have a direct impact on their overall engagement and persistence given that students tend to hold faculty in high esteem. Furthermore, faculty who have taken a genuine interest in these students’ academic and social development by engaging with them outside of the classroom, by attending events of interest to them and incorporating their interests into the curriculum, have seen positive results in terms of persistence of this group (Leath & Chavous, 2018). These students are more eager to succeed once they realize the faculty is interested in their academic trajectory.
As White et al. (2020) described, faculty who have recommended relevant conferences and enrichment programs, particularly predominantly Black ones, that allow Black female students to make connections with those in similar disciplines, have proven to be beneficial. Another factor for consideration is the disposition of the STEM faculty at PWIs. More deliberate efforts are being made to diversify the faculty to be more representative of society (Russell & Russell, 2015), which could positively influence Black women’s feelings of belonging, ultimately aiding their ability to cope.

**Negative faculty influences.** Alternatively, Black women who experience non-supportive or biased faculty respond with feelings of lowered self-esteem and emotional withdrawal ultimately resulting in depression, withdrawal from classes, and poor academic performance (Gershenson & Papageorge, 2018). Compounding the issue is the lack of diversity among faculty and advisors at PWIs, which makes it difficult for Black women to identify and make mentoring connections (Brittian et al., 2009). The absence of a diverse faculty also insinuates a lack of interest or ability by people of color within that area of study. In addition, as Hill et al. (2010) highlighted, confidence diminishes due to feelings of marginalization and isolation notably when the abilities of these students are questioned.

Consequently, faculty who are unwilling to adjust their long-standing stereotypical views become complacent with their negative actions and normalize the marginalization directed by other faculty members and imitated by peers (Charleston et al., 2014). Disregarding the interests and needs of Black women creates a negative classroom experience. Gayles and Ampaw (2014) described the ways in which faculty pay more attention to male students in the classroom and focus on their career preparation which has a negative impact on the Black women’s experiences. Black women are negatively influenced by these actions. These inequitable
experiences, coupled with instances of marginalization at the hands of faculty, contribute to the underrepresentation of Black women in STEM fields, which further continues the presence of a male-dominated field (Leath & Chavous, 2018).

**Role of Campus Culture**

While culture and climate are often used synonymously, the campus culture reflects an institution’s foundational values and beliefs which then influences interactions and the level of engagement of students (Kuh & Whitt, 1988). The campus climate is informed by the institutional culture. While not present at all PWIs, a long-standing aspect of the culture at some PWIs involves Black female students being relegated to areas beneath their capabilities, discounting their needs and ambitions (Evans, 2008).

Some Black female students’ cultural experiences at a PWI are an extension of the societal race and gender biases felt throughout the mainstream community, and the promotion of diversity is superficial without relevant actions (Green et al., 2018). Present on some campuses is the White male dominance that is perpetuated throughout society and then replicated and normalized within the STEM culture (Morton & Parsons, 2018). In areas where this White male privilege is present, it has to be addressed to prevent the perpetuation from continuing once the students reach graduate school and later the workforce, allowing the negative cycle to repeat itself. As Bourke (2016) described, some White students consider the culture at PWIs as welcoming because of the access made available to them and their campus dominance. The cultural experiences have a direct impact on Black women. Furthermore, Black students who are more closely aligned with their cultural backgrounds experienced greater levels of disconnect at PWIs (Thelamour et al., 2019). Campus cultures that fail to align with their promoted mission of diversity and inclusion send a contradictory message to Black female students when their
in institutional actions exclude minorities (Leath & Chavous, 2018). In order for a campus culture to be perceived as welcoming there has to be consideration of individual experiences in terms of race, gender, and class (Pascarella & Terenzini, 1991; Rankin & Reason, 2005).

Additionally, a culture that does not acknowledge or consistently respect the needs of Black women has the potential to increase stress and anxiety levels as this group searches for ways to cope (Ong et al., 2018). Illuminating ways to influence the educational climate by challenging long-standing institutional cultural policies that do not clearly denounce acts of racism and sexism should be a consideration when seeking to improve conditions for Black women in STEM. As Charleston and colleagues (2014) described, the identity of Black female students has to be recognized and intentionally integrated into the institutional culture at all levels, including academically and socially. Moreover, broader diversity among the faculty could contribute to more tailored advising, ultimately improving persistence rates.

**Student Involvement**

Another theme present throughout the literature is the manner in which Black women become involved in predominantly White spaces. As they seek out ways to become involved, their experiences with establishing a sense of belonging unfold. As Poitier (2000) eloquently described, some Black women’s way to *charm* their peers into a neutral position where they are only judging them by their skills include masking their identities. This causes both positive and negative consequences. On the other hand, some women rely on their inner strength to persevere, which will be covered further in this section.

A sense of belonging can be established for Black women when a space for interaction and dialogue is established (Hannon et al., 2016; Porter et al., 2020). These practical spaces must exist both inside and outside of the classroom. Connections formed among Black women equip
them with the needed socialization and relationship building to thrive and navigate in predominantly White spaces (Porter et al., 2020). Black women tend to be more inspired and motivated by other Black women who have overcome similar obstacles. Furthermore, Black women who engaged in women-only living and learning communities geared towards STEM displayed greater interest in persisting and later pursuing graduate studies (Szelényi & Inkelas, 2011). Spaces that are intentionally created to foster engagement have improved social interactions for Black women. Residence hall resources, encouragement of peer groups within social living spaces, and community and service projects that require a team approach all positively contribute to feelings of belonging among Black women while attending a PWI (Szelényi & Inkelas, 2011).

In an effort to cope and survive, some Black women portray themselves as unbothered by their surroundings, suppressing their true emotions and feelings of anxiety, anger, and stress even to members of their own social groups. Racial battle fatigue is considered a coping mechanism or psychosocial response to being marginalized either directly or indirectly (Corbin et al., 2018; Haynes, 2019). Developing ways to persist has consequences. The negative implications of racial battle fatigue include it eliciting emotions such as irritation, frustration, and apprehension that are directed towards other students and faculty (McGee & Bentley, 2017).

**Belonging**

Believing in one’s ability to successfully complete a particular course of action, though essential to persistence, does not in itself ensure persistence. What is also required is that students come to see themselves as a member of a community of faculty, staff, and other students who value their participation, that they matter and belong. (Tinto, 2017, p. 258)

Historically, Black women have subverted their identity or attempted to assimilate on predominantly White campuses (Morton & Parsons, 2018). Identifying as Black women comes
with additional complex challenges because their social experiences as women are not often separated from their racial identity. An overall sense of belonging has a significant impact on behavior. When it is lacking, stress levels are heightened and their overall mentality with decision making is jeopardized (Hausmann et al., 2009). Black women navigating through the course curriculum of STEM fields at PWIs are at greater risk of experiencing alienation, isolation, and racial tension.

As Gummadam et al. (2016) described, psychological outcomes worsen when a sense of belonging is absent; however, students with increased levels of self-worth rely on their inner strengths to successfully navigate these spaces. The existing racial climate contributes directly to students’ sense of belonging (Shavers & Moore, 2014). Shahid et al. (2018) described the strong Black woman cultural construct as a protective mechanism that enables Black women at PWIs to counteract negative stereotypes, effectively increasing their feelings of belonging, and managing stress; however, excessive reliance on it can contribute to depression.

Furthermore, areas outside of the classroom including residence halls contribute to Black women’s sense of belonging. When there is camaraderie and a sense of community among residents, these students feel supported (Johnson, 2012). The residential space can positively provide social support and allow avoidance of feelings of isolation due to the more relaxed space being less judgmental. However, Black women who experienced microaggressions and separation within the residence hall opted to live off campus to avoid these interactions (Haynes, 2019). Women who chose this option were confident in their ability to successfully live and thrive on their own. Johnson (2012) further observed that sense of belonging diminished as Black women in STEM progressed academically resulting in upper-level students experiencing greater levels of isolation as they focused more heavily on their studies.
Specifically, positive perceptions of climate can influence sense of belonging. To combat the negative experiences of Black women outside of the classroom, residence life departments can be more intentional in their hiring practices, employ more women of color in STEM as resident advisors, and tailor activities in the residence halls to be inclusive of the needs of Black women (Johnson, 2012). These efforts can positively contribute to persistence of Black women pursuing STEM.

**Masked Identity**

Also illuminated within the literature is the masking of identity by Black women at PWIs, increasing their levels of stress in an effort to improve their feelings of belonging. Shahid et al. (2018) described Black women as experiencing greater psychological stress than Black men at PWIs. It is assumed that when students feel isolated, their sense of belonging is more likely to deteriorate. Shavers and Moore (2014) further revealed the difference between the way in which Black women believed they should present themselves and what they knew as their actual true reflection. Altering their identity serves as a viable alternative. This phenomenon in which their identities are altered is seen throughout the literature (Stanton et al., 2017; Winkle-Wagner, 2015).

Overshadowing their true identity is the strong Black woman persona (Shavers & Moore, 2014) which can inhibit the full expression of their vulnerabilities and weaken areas of anxiety and depression they may experience. This persona also prevents them from seeking help. While this self-reliant strength may contribute to their persistence, it also contributes to the further masking of their cognitive identities. Furthermore, being labeled as a strong Black woman also causes women to be considered mentally invincible and capable of withstanding stress and added pressures (McGee & Bentley, 2017).
The masking of their emotional state was further described by Corbin et al. (2018) as Black women traverse through macro and microaggressions of those at PWIs by relying on the qualities that make them strong Black women. These actions are taken to counter tensions and feelings of vulnerability. The positive benefits from masking their identity include being viewed as a strong leader who is not fazed by the environment they have been placed in. Jones and Day (2018) drew a parallel between the inner strength and self-determination of Black women and their level of persistence while faced with stereotypes and microaggressions at a PWI. Most noticeably, Black women in mostly homogeneous spaces adjusted their identities in an effort to improve socialization and meet their needs of inclusion (Porter et al., 2020).

**Resiliency and Grit**

The stereotypical roles of Black women as resilient and stoic compound the masking of mental vulnerabilities, and there is a need to understand this group better as they navigate the complex STEM track in search of belonging. As Evans (2008) described, generations of Black women have strived to make their voices heard. They have been driven by the possibility of their actions creating opportunities for those students who would come after them. Through the framing of stressful situations as challenges instead of threats, Black women are able to channel their emotions and assist their motivation to persist (Leath & Chavous, 2018).

Fundamentally, Black women remain academically motivated and driven to persist through reliance on their innate confidence, individual strengths, and collective cultural experiences (Thomas et al., 2009). When faced with challenging disciplines in STEM, it is even more advantageous for these women to have the internal fortitude to assist them with thriving while at a PWI. A contributing factor is the large percentage of Black families being run by single mothers; these resilient decision-makers serve as direct visible examples for Black women
of the unwavering aptitude they must possess in order to survive, regardless of the circumstances (Abrams et al., 2014). Witnessing these actions has a lasting impression. As Jones and Day (2018) noted, “parents, specifically mothers, instilled in their daughters the importance of being self-determined (e.g., rising above stereotypes and independence) and pursuing academic achievement” (p. 2). Based on supplementary survey data from the U.S. Census Bureau (2002-2018), over 65% of Black households have consistently been run by single mothers. This family dynamic influences the outcomes of Black women’s outlook on their pursuit of challenging majors such as STEM.

Furthermore, possessing self-confidence has been a present and necessary trait for Black women in STEM who experience racial and gender stereotypes (Johnson, 2012; Leath & Chavous, 2018). Examples of this self-confidence has been seen throughout history by people such as Coppin, Copper, and McLeod-Bethune. McGee and Bentley (2017) revealed that some researchers’ emphasis on Black women’s resiliency and grit failed to incorporate the role of structural racism on hindering a sense of belonging and producing anxiety. In an effort to circumvent and dismantle the stereotypical, oppressive networks on predominantly White campuses, some determined Black women channeled their inner strength to defy expectations and prove the naysayers wrong, especially in the areas where they were not expected to thrive such as STEM (Winkle-Wagner et al., 2019).

Developing coping mechanisms that include stepping outside of comfort zones proved to be beneficial to Black women who were trying to manage adjustment (Hannon et al., 2016). Additionally, social connectedness allows students to become more accustomed to their college environment resulting in diminished anxiety levels. These feelings are further improved when students are able to identify with others from their ethnic group.
Social Media Influence

To further support the development of an alternative identity, some Black women rely on social media outlets to allow them to transform into their desired racial identity and present themselves in the way they wish to be perceived (Stanton et al., 2017). Some Black women are able to feel celebrated through social media as they seek out groups that are designed to recognize their achievements. For example, the formation of support networks or sister circles gives Black women a safe space to share their experiences (Winkle-Wagner et al., 2019). Their comfort level increases as they are able to identify with other women with similar experiences. However, as Preston-Sidler (2015) pointed out, given virtual spaces’ connection to reality, it is important for Black women to be educated at an early age on digital literacy which includes recognizing the influences on identity formation. Stanton et al. (2017) revealed that data are mixed in terms of the effectiveness of social media on the mental stability of Black women given that prolonged use of Facebook can contribute to depression, while association with inspirational blogs and pertinent hashtags can improve overall well-being.

Alternatively, social media can also negatively influence students’ sense of belonging by further perpetuating racist rhetoric aimed at undermining a welcoming environment (Griffith et al., 2019). When faced with this opposition through online platforms, Black women question whether they should trust their peers and are unaware if they feel negatively towards them. While social media can unite groups, it also has the power to further isolate and oppress minority groups such as Black women. Contributing to the levels of stress and anxiety was the social media platform Yik Yak, which allowed anonymous posts within a five-mile radius. This often resulted in blatant racist and discriminatory comments seemingly from the peers of Black women (Griffith et al., 2019). Acts such as these hinder belonging and negatively impact trust.
Theoretical Framework

As explained by Esposito (2011), “it is important that women of color be continually recognized as agents in their own lives so that researchers do not continue the tradition of deficit thinking regarding Black female students” (p. 144). The theoretical framework that was the genesis of this study is the Anti-Deficit Achievement Framework. Harper (2010) developed this framework in order to study students of color in STEM programs. The Anti-Deficit Achievement Framework (Harper, 2010) focuses on the achievement of students of color in STEM and provides an understanding of Black women who are successful in managing their stress and anxiety at a PWI. The foundation of this framework focuses on the inequalities of minority groups and it includes theories in sociology, education, and psychology (Harper, 2010). As Mejia et al. (2018) described, anti-deficit reframing accounts for the understanding of what stimulates students to persist and overcome challenges.

In response to Critical Race Feminism (CRF), Harper (2010) developed the Anti-Deficit Achievement Framework to allow Black women to be recognized as experts on their empirical realities. It also encourages them to offer counter-narratives concerning their success in STEM fields by allowing the opportunity to capture why they excel instead of primarily focusing on reasons for failure. Counter-narratives create space to challenge existing deficit narratives and limited perspectives, particularly for marginalized groups (Solorzano & Yosso, 2002; Williams et al., 2019).

Patton and Ward (2016) highlighted the ways in which CRF allows the analysis of socially constructed racism to surface in dominating White spaces. This understanding was critical to the framing of the experiences of the Black women studied. As illustrated in Figure 1,
this framework allowed the discovery and examination of Black women’s success in STEM, including review of familial support, classroom interactions, and external factors.

The anti-deficit achievement framework includes interchangeable sample questions designed to allow the researcher to gain a better understanding of Black women’s ability to persist and navigate their pursuit of STEM majors (Harper, 2010). For the purpose of this research, the post-college persistence described in the framework, which includes questions regarding industry careers, graduate school enrollment, and research careers, were excluded. The focus of this study was to gain a better understanding of the sense of belonging for Black women in STEM at a PWI during their undergraduate years; therefore, the post-college, graduate, and career considerations of the framework were beyond the scope of this research. Building upon Harper’s perspective of invoking CRF, this research pivots to capture the structural barriers in addition to individual barriers that influence the sense of belonging and persistence for this group.

<table>
<thead>
<tr>
<th>Pre-College Socialization and Readiness</th>
<th>College Achievement</th>
<th>Post-College Persistence in STEM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FAMILIAL FACTORS</strong></td>
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<tr>
<td>How did parents help shape one’s college and STEM career aspirations?</td>
<td>How did one negotiate “onlyness” and underrepresentation in math and science courses?</td>
<td>Which pedagogical practices best engaged one in math and science courses?</td>
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<tr>
<td>What did parents do to nurture and sustain one’s math and science interests?</td>
<td>What compelled one to persist in STEM despite academic challenge and previous educational disadvantage?</td>
<td>How did one craft productive responses to racist stereotypes in the classroom?</td>
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<tr>
<td><strong>K-12 SCHOOL FORCES</strong></td>
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<tr>
<td>What was it about certain K-12 teachers that inspired math/science achievement?</td>
<td>What compelled one to take advantage of campus resources, clubs, and student organizations?</td>
<td>Which college experiences enabled one to compete successfully for careers in STEM?</td>
</tr>
<tr>
<td>How did one negotiate STEM achievement alongside popularity in school?</td>
<td>What value did leadership and out-of-class engagement add to one’s preparation for STEM careers?</td>
<td>Which college experiences best prepared one for racial realities in STEM workplace environments?</td>
</tr>
<tr>
<td><strong>OUT-OF-SCHOOL COLLEGE PREP EXPERIENCES</strong></td>
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<tr>
<td>Which out-of-school activities contributed to the development of one’s science identity?</td>
<td>Which peer relationships and interactions were deemed most valuable to STEM achievement?</td>
<td>What did faculty and institutional agents do to encourage one’s post-undergraduate aspirations?</td>
</tr>
<tr>
<td>Which programs and experiences enhanced one’s college readiness for math and science interests?</td>
<td>What did one go about securing a STEM-related summer research experience?</td>
<td>Who was most helpful in the graduate school search, application, and choice processes?</td>
</tr>
<tr>
<td><strong>PEERS</strong></td>
<td><strong>PERSISTENCE</strong></td>
<td><strong>FACULTY</strong></td>
</tr>
<tr>
<td><strong>OUT-OF-CLASS ENGAGEMENT</strong></td>
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<tr>
<td>What compelled one to take advantage of campus resources, clubs, and student organizations?</td>
<td>How did one go about securing a STEM-related summer research experience?</td>
<td>Which college experiences enabled one to compete successfully for careers in STEM?</td>
</tr>
<tr>
<td><strong>EXPERIENTIAL/EXTERNAL OPPORTUNITIES</strong></td>
<td></td>
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<tr>
<td>How did one go about securing a STEM-related summer research experience?</td>
<td>In what ways did research opportunities, conference attendance and presentations, and so on help one acquire social capital and access to exclusive, information-rich professional networks?</td>
<td>Which college experiences best prepared one for racial realities in STEM workplace environments?</td>
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</tbody>
</table>


Further, with emphasis on Harper (2010), several dimensions of the Anti-Deficit Achievement Framework, including classroom interactions, familial factors, engagement outside of class, and precollege academic forces, allows the examination of the whole student in their pursuit of STEM majors. This framework was informed by what was inductively learned from this research (Merriam & Tisdell, 2016). Additionally, this framework guided the way in which
data were collected and allowed the framing of research questions to capture the full experience. As Evans-Winters and Esposito (2010 described, “critical race feminism is currently the most useful lens for studying, analyzing, critiquing and celebrating the educational experiences of African American female student…” (p. 20).

Utilizing the anti-deficit approach, the experiences of Black women, including their sense of belonging, were examined through a Critical Race Feminism (CRF) lens. Derived from Critical Race Theory, Critical Race Feminism defines Black women as self-sufficient, independent decision makers, and describes the considerations for this study. CRF was developed to allow an accurate account of Black women experiences, separate and unique from the Black male experience (Wing, 1997). With a focus on the issues facing Black women, CRF framed the parameters of this research. Specifically, this framework highlights the connection of race and sex, and Black women experiences are uniquely considered instead of treated as an aggregate collective sum of all women or all within a particular race (Leath & Chavous, 2018; Patton & Ward, 2016; Wing, 1997).

CRF shares a number of assumptions with CRT, including belief in the following ideas: the permanence of racism in our society; the importance of narratives, storytelling, and counternarratives to disrupting taken-for-granted and normative views about the world; the social constructedness of race… (Childers-McKee & Hytten, 2015, p. 395)

CRF was utilized to understand the experiences of participants and create a critical lens to examine their individual experiences. CRF provided a framework through which Black undergraduate females, who attend a PWI, may describe the facets of their identity and their college persistence. These two frameworks were utilized for this study because the anti-deficit achievement framework allows space for counter-narratives that include capturing the successes and achievements of these students while CRF allows these students to be experts of their own narratives, interpreting their lived experiences precisely as they are. While these frameworks
both support counter-narratives, they are not congruent. They collectively permit examination of Black women in STEM.

Since this study examines the sense of belonging of Black women in STEM at a PWI and persistence, consideration was given to the students’ institutional persistence as described by Tinto (2017), who examined factors that influenced social involvement and integration. Students’ perceptions of their interactions within the campus climate will shape their perspectives and the ways in which they persist. As highlighted by Harris and Patton (2019), systems of domination and privilege, in the context of PWIs, were critically examined to gain a complex understanding of the intersectionality that exists. Internalizing their true identity results in compromised mental health outcomes, including heightened levels of depression (Hughes et al., 2015). The literature findings, which align with the anti-deficit approach, warrant further review and explanation in order to inform policy and improve student outcomes.

In addition to multiple marginalized statuses, Black women entering college for the first time must manage feelings of isolation and stereotypical narratives of their abilities. Suppressed emotions have the potential to influence feelings of belonging and increase levels of anxiety and depression, particularly for students pursuing more challenging fields of study such as STEM. Alternatively, some Black women utilize their engrained strength and influences to confidently navigate predominately White spaces. Through a CRF lens, the anti-deficit approach allowed a balanced examination of Black women experiences, including areas of persistence and success. The anti-deficit achievement framework provided the opportunity to examine the elements that contribute to the success of Black women in STEM while CRF allowed these students to share their experiences exactly as they are, capturing both positive and negative experiences when seeking belonging.
In this respect, this research examined the layers of this unique group, which previous research has largely ignored due to an emphasis on aggregate data of the entire Black or minority student body and indicate areas in need of improvement or replication. Exploring the experiences of this specific segment of the student population will more clearly reveal the mentality and resiliency efforts of these students which will provide higher education administrators more insight on how to address the needs of these students and maintain engagement, ultimately contributing to their successful matriculation.

**Chapter Summary**

This chapter began with an examination of the precollegiate influences such as family, faith, religion, middle school, and high school that contribute to the experiences of Black women pursuing the STEM majors defined by this study. Also included in this chapter were three other key areas of focus including the role of (a) campus climate, (b) campus culture, and (c) clear distinctions between these two phenomena. Considerations were given to the influence of peers, advisors, and faculty from both positive and negative perspectives. The last key area covered in this chapter was student involvement. Areas contributing to or negating feelings of belongings were explored along with the masked identity these students portray. An important element seen throughout the literature is the resiliency and grit of Black women and these influences, followed by those of social media. The literature reviewed in this chapter portrayed the full experience of Black women in STEM before and during college. This chapter concluded with the reasoning for the chosen theoretical framework which guided the study.

In the next chapter, the rationale for the chosen research method will be provided. Also, the reasoning for the proposed design and framework will be explained. The rationale for the selected site will be discussed. Data collection and analysis techniques will be presented. The
chapter will conclude with the ethical considerations of this study, along with steps taken to ensure the quality of this research.
CHAPTER 3

METHODOLOGY

The purpose of this study was to examine the sense of belonging of Black women pursuing STEM majors at a PWI with considerations of the intersection of their race and gender. Additionally, I sought to understand this group’s individual experiences in an effort to improve academic and social outcomes. This chapter provides information on the methodological approach, philosophical assumptions, research design, rationale for site and participant selection, data collection procedures, techniques used with data analysis, acknowledgement of ethical considerations, assumptions, and limitations. The chapter concludes with an explanation of the quality measures employed. Before conducting any research, an application to conduct research involving human subjects was submitted to the Office for Research Compliance for review and approval.

Methodological Approach

To accomplish the purpose of this study, basic qualitative methodology was chosen in an effort to gain an understanding of Black women in STEM experiences and influences. Creswell and Creswell (2018) described qualitative research as “an approach for exploring and understanding the meaning individuals or groups ascribe to a social or human problem” (p. 4). Furthermore, Merriam and Tisdell (2016) noted, “qualitative researchers are interested in understanding how people interpret their experiences, how they construct their worlds, and what meaning they attribute to their experiences” (p. 6). Capturing the meaning that participants had regarding this research topic was the focus.
The goal of this basic qualitative study was to record the interpretation of participants’ experiences and the meanings they apply to them. Attention was paid to any reoccurring patterns seen in the data (Holley & Harris, 2019) in an effort to better understand the sense of belonging of Black women pursuing STEM disciplines at a PWI. Given the limited qualitative research of the experiences of Black women in STEM (Stitt & Happel-Parkins, 2019), this study is warranted. Still in question from the previously conducted research is an understanding of the sense of belonging of Black women pursuing STEM majors. Findings will provide a clearer picture of their challenges, levels of engagement, and strategies they employ.

**Philosophical Assumptions**

Philosophical assumptions influence research practices and should be identified (Creswell & Creswell, 2018). The social constructivism approach utilized for this study is based on the belief that individuals pursue understanding of the world resulting in multiple subjective meanings of their experiences in which the researcher determines the intricacies of the views (Crotty, 1998). This research relied on participants’ experiences regarding their sense of belonging at a PWI while pursuing STEM, which directly aligns with the goal of social constructivism. As Creswell and Creswell (2018) described, the structure of the open-ended questions allows participants to ascribe their meaning to the situation. Historical and cultural settings as well as social interactions play a role in forming the experiences of participants, and social constructivism accounts for each of these elements (Creswell, 2012). Recognition of my positionality as a Black female former STEM student at a PWI and acknowledging the ways in which my interpretations are shaped by my historical and cultural background is also a key element of social constructivism.
Furthermore, social constructivism is an appropriate paradigm for this research since it allows Black women in STEM the space to define their sense of belonging through their individual experiences at a PWI and allows them to develop their understanding of the ways in which this belonging influences their ability to persist. Through social constructivism, this basic qualitative research generated meaning of these experiences based on the data collected in the field involving interactions with participants’ environments (Crotty, 1998). Addressing interactions among individuals and considering the meanings that are formed made social constructivism an ideal approach.

**Study Design**

Driven by the research questions and the topic of sense of belonging for Black women in STEM at a PWI, basic qualitative research was the research design used. The purpose includes understanding this group’s individual experiences to improve outcomes. Participants’ unique lived experiences as Black undergraduate women in STEM at a PWI warranted a qualitative approach due to this common phenomenon (Creswell, 2012). Utilizing Black women in STEM at a PWI in the southern region as the unit of analysis effectively shaped the scope and purpose of this research.

From a qualitative perspective, the following research questions were explored to aid in determining what factors shape the academic trajectory of Black women during their undergraduate years at a PWI:

1. How do Black undergraduate women describe the early influences regarding people, places, and experiences that influence their early interest in STEM majors?
2. How do Black undergraduate women describe their sense of belonging at a PWI?
3. How do Black undergraduate women majoring in STEM cope or persist at a PWI?
4. How do Black undergraduate women describe their experiences with faculty, academic advisors and peers that cultivate their sense of belonging in a STEM major at a PWI?

As illustrated in Table 1, the research and protocol questions were framed by the anti-deficit achievement framework through the CRF lens, which considers aspects that contribute to student persistence and successful matriculation (Harper, 2010; Mejia, 2018). Included in Table 1 are sample questions from the anti-deficit achievement framework, the connection of these questions to the research questions, and protocol questions.

While the sample questions provided in the framework are flexible and exchangeable, they are designed to be “instead of” queries; that is, instead of relying on existing theories and conceptual models to repeatedly examine deficits, researchers using this framework should deliberately attempt to discover how some Black women have managed to succeed in STEM. (Harper, 2010, p. 68)

The framework questions provide an opportunity to engage in questions that do not focus only on deficits but also success and persistence. Protocol questions, which have been arranged in themes, allow participants to share their individual responses based on their understanding of their interactions, engagements, and experiences. Understanding the influence of students’ college classification may influence their overall sense of belonging and persistence. The CRF framework allows participants to reflect on their individual experiences as they consider the intersection of their sex and race.
### Table 1

**Research Design**

<table>
<thead>
<tr>
<th>Research Questions</th>
<th>Theoretical Framework</th>
<th>Interview Questions</th>
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<tbody>
<tr>
<td><strong>1. How do Black undergraduate women describe the early influences regarding people, places, and experiences that influence their early interest in STEM majors?</strong></td>
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<tr>
<td>Pre-College Socialization and Readiness</td>
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<tr>
<td>Familial Factors</td>
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<tr>
<td>“What did parents do to nurture and sustain one’s math and science interests?”</td>
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<td>K-12 School Forces</td>
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<td>“What was it about certain K-12 teachers that inspired math/science achievement?”</td>
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<tr>
<td>Customized Anti-Deficit Achievement Framework for Studying Students of Color in STEM (Harper, 2010)</td>
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<tr>
<td><strong>Family:</strong> Tell me about your upbringing and family?</td>
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<tr>
<td>Probe: Who raised you?</td>
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<td>How has your family influenced your sense of belonging in STEM prior to entering college?</td>
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<tr>
<td><strong>Precollege Experience:</strong> What motivated you to pursue a STEM major?</td>
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<td>Probe: What person or event played a role in this decision?</td>
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<tr>
<td>Did you experience any educational disadvantages before college? If so, how did you overcome them?</td>
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<tr>
<td><strong>2. How do Black undergraduate women majoring in STEM cope or persist at a PWI?</strong></td>
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<tr>
<td>College Achievement</td>
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<tr>
<td>“How did one negotiate “onlyness” and underrepresentation in STEM courses?”</td>
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<tr>
<td>Customized Anti-Deficit Achievement Framework for Studying Students of Color in STEM (Harper, 2010)</td>
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<tr>
<td><strong>College Persistence:</strong> Who or what influenced your persistence in STEM at a PWI?</td>
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<tr>
<td>As a Black female STEM student, what is your overall perception of your college experience?</td>
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<tr>
<td>Probe: How do you think your experience differs from that of other students?</td>
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<tr>
<td>Tell me about a positive or negative college experience that you attribute to being a Black female STEM student.</td>
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<tr>
<td>Question</td>
<td>Response</td>
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<tr>
<td>“What compelled one to persist in STEM despite academic challenge and</td>
<td>What specific activities, skills, resources (if any) contributed to your success in STEM before and</td>
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<tr>
<td>previous educational disadvantage?”</td>
<td>during college?</td>
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<tr>
<td><strong>Self-Efficacy:</strong> How do you stay motivated?</td>
<td><strong>Belonging:</strong> Tell me what you do, if anything, to establish a feeling of belonging or acceptance on</td>
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<tr>
<td>Probe: What do you do for yourself to help you persist or continue on</td>
<td>campus.</td>
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<tr>
<td>your college journey to graduation?</td>
<td>Probe: Describe your experiences being engaged with student groups.</td>
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<tr>
<td>Probe: Please explain whether or not you feel like you fit in.</td>
<td><strong>Campus Climate:</strong> How would you describe the campus environment?</td>
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<tr>
<td>Describe a time when you felt a part of the campus community.</td>
<td>Probe: In what ways does the campus environment influence your feelings of belonging?</td>
<td></td>
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<tr>
<td>Probe: What made you feel connected?</td>
<td>Describe a time when you felt excluded from the campus community.</td>
<td></td>
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<tr>
<td>Describe a time when you felt excluded from the campus community.</td>
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</tbody>
</table>
“In what ways did research opportunities, conference attendance and presentations, and so on help one acquire social capital and access to exclusive, information-rich professional networks?”

**Probe:** What caused the disconnect?

**Campus Culture:** Do you feel you are represented in university programming, activities, and student engagement? Why or why not?

What changes (if any) should be made in order to improve Black women in STEM experience at PWIs?

**Probe:** If you could make a suggestion to university administration to improve the sense of belonging for Black women in STEM what would you recommend?
4. How do Black undergraduate women describe their experiences with faculty, academic advisors and peers that cultivate their sense of belonging in a STEM major at a PWI?

<table>
<thead>
<tr>
<th>Customized Anti-Deficit Achievement Framework for Studying Students of Color in STEM (Harper, 2010)</th>
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</thead>
<tbody>
<tr>
<td><strong>Classroom Interactions</strong></td>
</tr>
<tr>
<td>“How did one craft productive responses to racist stereotypes in the classroom?”</td>
</tr>
<tr>
<td>“Which pedagogical practices best engaged one in math and science courses?”</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Faculty Influences</strong>: In what ways does interacting with faculty contribute to your academic success or hinder it?</th>
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</thead>
<tbody>
<tr>
<td>Probe: How does faculty expectations influence you?</td>
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<tr>
<td>Probe: In what ways, if any, does the faculty interactions influence your feelings of belonging?</td>
</tr>
<tr>
<td>Does the race/ethnicity of faculty influence your experiences?</td>
</tr>
<tr>
<td>Probe: Please elaborate and provide an example.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Academic Advisors</strong>: In what ways does interacting with academic advisors contribute to your academic success or hinder it?</th>
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</thead>
<tbody>
<tr>
<td>Probe: How does academic advisor interactions influence you?</td>
</tr>
<tr>
<td>Does the race/ethnicity of academic advisors influence your experiences?</td>
</tr>
<tr>
<td>Probe: Please elaborate.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Peers</strong>: Describe your experiences with peers in STEM at a PWI.</th>
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<tbody>
<tr>
<td>Probe: Describe what your experience is like inside and outside of the classroom.</td>
</tr>
<tr>
<td>How do your peers contribute to or hinder your sense of belonging?</td>
</tr>
<tr>
<td>Probe: Describe how they make you feel.</td>
</tr>
</tbody>
</table>
Site Selection

The site for this qualitative research study is a large public PWI in the southeastern United States that will be referred to using the pseudonym Prospect Central University (PCU). This public research university has enrolled more than 38,000 students annually for the past several years with 10% to 12% of the student body comprised of Black students. Selecting PCU as the site creates a space to better understand how this group of students interpret their experiences and the meaning associated with it. Based on data from IPEDS 2019 Fall Enrollment Report, PCU enrollment was approximately 18,000 undergraduate females. Of that number, only 2,200 are Black female students. This number decreases even more significantly when considering the number of Black women in STEM majors, and this study is seeking to understand why.

Participants

Black women pursuing STEM disciplines, specifically Computer and Information Sciences, Engineering, Biological and Biomedical Sciences, Mathematics, and Physical Sciences were the focus of this study. The broad range of STEM majors within these disciplines includes Marine Science, Microbiology, Operations Management, Computer Science, Aerospace Engineering, Architectural Engineering, Chemical Engineering, Civil Engineering, Computer Engineering, Construction Engineering, Electrical Engineering, Environmental Engineering, Mechanical Engineering, Musical Audio Engineering, Mathematics, Environmental Science, Chemistry, Geology, and Physics. Undergraduate classifications consisted of freshmen, sophomores, juniors, and seniors. Prior scholarly research has focused on doctoral students’ experiences (Shavers & Moore, 2014) which is why this research focused on the undergraduate experience.
The researcher identified 23 participants who self-identify as Black females in one or more of the STEM disciplines. Given the limited resources available at the high school level, studying the experiences of these women will provide useful information regarding their mentality or way of thinking as they traverse White spaces. Concentrating on this group of students will allow a deeper understanding of the ways in which they effectively cope, thrive, and persist. This gained knowledge will be beneficial to improving academic and social outcomes for this group.

**Data Collection Procedures**

Including space to account for CRF, the anti-deficit approach guided the interview protocol to explore challenges and areas of persistence. With well-defined objectives, 90-minute, semi-structured, face-to-face and Zoom interviews were conducted with a focus on gaining an understanding of participants’ experiences during their undergraduate years. Semi-structured interviews are ideal because they allow exploration of “a topic more openly and allow interviewees to express their opinions and ideas in their own words” (Esterberg, 2002, p. 87). Through initial background questions, inclusion of historical references, such as middle school and high school influences, were documented.

The Institutional Review Board (IRB) was presented with Zoom and telephone interview scripts for consideration (see Appendix B and Appendix D). Additionally, a research interview protocol arranged thematically was developed (see Appendix E). Due to the ongoing pandemic, twenty-one of the participants chose to complete the interviews by Zoom. Two of the participants opted for socially distanced face-to-face interviews.

As Henning and Roberts (2016) described, new element prompts were utilized as needed to progress the interview through perceived challenging questions framed through the anti-deficit
approach. Since the anti-deficit achievement framework creates space to capture the success of these students, engaging them through prompts or probes that do not rely heavily on deficit thinking were also used to facilitate interviews. Examination through the CRF lens allows the issues that Black women face to be highlighted. Additionally, semi-structured interviews allowed probing for additional information (Henning & Roberts, 2016), which was necessary given the potentially sensitive subject matter. A list including the names and email addresses of Black female students in the STEM discipline specifically including the following STEM majors was provided by the Office of Institutional Research and Assessment: Computer and Information Sciences, Engineering, Biological and Biomedical Sciences, Mathematics, and Physical Sciences which includes the following majors: Marine Science, Microbiology, Operations Management, Computer Science, Aerospace Engineering, Architectural Engineering, Chemical Engineering, Civil Engineering, Computer Engineering, Construction Engineering, Electrical Engineering, Environmental Engineering, Mechanical Engineering, Musical Audio Engineering, Mathematics, Environmental Science, Chemistry, Geology, and Physics. The students within these disciplines will be the focus of this study.

The IRB approved the research design in January 2021. After obtaining IRB approval, I utilized single stage sampling by requesting a listing that includes email addresses of all Black women in STEM from the university’s record’s office (a pseudonym). The record’s office was not able to provide these data in this way and instead provided a listing of all 26,000 full-time undergraduates. After further discussion with IRB officials, who agreed that a more manageable subset was warranted, I contacted the Office of Exploration (a pseudonym) which was able to present my approved recruitment letter (Appendix C) along with a yes/no question asking students if they were interested in participating. The Office of Exploration also informed me that
only 226 of the 279 Black women in STEM disciplines returned for the Spring 2021 semester. This notification went out to the 226 remaining Black Women in STEM. If they responded affirmative for participating, the Office of Exploration provided me their name, major, and email address. I was then able to contact these students, review the informed consent with them, and successfully enroll them. As indicated in Table 2, a total of 23 students across nine different STEM majors agreed to participate in this study.

As an alternative approach to recruitment to garner enough responses, the plan was to extend recruit to include women resource centers, diversity engagement programs, first-year experience programs, and student organizational meetings attended by Black women. However, due to the positive rate of responses and reaching the point of saturation with the participants, this alternative approach was not necessary.

**Table 2**

*Participating STEM Majors*

<table>
<thead>
<tr>
<th>STEM Majors</th>
<th>Number of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical Engineering</td>
<td>4</td>
</tr>
<tr>
<td>Computer Science</td>
<td>3</td>
</tr>
<tr>
<td>Aerospace Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics</td>
<td>3</td>
</tr>
<tr>
<td>Environmental Science</td>
<td>3</td>
</tr>
<tr>
<td>Biology</td>
<td>2</td>
</tr>
<tr>
<td>Chemical Engineering</td>
<td>2</td>
</tr>
<tr>
<td>Chemistry</td>
<td>2</td>
</tr>
<tr>
<td>Architectural Engineering</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>23</strong></td>
</tr>
</tbody>
</table>

**Data Analysis**

Data analysis consisted of identification of reoccurring themes (Holley & Harris, 2019) through multiple levels of analysis (Creswell & Creswell, 2018). With participants’ permission,
interviews were recorded and transcribed verbatim using professional transcription software. As Seidman (1998) described, data analysis occurs concurrently with data collection, and as the interviews are completed, they will be transcribed and categorized. “Data that have been analyzed while being collected are both parsimonious and illuminating” (Merriam & Tisdell, 2016, p. 197). Every interview was coded and examined for themes or dimensions of information among participants, which clarified the formation of relationships with the data and research questions. Data were arranged and sorted. After organizing the data, transcriptions were promptly coded to identify patterns and relationships. Data from the transcripts were entered into NVivo qualitative software for the purpose of organization.

The data analysis process consisted of the following steps as described by Merriam and Tisdell (2016) with consideration for the researchers’ positionality and biases throughout the process:

1. Consider the purpose of the study and what the researcher hopes to accomplish.
2. Consider the social constructivism lens through which the research is taking place and the role of the critical race feminist framing.
3. Code the data guided by the theoretical framework through open coding which allow responses to the research questions to be captured.
4. Determine the themes that have emerged in response to the research questions.
5. Determine if the individual coded responses support the main themes.
6. Develop categories, combining or grouping open codes where possible. (pp. 207-208)
After transcription was complete, data were reread in search of similarities and differences among participants and recoded as new themes emerged (Calabrese, 2006), particularly as it related to participants’ experiences pursuing STEM majors as Black women. The anti-deficit approach guided data analysis, and CRF allowed for an accurate account of participants’ experiences. A detailed explanation of themes and areas of alignment with the theoretical underpinnings was provided. Findings were limited to the perceived accuracy of participants’ responses.

Trustworthiness

Through inductive data analysis to develop a comprehensive set of themes, the problem was explored from the participant perspective (Creswell & Creswell, 2018). Given the need to capture the diverse experiences related to this study’s focus and understand the problem, purposeful sampling (Creswell, 2012; Creswell & Creswell, 2018) was used. Quality assurance measures of this study included triangulation to confirm the trustworthiness of the data. Field notes and transcripts were utilized to confirm the consistency of findings (Calabrese, 2006). To ensure credibility of the data, clarification regarding the understanding of participant responses was confirmed throughout the interview. To that end, participants were given the opportunity to engage in member checking. Individual interview transcripts were sent to participants to confirm their responses in an effort to strengthen the validity of the study (Holley & Harris, 2019).

Ethical Considerations

As described by Holley and Harris (2019), qualitative research allows spaces for empathic connection as participants share their lived experiences. Safeguards were put in place to protect participants’ rights, such as clearly articulating the research objectives, including the ways in which the data will be used, obtaining written permission, and IRB approval (Creswell
The ethical guidelines, including the procedures regarding confidentiality, of the study were clearly explained to participants.

Furthermore, data collected from the interviews were kept confidential with pseudonyms assigned to protect their identity. Participants were encouraged to communicate any concerns regarding the subject matter at any point during the study. It was articulated to participants that their participation was voluntary, and they had the option to end the research study at any time without any repercussions. Electronic data collected were confidentially stored on a password protected computer. Additionally, all interview notes, files, recordings, or any information pertaining to the research study were restricted and stored in a locked file cabinet. To acknowledge their agreement with the terms of the research prior to data collection, participants were asked to sign a consent form.

Positionality

As described by Creswell (2007), “clarifying researcher bias from the outset of the study is important so that the reader understands the researcher’s position and any biases or assumptions that impact the inquiry” (p. 208). I would like to acknowledge and identify my reflexivity, or how my personal background including gender and culture may influence the direction and formation of my interpretations during this study (Creswell & Creswell, 2018). I am a Black female who attended a PWI, initially as a STEM undergraduate student before changing my major to business. Transitioning from STEM early during my undergraduate years allowed no disruption or delay in my academic studies.

Additionally, as an administrator at the university that is being studied, and a Black female, I have an interest in the success of these students. As an administrator and an alumnus of the university, I am interested in the collective success of the university and the students being
studied. However, my position is not involved in any academic or social engagements involving these students, and I have no personal relationships with any of them that would affect their responses regarding their individual experiences. To maintain integrity of the research, qualitative researchers should disclose their “past experiences, biases, prejudices, and orientations that have likely shaped their interpretation and approach to the study” (Creswell, 2007, p. 208). Furthermore, to avoid bias, in addition to disclosing my positionality here, I will engage in member checking and maintain awareness of potential researcher bias throughout this research project.

**Limitations**

Since participation was voluntary, it is impossible to assess whether participants were an accurate portrayal of the diversity of all Black undergraduate women. The results cannot be generalized to all Black women in STEM at a PWI. It is assumed that the importance of the strong persona Black women exhibited in their high schools, homes, and communities is present when they arrive at college (Hannon et al., 2016). Another assumption surrounds the disengagement of Black women as a result of their challenges to belong, because they lack a sense of belonging, they are not engaging with the campus community, which directly impacts their persistence and retention rates in STEM. Additionally, by virtue of the lack of diversity within STEM (Reilly et al., 2019), the results will be limited to the number of participants.

**Delimitations**

The delimitations include the school selection because generalizations have to be made in order to produce results and the focus is only on Black STEM students. Students who self-identified in two or more races were excluded. The study results did not include students who dropped out during their first year. Based on Fall 2020 data provided by the Office of
Institutional Research and Assessment (OIRA), the STEM disciplines included academic majors identified in Table 3. These STEM disciplines are also recognized as such by the National Science Foundation.

Table 3

Undergraduate Majors by STEM Discipline

<table>
<thead>
<tr>
<th>STEM Discipline</th>
<th>Undergraduate Black Female STEM Majors</th>
<th>Other Undergraduate STEM Majors</th>
<th>Total</th>
<th>STEM Major*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Sciences</td>
<td>121</td>
<td>1,344</td>
<td>1,465</td>
<td>Biology</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Marine Science-Biology</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Marine Science-Chemistry</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Marine Science-Geology</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Microbiology</td>
</tr>
<tr>
<td>Business and Management</td>
<td>9</td>
<td>295</td>
<td>304</td>
<td>Operations Management</td>
</tr>
<tr>
<td>Computer and Information Sciences</td>
<td>25</td>
<td>644</td>
<td>669</td>
<td>Computer Science</td>
</tr>
<tr>
<td>Engineering</td>
<td></td>
<td>4,284</td>
<td>4,377</td>
<td>Aerospace Engineering</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Architectural Engineering</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Chemical Engineering</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Civil Engineering</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Computer Engineering</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Construction Engineering</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Electrical Engineering</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Environmental Engineering</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Metallurgical Engineering</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Musical Audio Engineering</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Undesignated Engineering</td>
</tr>
<tr>
<td>Mathematics</td>
<td>6</td>
<td>264</td>
<td>270</td>
<td>Mathematics</td>
</tr>
<tr>
<td>Natural Resources and Conservation</td>
<td>3</td>
<td>99</td>
<td>102</td>
<td>Environmental Science</td>
</tr>
<tr>
<td>Physical Sciences</td>
<td>22</td>
<td>365</td>
<td>387</td>
<td>Chemistry</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Geology</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Physics</td>
</tr>
<tr>
<td>Total UG STEM Majors</td>
<td>279</td>
<td>7,295</td>
<td>7,574</td>
<td>Total UG STEM Majors</td>
</tr>
</tbody>
</table>

If a student was enrolled in an academic major that is in a STEM discipline, that student was included in that STEM discipline. Additionally, students with more than one STEM discipline were only included in the first occurring STEM discipline. It was reported by OIRA that of the 279 undergraduate Black female STEM majors only 226 returned for the Spring 2021.
Chapter Summary

This chapter began with an explanation of why basic qualitative research was the best approach for this research study. Also noted in this chapter is the reasoning for the selection of the site and participants, which aligns with the objectives of this study to understand the experiences of belonging of Black women in STEM at a PWI. Data collection and analysis were described along with the ways in which the safety and integrity of the information was safeguarded to protect participants. The next chapter will include data from the semi-structured interviews including individual participant profiles. These profiles will provide a deeper level of understanding of participants and highlight the precollege and college influences that contributed and hindered their sense of belonging and academic trajectories. To conclude this research study, Chapter 5 will highlight the themes that emerged along with a summary of findings. Finally, Chapter 6 will conclude with implications for practice and policy and recommendations for future research based on study results in an effort to improve outcomes.
CHAPTER 4
PARTICIPANT PROFILES

This chapter presents and describes the 23 Black female STEM students who participated in this study to provide a deeper understanding of who these women are individually and as students. Each participant was assigned a pseudonym that will be used throughout this chapter to identify each female. Displayed in Table 4 are the 23 participants listed in alphabetical order based on their pseudonym. Individual profiles are presented including poignant quotations from the interviews. Within each profile is an overview of the participant’s precollege and college experiences including persistence elements; contributors to belonging; and interactions with faculty, academic advisors, peers, and the campus as a whole. The challenges to persistence the participants faced both inside and outside of the classroom are discussed.

The 23 cases represented in this study were selected using maximum variance sampling among students who responded to the recruitment email. This purposeful sampling strategy allows maximum diversity of participants (Creswell & Creswell, 2018). Table 4 summarizes the selected participants along with their year of study, major, high school racial make-up, the greatest contributor to belonging, and their main reason for persisting. Of particular note, 70% of participants attended predominantly White high schools, and their responses revealed that these experiences better equipped them to be successful in predominantly White classrooms once they reached college. Additionally, a few participants voluntarily disclosed their mental health challenges, and each of them confirmed that there is an ongoing relationship with the counseling center to address their challenges.
### Table 4

**Study Participants**

<table>
<thead>
<tr>
<th>Pseudonym</th>
<th>Year of Study</th>
<th>Major</th>
<th>HS Racial Make-up</th>
<th>Largest Contributor to Belonging</th>
<th>Persistence Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anna</td>
<td>Junior</td>
<td>Architectural Engineering</td>
<td>PW</td>
<td>NSBE</td>
<td>Future lifestyle</td>
</tr>
<tr>
<td>Betty</td>
<td>Freshman</td>
<td>Biology</td>
<td>PW</td>
<td>Self-motivation</td>
<td>Diversifying the field</td>
</tr>
<tr>
<td>Christy</td>
<td>Senior</td>
<td>Computer Science</td>
<td>PB</td>
<td>Joined legacy programs</td>
<td>Faith</td>
</tr>
<tr>
<td>Claire</td>
<td>Sophomore</td>
<td>Chemistry</td>
<td>PW</td>
<td>Supporting peers</td>
<td>Faith</td>
</tr>
<tr>
<td>Delora</td>
<td>Senior</td>
<td>M.E.</td>
<td>PW</td>
<td>NSBE</td>
<td>Financial independence</td>
</tr>
<tr>
<td>Denise</td>
<td>Senior</td>
<td>M.E.</td>
<td>PW</td>
<td>NSBE</td>
<td>Faith</td>
</tr>
<tr>
<td>Eve</td>
<td>Freshman</td>
<td>M.E.</td>
<td>HS</td>
<td>Roommates</td>
<td>Roommate</td>
</tr>
<tr>
<td>Felicia</td>
<td>Senior</td>
<td>Environmental Science</td>
<td>PW</td>
<td>Sorority</td>
<td>Future lifestyle</td>
</tr>
<tr>
<td>Harper</td>
<td>Senior</td>
<td>Computer Science</td>
<td>Mixed</td>
<td>NSBE</td>
<td>Faith &amp; Peers</td>
</tr>
<tr>
<td>Janet</td>
<td>Senior</td>
<td>Mathematics</td>
<td>PW</td>
<td>Self-motivation</td>
<td>Faith</td>
</tr>
<tr>
<td>Kelly</td>
<td>Senior</td>
<td>Chemistry</td>
<td>HS</td>
<td>Caring professor</td>
<td>Faith</td>
</tr>
<tr>
<td>Laura</td>
<td>Junior</td>
<td>M.E.</td>
<td>PW</td>
<td>NSBE</td>
<td>Faith</td>
</tr>
<tr>
<td>Lisa</td>
<td>Sophomore</td>
<td>Engineering</td>
<td>PB</td>
<td>NSBE</td>
<td>Future lifestyle</td>
</tr>
<tr>
<td>Mary</td>
<td>Freshman</td>
<td>Aerospace Engineering</td>
<td>PB</td>
<td>Student organizations outside of STEM</td>
<td>Self</td>
</tr>
<tr>
<td>Monica</td>
<td>Senior</td>
<td>Mathematics</td>
<td>PW</td>
<td>Never found it</td>
<td>Faith</td>
</tr>
<tr>
<td>Myra</td>
<td>Sophomore</td>
<td>Aerospace Engineering</td>
<td>PW</td>
<td>Tailgating</td>
<td>Self</td>
</tr>
<tr>
<td>Nicole</td>
<td>Senior</td>
<td>Mathematics</td>
<td>PW</td>
<td>Black Student Organization</td>
<td>Potential future salary</td>
</tr>
</tbody>
</table>
Furthermore, 39% of participants credited their faith in God with sustaining them and allowing them to persist regardless of whether they had established a sense of belonging on campus. Likewise, 39% of participants described their vision of the bigger picture which extends beyond college, including better lifestyles, financial stability, and independence, as motivators that drive their persistence in STEM. One of the greatest indicators of belonging centered on involvement in student groups that were specific to their majors or other campus student groups if they were not aware of STEM-specific groups. These student groups have been described as communities in which they can identify with and share experiences and resources. The following participant profiles provide a brief synopsis of who these women are as individuals and their experiences with their sense of belonging. The information includes their precollege experience as well as the role of their families, communities, and resources. Additional information regarding their experiences can be found in the themes presented in Chapter 5.
Anna

Anna is a junior majoring in Architectural Engineering. Anna is the product of a two-parent middle class household. She described her upbringing as great and indicated that she had resources at her disposal. As early as elementary school, her parents ensured she was included in the same academic programs and activities as her peers, who were mainly White. Anna enjoyed the small class sizes at her private school and credits her Advanced Placement (AP) Calculus teacher, who was also an aerospace engineer, with motivating her to pursue a STEM major.

After arriving at college, Anna’s persistence was encouraged mostly by her mother. She became involved with the National Society of Black Engineers (NSBE) during her freshman year and credited the organization with helping her to establish a feeling of belonging through connections with the group. She easily made friends and felt that this was largely because she is accustomed to thriving in a predominantly White environment from as early as middle school.

Anna feels that she has a good mix of friends inside and outside of her major. She described the best friends as those who “are focused on the big picture and can think long-term”. Anna described her only vivid memory of not feeling like she belonged:

I toured labs with my class and all the White males in the class walked in the front of the group ahead of me. No one wanted to be near me, so I walked alone. That scene has stuck with me ever since it happened.

Anna felt that she built good rapport with the faculty, including the academic advisors, by visiting their office hours, and making them aware of how serious she was about learning. She confidently stated, “it is very important to not feel like a number to your academic advisor and know they have an interest in your success.” She described her overall college experience as positive.
Betty

My parents always told me there will not be a lot of people like me. They meant that I should not be afraid to stand out or be different because I am just as good as them. I took that advice and keep it in mind as much as I can.

Betty is a freshman majoring in Biology on the Pre-Med track. Betty was raised by a middle class military family, who moved around several times during her precollege years. She described herself as self-motivated and utilizes the experiences of successful family members who have excelled academically as encouragement. Betty felt that because of different classroom environments, which have been mostly White, she had to learn how to thrive which prepared her to be successful at this PWI. She also described her parents as deliberately ensuring that she persisted in predominantly White settings. The foundation her parents established equipped her with effective tools to thrive.

Betty stated, “I got lucky because my roommates were Black females in STEM, so we were able to encourage each other.” She also encouraged other students who look like her:

Put yourselves out there, and your peers will notice you. I have not had any negative experiences with my peers, faculty, or advisors. The campus can be rowdy, but there is a place for you. Don’t be afraid to figure out where you belong.

Betty said that her hobbies were considered to be more suited for White people. This made her feel left out at times, and also caused her to question where she belonged. Despite the plethora of emotions, she has felt so far, Betty described her experience as a necessary process. Even though she was just beginning her journey, she was confident in her ability to persist because she was focused on the big picture of diversifying her field of study.
Christy

I felt excluded in class because I did not understand at their level and I often wondered if I was good enough; however, being excluded by my peers made me motivated to learn even more. I was not going to allow their perception of me to hinder my progress.

Christy is a first generation senior majoring in Computer Science. Christy described her predominantly Black high school as disadvantaged and recalled having to teach herself how to code because computer science was not offered in her high school.

I learned online and on YouTube. I would not have had to repeat so many of my classes if I had exposure. Even though I am shy, I had to make it a priority to get help. Being the only Black female in my class has been extremely hard.

Christy said her love for computer games and programming along with her mother, motivated her to persist with her interest in STEM before she arrived on campus. Establishing a sense of belonging for Christy consisted of her helping other Black females learn how to code or maneuver through their classes “because I know how they feel”. She also credited the first generation legacy program with motivating her to persist in her major once she arrived on campus and began encountering negative experiences:

In labs, my hand is ignored when it is raised in class. My professor also expects me to speak for all African American females and describe what they may or may not like. Also, my academic advisor literally laughed in my face at the fact of me taking computer science classes, which made me feel like I did not belong, and I was simply a Black girl with wishful thinking.

Christy also described her peers taking credit for her work during group assignments. While she saw the campus environment as intimidating, she shared, “you have to go through the forest to
find the treasure.” She credited her work as the professor’s assistant as her greatest source of belonging because she was helping other students. Christy never questioned whether she would be able to persist despite the challenges:

I stay motivated by staying in God’s word and praying every day. It keeps me going even when I want to give up. My mother reminds me that I have the best teacher in Christ Jesus. My faith has grown on this journey.

Christy would love to see previous students’ mentor younger students and help them to establish a feeling of belonging.

Claire

It is a disadvantage of always having to be aware of myself and not come off as threatening or disrespectful because of who I am. You have to know you are at a disadvantage and prove yourself from there, there is no baseline grace extended.

Claire is a sophomore majoring in Chemistry. She is the product of a two-parent household where she lived with her sister who is 14 years older. Claire has always attended predominantly White schools; however, she did briefly attend a predominantly Black school because her parents “wanted me to understand my history”. Claire has been motivated from a very early age in middle school to pursue Chemistry because of her love for what Chemistry entails. As she got older, she was motivated “to have more Black faces in STEM and Black voices to close the disparities gap.” Claire believed she was no longer trying to discover a sense of belonging due to her experiences with faculty who reminded her often that she should not be at the university through their actions.

Some White faculty have already established in their minds certain images of who I am as well as my knowledge base. I work late and professors question me because they don't
I feel I have the right to be there working in a lab; even Asian students are not questioned. It is an interrogation for me that happens on a regular basis.

Interactions with her peers both inside and outside of the classroom have also contributed to her feeling that a sense of belonging will never be established. She did, however, describe glimpses of a feeling of community:

When there are peers willing to share tips on how to figure things out. When you have someone, who is willing to tell you where to find that $200 study guide and not spend that much and maybe even get it for free, a sense of belonging is felt, and I feel seen.

Claire described her feelings of belonging as short-lived:

My answers are always questioned in study group and my peers, who are predominantly White, are very comfortable interrupting me. Eye contact is avoided in lab settings because no one wants to partner with me. It happens every single time.

Claire felt strongly that White students simply tolerate Black students on campus as a consequence of being able to have athletic teams that they value and love. She concluded, “they (White students) can appreciate those on the field or the court but not those they sit next to.”

Despite some negative experiences, Claire has also had some positive experiences with her academic advisors. She confidently stated, “it has nothing to do with their race, it is about their heart.”

I have an advisor who has never hesitated to give me a resource. Every opportunity is shared with me. My advisor has made sure I was in the room and present since we are not always made aware of resources, she has been pivotal in my success.

Additionally, Claire credited her faith in God and her desire to live out an image that is pleasing to God as her reason for persevering. She also utilized her mother’s experience to fuel her desire
to ensure Black women will not be overlooked medically. To improve experiences for Black women in STEM and help them feel like they belong, Claire felt that teachers and professors beginning as early as middle school need to have diversity training “beyond reading about it and includes the negative impact of microaggressions.”

**Delora**

I was not afraid to come to a PWI because I learned to thrive in this environment in middle and high school. I still wanted to transfer after my first year because I did not feel like I had found a place that I could belong. Seeing someone who looked like me did not make it better because we never worked together.

Delora is a senior majoring in Mechanical Engineering. She was motivated to excel academically by her mother who was a computer science major and also a single parent. Delora also gained inspiration from her high school STEM-related course work. Delora credited her engagement with university programs and NSBE as the main sources that allowed her to create a sense of belonging on campus. Delora described her interactions with the faculty as limited, however, “if they see you are trying, they will help you.” In comparing her experience to her friends outside of STEM, Delora hoped for more consistency in her academic advisors, “I had a different advisor every year, which made it hard to build a relationship.” While Delora was aware that some of her Black friends have had negative, racist experiences, she felt that her peers can tell she had been exposed to predominantly White settings and therefore, were more accepting of her. She was confident that her feeling of belonging was solidified through NSBE, which also helped since it was more difficult to make friends due to the pandemic. Delora’s main reason for persisting through college was gaining financial independence. She believed a group specifically meant for Black women in STEM would be advantageous and was confident alumni
would be willing to be a participant in such a program in order to help these students establish a feeling of belonging. Delora also stated, “a stipend like the one given by some other universities is an incentive that could assist with offsetting cost.”

**Denise**

I have always taught myself to be authentic and not bend to try to conform to certain standards people set in order to feel like I belong. If you are authentic, people will gravitate towards you. I am confident of that.

Denise is a senior majoring in Mechanical Engineering. She is the product of an upper middle class family. Having a father who was an engineer, as well as her experience with AP high school course work, fueled her interest in this major. Denise also credited her exposure to her father’s workplace and her involvement in extracurricular activities as early as middle school for shaping her character and allowing her to find belonging and thrive in predominantly White spaces. Denise credited her persistence in college “largely due to my involvement in NSBE, which was a community where I found belonging.” Denise wished that she had taken more opportunities to interact with the faculty and build relationships with them. Regardless of the race of her academic advisors, Denise has had great experiences.

I was super excited to see a Black academic advisor, but I also had two White advisors after that. They were still very helpful, which reminded me that race is not an issue if you want to help someone. My advisor did not treat me any differently because of my skin color.

Denise’s experience with her peers affected her feelings of belonging when it came to group work. This was true particularly if she was in a group with White males, “they worked to make me feel isolated.” Denise credited her personality and her faith for not allowing her to feel
excluded from anything. She also shared the following from her experience, “White people are more comfortable talking to light-skinned Black females than dark-skinned.” She felt development of Black females in STEM “has to start in middle school because they need to see successful representation that looks like them.” Denise hoped to carry what she has learned from college into the workplace and planned to strive for equality in all aspects of her life. She concluded, “don't give me a job because you are being inclusive, give it to me because I earned it”.

Eve

The strong Black woman persona that has been associated with us is a myth, I am not strong. There was a whole module on wellness during the admissions process but finding consistent counseling for my mental health issues has been challenging. I am grateful for the connections to faculty and staff that I have.

Eve is a freshman majoring in Mechanical Engineering. She relied on motivation from her mother and sister who both are alumni of her PWI, to encourage her when she felt overwhelmed. Eve said, “I had no college-level Calculus because I was home-schooled, I am disadvantaged academically.” She was grateful for her exposure to STEM camps, which began in middle school. Eve shared that she came to the university suffering from depression, “(I) had to repeatedly seek out resources, even as an introvert because I initially could not afford counseling services.” She developed a small community of professors who she knew personally as well as several in administration who arranged tutors and counselors for her. While she had limited interactions with her advisors, she was hopeful that future interactions would be great since she knew how to build rapport with faculty. Eve described her experience with her peers as “exhausting” due to the “belittling comments” she hears in the classroom. She was very grateful
for her roommates with whom she created a “sisterly bond” and credited them as being her
greatest source of belonging. However, she reported feeling excluded “every time I enter class.”
Eve described being capable of masking her depression prior to college. However, due to the
rigorous, stressful schedule, she has not been able to mask it, “it has actually worked in my favor
to be able to talk about it with my roommates and my counselor.” For other students who were in
a similar situation as she was, and battling depression, Eve expressed the following desire,
“counseling to be a necessity, not beyond financial reach.” She also hoped that she had more
students in her class that look like her because “being the only one in class makes it even harder
to figure out where I belong.”

**Felicia**

I have always been pretty sociable, but I became anti-social after being on campus awhile
because my White peers group to themselves and constantly being rejected is exhausting.
It became easier for me to not attempt to get to know anyone.

Felicia is a senior majoring in Environmental Engineering. She is the product of a middle
class family in which her father was a mechanical engineer with military roots. Both her mother
and father raised her to be very independent and to thrive in diverse settings. Felicia recalled
experiencing microaggressions from her teachers in middle school which continued once she
reached high school. She also described having microaggressions directed towards her in college,
“it is hard to articulate your experiences without offending someone.” Felicia believed that
establishing a sense of belonging related mostly to how well one is able to adapt.

I engage in code switching, or socially adjusting to the setting that I am in, to try to make
myself more approachable if my friends are not responding to me. Being here is a culture
shock. Being the only Black woman in most of my classes is hard, but I had to learn how to be assertive particularly in group work, while still being approachable.

Felicia was grateful for her advisor and other leaders within administration at the university with whom she has built great rapport. She described one professor as “invested in my success” because he took a genuine interest in her course work. While Felicia did not feel like people actively work to make her feel excluded, she stated:

I felt like I did not belong during the election cycle, or when I was trying to explain the importance of why colleges across the country should change the names of buildings with historical racist ties. The looks I would receive made me think that I clearly don’t belong here.

Felicia felt that she truly found belonging through the sisterhood of her sorority. She recalled a White roommate “giving the other Black roommate a pair of socks with a monkey and the White roommate telling her the monkey looked like her,” she did not allow the negative encounters to influence her ability to persist. She was motivated to persist because of witnessing the success of her dad and her desire to see change on campus. Felicia also wanted to share what it will take to make the campus environment more of a community for all students.

I suggest it is authentically shown what diversity looks like. This will require structural changes as well as increasing the number of Black faculty. I am my own representation because we currently feel deceived instead of represented in our STEM classes.

Harper

I felt lesser than, me being a female and on top of that being Black. When I would speak up in a group, I was not heard. Being the only Black female in a class is hard. My peers
would repeat the same thing I said but because it is coming from them, it is actually heard.

Harper is a first generation college student. She is a senior majoring in Computer Science. Harper described her family as “having very limited education.” Harper’s precollege experience was challenging because she did not feel that she had the resources to be successful academically. Growing up in a remote, small “country” town made access to wi-fi signals impossible. This resulted in Harper having to stay at school late to complete her classwork. Harper felt that arriving at college financially insecure also limited her ability to establish a feeling of belonging.

Imagine arriving on a college campus as a Computer Science major with no computer. I would check out the computer from the library in 48 hour increments every other day and rush to get as much work done as possible. Having to do this was very stressful.

As she advanced through college, she continued to struggle financially and worked a 40-hour-a-week job in order to make ends meet. She viewed her financial situation as her biggest hindrance to persisting. Harper emphasized that despite her financial setbacks, she has never wanted any special treatment. She simply wanted to be treated fairly. Harper credited her love of math and the encouragement from her community to do something positive with her life as motivating factors that made her choose to pursue STEM during her precollege years. Since arriving at the university, Harper relied on her faith in God and her peers in STEM. She noted, “even though my family don’t know anything about college, they would say, we will encourage you.”

Harper is grateful for her Asian professors with whom she has built the best relationships because she felt that they identified with each other through their limitations with their language.
The Asian teachers were the best, they saw themselves as minorities and knew they had difficulty speaking. They also knew my English was not perfect. They were very supportive and reminded me that as long as I did my work, we could overcome my other challenges together.

Harper was also grateful for her community of friends who she met through NSBE and other university programs. To improve feelings of belonging for incoming freshmen, Harper recommended that organizations should be more publicized. She passionately stated, “there should be a collective way to connect all Black women in STEM and allow us to collaborate and share what our needs are.”

**Janet**

My overall perception as a Black female STEM student is that college is a battlefield, and I have been holding my breath for four years and when I graduate, I will breathe again. However, I also feel that I would not survive in the work environment I am going to go into if I did not go to this PWI.

Janet is a senior majoring in Mathematics. She is a first generation college student who developed a love for STEM after a teacher at her predominantly White high school challenged her to provide more than average work and consider STEM activities. Janet also credited the leadership roles she held among her peers as early as middle school as key influencers to her overall confidence. Janet felt that her high school did not properly prepare her for her challenging classes such as Physics. When she wanted to quit, “my parents encouraged me to not give up.” She joined NSBE during her sophomore year and instantly felt a sense of belonging.
The impact of a community of people who look like you and understand you through NSBE is life changing. The peers I met through NSBE made all of the difference to me being successful in this type of campus environment. I am so glad I found them.

Janet felt that “the more faculty that know you, the more likely they will give you grace.” She recommended building relationships with professors even if you are introverted like she initially was. Janet believed that connecting with faculty was essential to getting the help required to be successful. Janet sympathized with the academic advisors who she felt “have too many students, and therefore may provide misinformation because they are overwhelmed.”

She felt that the greatest improvements needed to be made with the campus environment overall to change some longstanding prejudices.

Both times that I have lived on campus, I have been called the n-word while walking on campus by a White student driving by. This campus environment is like no other because during tailgates there is no greater feeling of family. My upbringing and my faith in God remind me that I can still persist despite what is happening around me.

Janet also said that she often envisioned where she wanted to be as an independent, gainfully employed adult and allowed those images to fuel her motivation. She felt there has to be a greater emphasis on accountability, “By encouraging the students to fully understand why they are pursuing their STEM majors. Once they understand their purpose, they are more likely to stick with it. They have to figure this out before they even get to college.”

Kelly

I had a professor who took the time to tell me that I am enough, and I do belong here. He also shared his college experience with me during my freshman year which actually meant everything to me. I will never forget that experience.
Kelly is a senior majoring in Chemistry who was primarily homeschooled but also experienced a predominantly White elementary school and briefly a predominantly Black high school. Raised in a middle class family, Kelly credited her exposure to science outside of the traditional classroom to her mother and her encounter with a successful doctor during her middle school years as her main motivators for pursuing STEM. Kelly considered her time at her predominantly Black high school as a disadvantage:

I made A's in my Chemistry class, but I did not learn anything. My teacher was later fired but arriving to college with limited knowledge was really hard. I had some professors who made me feel like I was not worthy enough to be in the STEM field.

Kelly believed that several of her professors’ main objective was research, and they were therefore not motivated or interested in teaching, which made learning more challenging.

One of my Chemistry professors called my class dumb and told us not to ask questions. He admitted that he did not take the job with the intent to teach, he said teaching terrifies him. He took the job to do research. We can tell when they don’t want to teach us.

On the other hand, Kelly felt that there were caring professors who were passionate about teaching. She credited her Cell Biology professor with motivating her and wanting to see the best in her. This helped restore her love for the field. Kelly also worked to encourage her peers who look like her to not give up.

I try to connect with Black people if I see one in class, so they feel like they have someone who makes them not feel alone. I want to remind them that they do belong here. I have friends who have major anxiety about going to a professor's office hours because they don't want to hear condescending remarks.
Kelly recalled the benefit of having a tutor who looked like her during her first couple of years in college, and she wanted to be that encouraging voice for her Black peers also. Despite overcoming early challenges, she still felt overwhelmed and isolated at times. Kelly’s experience with patronizing comments from her White peers made her feel as if she did not belong. She allowed her faith in God to “help me stay grounded in my purpose.” Kelly felt that not only could college interactions with professors and peers “cause you to lose your passion, it can also make you feel like you will never have a sense of belonging.” She felt that as long as she maintained her faith in God, she could continue to find inspiration to persist.

Kelly described having an academic advisor who “did not realize how rigorous the classes were” and therefore recommended that she take the most difficult classes during her freshman year. Since classes were not better distributed, Kelly described her course work as extremely challenging. As a result, she avoided visiting her academic advisor in the future.

I avoid the academic advisors because they don't understand what STEM students go through. It also doesn’t help that their first response is to tell me to change my major to Business or Criminal Justice. I know I shouldn’t treat them all the same, but having that experience is hard to erase.

To improve retention rates of Black women in STEM, Kelly recommended that faculty complete mandatory diversity training that included a focus on microaggressions—particularly microaggressions directed towards Black females. Kelly also wanted to share advice that she felt should be considered:

Treat everybody like you would want somebody to treat your child. Let professors, advisors, and students know the impact of their words. To improve persistence, offer more open resources for women of color. There are resources, but they are hidden.
Advertise the opportunities better. Not just in-school, opportunities after graduation as well.

**Laura**

As I get higher up in my STEM course work, there are less women in my STEM classes. They need more support in order to persist. Helping them find a sense of belonging is key. There is more that needs to be done to make people who look like me feel like they belong here.

Laura is a junior majoring in Mechanical Engineering. She is a first generation college student who was motivated to pursue a STEM field by her sister who noticed her love for science and math at a very early age. Laura was also introduced to an engineering program through her predominantly White high school which further increased her interest. Upon arriving on campus, Laura used her desire to make her parents proud as motivation to continue to persist. Laura credited her Black female academic advisor with what she described as “playing a huge role on assisting and sharing resources with me.” Laura was also grateful for her involvement in NSBE which has made her establish a sense of belonging “because of the community of liked-minded peers.”

While she felt that she had been treated fairly by her professors, Laura became discouraged by the low number of Black females in her classes. Laura described the campus environment as positive and “what you make of it.” She has grown as a leader through her involvement in NSBE, her sorority, and other service organizations on campus. Although she described her early journey in college as challenging, she acknowledged her faith in God as the main contributor to her success and persistence in STEM. Laura said, “I know I am going to make it because I read my Bible every day and I talk to my family every day for
encouragement.” She was hopeful that more resources would be made available to encourage Black females to persist in STEM and “not give up when they reach their upper level classes.”

Lisa

It is hard to find someone to collaborate with in class because there is no one there like me, and I feel I can’t relate to anyone. I am grateful for my friends in other majors outside of STEM who want to build relationships and make me feel like I belong.

Lisa is a sophomore majoring in Chemical Engineering. A product of a two-parent, middle class family, she felt that her predominantly Black high school did not do enough to adequately prepare her for the rigor of college. The all-Black STEM program she was exposed to in high school motivated her to want to “prove” herself at a PWI.

Students were encouraged as early as middle school to consider attending a HBCU, and it was often described as the only option or opportunity to thrive in a college setting. I wanted to show that I could make it, even if I was at a PWI.

Lisa felt like she discovered her feeling of belonging through NSBE which served as a community of support that embraced her as she was. “Seeing students who looked like me made me want to persist.” Additionally, the companies and Black leaders that she was introduced to through NSBE were encouraging and a motivator of her persistence. Lisa said she did not have any relationships with the faculty because “I don’t feel like they know me or want to know me.” On the other hand, her experience with her academic advisor has been very encouraging and she appreciated the guidance and candor of her advisor. Consequently, Lisa strongly felt that the stipulations surrounding Covid-19 had negatively influenced her interactions with her advisor.

Lisa described the campus environment as “intimidating”, and she felt as if she was excluded in class on a regular basis by her peers. On a journey to belonging, Lisa also described
her experience with attempting to join a few predominantly White women societies on campus; however, she never felt included and therefore did not remain a part of these organizations.

While college has been challenging so far, Lisa was confident that she would continue to persist.

I stay motivated by looking at the big picture. I also keep in mind the type of life that I want to live. This experience has been hard but will be very worth it in the end. I allow these things to keep me motivated, especially when I want to give up.

Lisa felt that improvements could be made by “starting a group just for Black women in STEM”. This would allow students to all come together. Lisa also wanted the school’s student ambassadors to be more reflective of the diversity on campus.

Mary

I have friends outside my major who have helped me establish a sense of belonging. It would be great to have connections within the STEM pathway. The challenge is figuring out how to connect with them and remain connected once I find them.

Mary is a freshman majoring in Aerospace Engineering. After attending a predominantly Black high school, Mary was motivated to come to a PWI “to prove to myself that I could be successful here.” She suggested that she did not have adequate resources or opportunities in high school and received confirmation of that after arriving at college. From a very early age, Mary was motivated to pursue her STEM major due to her love for the National Aeronautics and Space Administration (NASA). She credited her self-determination as the key to her perseverance before and during college. Mary considered college as a necessary requirement to live the life she desired. She summarized college, “it is just about getting in and getting out.” While not deliberately seeking to make friends, she was able to create relationships through student
organizations outside of her major. This made her feel a part of the campus community, despite the overwhelming feeling of unpreparedness she initially felt.

Mary described her interactions with her professors as frustrating:

My professors have been making broken promises to get back to me and they have been brushing me off. I feel like they don’t want to help me when I reach out and ask questions. If they respond, it is the bare minimum short answer response.

Mary insinuated that her race was the reason for these types of responses. Conversely, Mary considered her advisors to be helpful; however, she was still trying to determine the extent of their role.

Mary thought that her peers, especially those within the classroom, hindered her sense of belonging, and often undermined her efforts. She also felt that group assignments were particularly challenging.

It took me three days to find a partner for my class of over 100 because everyone would say they are already in a group. I believe it was because they did not want to work with me. It felt like it took forever to find someone who was willing to be in my group.

To remedy this type of exchange, Mary recommended more required classroom interactions to give students the opportunity to get to know each other better. She also suggested that professors assign groups more often in an effort to prevent students like her from feeling left out.

Mary relied on self-motivation, which she credited with her success in persisting prior to attending college. She also reflected on the importance of keeping the big picture in mind and considering the success she would like to have after graduation.
Monica

I often witnessed my professors giving more details regarding homework to my White counterparts. Also, I have often been told to just study harder instead of given specifics on how to improve. I failed a class as a result of this type of response.

Monica is a senior majoring in Mathematics. Raised by highly educated middle class parents, she was encouraged at a very young age to persevere. She always wanted to be a teacher and she chose math because “I did not like the rest of my subjects.” After arriving on campus, Monica battled feelings of isolation, which she overcame through experiences with a local church. Monica has not engaged in any activities as a STEM student. She was grateful to the professors who engaged with her and demonstrated a genuine interest in her success. Monica admitted that she did not trust her advisor after a negative experience with her professor and relied on the automated system to complete her course schedule.

Monica believed that her peers had stereotypical views and prejudices:

They don’t expect me to know much. They belittle me. They are more willing to do all of the work on their own than allow my input because they don’t trust my answers. This has been an ongoing experience no matter what the course is.

She described the campus environment as “hostile” and “unwelcoming,” and she said she became content with being looked at a certain way “not only because I am a STEM major but also because I am a Math major.” Monica had an image of what belonging would look like; however, she was confident that she has never achieved a sense of belonging and she has also never felt like she was a part of the campus community. Despite these feelings, which have challenged her mental health, she chose to stay motivated by relying on her faith in God and keeping the end goal in mind. Monica is hopeful that experiences for Black women in STEM
will improve if faculty receive diversity training that includes better understanding and communication with students. She felt that if professors received training, her peers would also be more accepting of students who do not look like them.

**Myra**

In order for me to have a feeling of belonging there needs to be a group beyond NSBE. Black female STEM students need their own group. A STEM group like this would be a great way for us to connect. We are the ones who sometimes end up without an area where we feel like we belong.

Myra is a sophomore majoring in Aerospace Engineering. Raised by a single parent, Myra considered herself a very sociable person who easily made connections with her peers at a very early age. She credited her experience at a predominantly White high school with preparing her for this experience at a PWI. While Myra knew that college had been a social challenge for many of her Black peers, it was not a “culture shock” for her. Prior to college, she relied on her self-motivation to persist and deliberately surrounded herself with peers who shared her goals. This was a habit that she continued in college.

Myra vividly described the experience of tailgating and how it surprisingly gave her an overwhelming feeling of belonging.

Seeing the fraternities, sororities, and other groups set up and having a good time, all excited about a common theme, football, made me feel like I belong here. When I walk around during tailgates, I don’t feel like I am being judged or isolated, it is just a large group of people having a good stress-free time.

Myra also enjoyed her interactions with NSBE and felt empowered by uniting with students who looked like her and shared the same path.
Myra felt that she had to present herself during her advising appointments with a certain level of confidence in order to be taken seriously. She candidly stated, “otherwise, they (advisors) will recommend other majors to me like Marketing or Nursing.” She also believed that her classroom experiences could be improved. Myra explained, “my peers speak over me and restate what I said, then it suddenly becomes correct.” While she desired more respect from her peers and professors, she also preferred to not get involved in any other activities on campus. She declared, “I don’t want to be hurt again.”

Myra described her self-confidence as the source of her strength and motivation. She felt that it developed while she was in middle school and has flourished over the years to her benefit. Myra also strongly believed that personifying the strong Black woman cultural construct was a necessity.

I stay motivated because I know who I am. Even if you have the lowest self-esteem on the planet, you have to fake it because you have to appear as confident as possible. Appearing weak in a STEM setting is not an option as a Black woman. They (other students) will use it against you.

Myra recognized that this type of logic is a hindrance in the long run but believed that the short-term benefits of temporary acceptance outweighed the harm.

Nicole

For labs, you are guaranteed to be the one Black female alone in the class. Everyone will flock away from you. People are not going to want to work with you. You will grow from that. My constant thought is that it is not right, but it’s real.

Nicole is a senior majoring in Mathematics. She had always attended predominantly White schools prior to college and her parents wanted that to continue for college as well. While
Nicole’s parents did not attend college, she credited them with motivating her to pursue higher education. Nicole initially preferred attending an HBCU but was grateful that she came to this PWI instead. She has had a genuine love for mathematics from a very early age and knew that this would be her future path. Nicole said that she felt comfortable arriving on campus. She explained, “touring this campus made me feel that I am back in high school again when considering the students.”

Nicole decided that she would establish a feeling of belonging by getting involved in several different student organizations on campus. When she met students in her major, it was very beneficial to her, and she felt that belonging was more critical as she progressed through college. She rationalized, “forming a study group of peers in my major made all of the difference for me.” She further explained:

Freshman year can give a false sense of what college will be like, we really need support in higher level courses. Having a community that you can identify with makes you not question if you belong, and that should be found early.

Nicole also described the challenges faced at her job on campus. She hesitantly stated, “it doesn’t mean I am angry simply because I am not smiling all of the time.” While she said that she expected some of her experiences to “come with the territory,” she was shocked by her interactions while working as a student. She credited those experiences at work with helping her maneuver through other aspects of her campus experience particularly with faculty.

Again, it is not right, but it is real. I reach out to my professors constantly to build rapport. I don't want any assumptions to alter the way I am taught. As a result, I feel like I have less problems with the professors than the students.
Nicole did not believe that her interactions with her academic advisors contributed to or hindered her success “because they change every year.” She also described an experience that made her not want to meet with her advisor in person anymore.

I noticed advisors talking about a student who could not pass math. I did not feel that was appropriate to discuss this in an area where other students could hear it. After that, I did not want to meet with them after hearing them tearing down a student.

As Nicole advanced through college, she credited her internships for solidifying her confidence in her major. She explained, “even if you are the only Black female in the room, it makes you feel validated in what you are doing.” Interning also allowed Nicole to focus on the bigger picture of the future salary she hoped to one day make. Nicole felt that a sense of belonging for Black women in STEM could be established by providing more representation of Black women who had been successful in STEM. She concluded, “I am confident there are so many women on this campus that could be highlighted to motivate us.” She expressed a desire for professors to take a more active role in class project assignments by appointing the groups to prevent uncomfortable moments, particularly for Black females. Nicole also noted, “talking to you in this interview has felt so great to have someone hear me and see me.”

Pam

This interview is exciting because it shines a light on Black women in STEM and I think most people assume we are all doing just fine, but that is not always the case. I know that most of the time we may look like everything is okay but it is not.

Pam is a senior majoring in Environmental Science. Raised in a two-parent home, Pam experienced both public and private school education. Growing up in a diverse area and attending a predominantly White high school, her parents instilled her with determination and
self-worth. Pam’s parents also made her aware that they would always provide her with the necessary tools to be successful. Pam considered herself to be self-motivated and credited her teachers with recognizing her passion for environmental science and the planet in middle school.

All of my teachers saw something in me whether I was at a public middle school or a private high school. They made sure I had all the resources I needed. My major is a calling. I have an end goal of saving the environment and ensuring clean drinking water.

Pam credited her feeling of belonging to her peers who are like-minded Black women in STEM. She stated, “Once I found my group that is on the same level as I am, I felt like I belonged.” She felt that it was important to have peers that she could share her true feelings and emotions with, absent of any judgment. Additionally, Pam speculated that the belief system of her professors has resulted in her strong connection with them. Her professors had recommended internships and job opportunities and she believes that this was a result of them realizing that she was serious about her major and her mission to succeed.

Pam’s overall perception of college was that the majority of faculty, including advisors, wanted students to be successful, and she deliberately placed her energy on the positive. She was also grateful for her precollege experiences which taught her how to navigate predominantly White spaces. She reflected, “even though I encountered some negative experiences, I would rather focus on the positive.” Pam remains motivated to continue her academic pursuit by seeking out stories of other successful Black women in STEM. She also purposefully used motivational quotes to keep herself uplifted.

I would not trade my experience here for the world, despite the struggles and trials because anything in life worth having is not going to come easy. I think when we as Black females in STEM accept that fact, we are able to push through.
Pam highlighted the significance of her self-motivation as a positive force that has contributed to her persistence. She was confident that additional minority representation within the STEM faculty and advisors along with diversity training that focused specifically on subliminal stereotypes directed towards Black women would drastically improve conditions.

I know students who started in Biology or Chemistry, but they did not have the support, so they changed their majors. I know that we can overcome this. Changing majors is not always the best option even though it may temporarily feel that way.

Stacey

Even though the pandemic has made it hard, I stay motivated to persevere through my college experience by thinking about the fact that when I am done, I will be free to do what I want. The big picture for me is the only thing I focus on.

Stacey is a freshman majoring in Computer Science. She attended predominantly White public and private high schools and felt that the exposure helped to shape her perception of what a PWI would be like. Stacey has several family members with STEM backgrounds and gained inspiration particularly from those who have a background in engineering. She credited her high school teacher from a private school for encouraging her to pursue STEM. Stacey also developed an admiration for coding through video games at a very early age.

Upon arriving on campus, Stacey relied on her involvement in non-STEM-related clubs to establish a sense of belonging. She allowed her interest in other extracurricular activities to help her connect with other students who did not look like her. She has had positive interactions with her professors and academic advisors.
My academic advisor cares about my decisions and I feel like she has contributed to my success so far. I can tell that she looks beyond my race and treats me just like any other student. I am very grateful for the way that she treats me.

Stacey has also had encouraging and positive interactions with her peers both in person and on their GroupMe app where they interact and discuss course work. While she saw the campus environment as welcoming, she did not feel that she was well represented in university programming and hoped that more will be done “to show greater representation of Black women in STEM in campus communications.”

Tammy

I had no feeling of belonging in middle or high school. They were predominantly White spaces. I was not considered Black enough by my few Black friends and rejected by my White peers. I was called "Oreo," and the name calling came from both sides.

Tammy is a senior majoring in Aerospace Engineering who learned to persist in STEM from a very early age through witnessing the success of her father who was an engineer. Tammy shared that her therapy sessions helped with her motivation and decreased her habit of procrastination once she arrived at college. She also disclosed that her anxiety has hindered her ability to connect with people; however, she still took advantage of the opportunity to join groups that would create the space to meet people outside of the classroom.

Tammy described how her professors have been particularly helpful to her as she navigated her way through college:

Talking to the faculty during their office hours helped me a lot. Sometimes it is intimidating to ask in class. They take the time to help me during their office hours.

I have found international people of color to be most helpful.
Tammy also felt that her academic advisor has been very resourceful. She explained, “she made me feel like I was not bothersome.” Despite her positive interactions with faculty, Tammy felt like she did not belong because she has not been able to successfully connect with her peers.

I don’t think I will ever have a sense of belonging on this campus. It’s like high school just carried over to college. I don’t even try anymore to connect with my peers. The last time I considered a girl a friend here, she told me she already had friends.

Tammy said she became comfortable with the feeling of exclusion in her classes. She also described the campus environment as intimidating and is excited about “the thought of leaving and beginning my life.” Tammy described her ability to persist as challenging but was confident that more Black female students would feel like they belong if there were more networking opportunities among peers and greater diversity among the faculty, particularly recruiting people from more diverse backgrounds.

**Tasha**

It is really intimidating when you don't see an example out there that looks like you.

After I created a study group, it gave other students confidence and they started changing their majors to STEM. We all started to develop a sense of belonging.

Tasha is a freshman majoring in Biology. Raised by a single mother, Tasha attributed her interest in STEM to her mother who always made sure she was exposed to STEM opportunities. She also described her Black science teacher as well as her high school internships as motivating factors. After arriving on the campus of a PWI, Tasha utilized her knowledge from her diverse high school experience to help her build relationships. She became involved in a living and learning community and stated, “Although it is not just for STEM majors, it is great to connect
with girls who look like me.” Tasha also met other STEM majors through this community and considered the relationships essential to her persistence.

The perception is that STEM is extremely hard. There were two Black students in my Chemistry class and they both dropped out. All of the White students knew each other or were in sorority together. Also, not seeing many Black doctors made me question what makes me so special that I will get through this.

Conversely, when others acknowledged her academic trajectory and did not question or prematurely judge her capabilities, she felt that she was exactly where she needed to be. Tasha considered her involvement with several organizations on campus, including opportunities to mentor other Black female STEM as essential to her feeling of belonging.

Additionally, Tasha described taking the initiative to get to know her professors which has resulted in her building rapport with them. Based on her interactions with her Black friends, she felt that connecting with academic advisors has been a challenge. She felt that two elements have to be present for there to be success with academic advisors, “relatability and comfortability.” Tasha was confident that she possessed both of these qualities in her partnership with her advisor and therefore has had a great relationship.

Tasha’s overall perception of campus was that it was intimidating. She described it in these terms because she believed that the mixed, diverse student body at her high school did not prepare her for a PWI. She also said, “I am afraid to bring up certain topics in class.” Tasha acknowledged the large White sorority presence on campus which she felt was a significant part of the culture that hindered her ability to connect with her White peers in the classroom due to their existing relationships that began outside of class. While she felt excluded when she considered the connections that sorority members had, she did not allow it to negatively
influence her overall feeling of belonging. Tasha relied on her faith, which was strengthened through a local church and the encouragement from her mom to positively influence her persistence. Tasha thought that more should be done to connect students with similar majors. She was confident that these connections would positively contribute to incoming Black female STEM students’ sense of belonging.

I wish administration would make it easier to connect with people in my major.

Encouraging study buddies, or social days ’specially for Black females in STEM would be helpful. I found my own sense of belonging by being heavily involved.

Tina

We, as Black females in STEM, lack a network and the way they clique up makes you feel even more alone. It is a lonely experience; you have to have internal motivation. Also, I got lucky my freshman year and met a friend who was with me for three years. Peers definitely add to belonging.

Tina is a junior majoring in Environmental Science on the Pre-Med track. Tina’s passion for STEM began in middle school. She believes that it grew as she was exposed to several different predominantly White educational settings. She became accustomed to relocating and attending different schools frequently and recognized the advantage of easily adapting to different environments. She also saw the disadvantage of a lack of consistent structure. She credited her structured upbringing and the discipline her parents established at an early age for her persistence in STEM prior arriving to college.

After beginning college, Tina developed an appreciation for her internal strength and self-motivation that drove her persistence. She stated, “realizing the value of my self-motivation, I found my own group of friends my freshman year.” She considered her interactions with her
professors as beneficial and credited being one of the few Black students as an advantage because she believed that she was more likely to be remembered. Tina had mixed experiences with her academic advisors.

The pre-med advising department is really weak. You kind of take classes and hope for the best. On the other hand, my Environmental Science advisor is amazing. She provides critical, necessary feedback. I wish there was more consistency with advising.

Tina described the campus environment as being dominated by Greek life. She rationalized, “they form groups at events so socially they already know each other before even arriving in the classroom.” Seeing the camaraderie among the sorority sisters further motivated her to seek out her own sense of belonging and rely on her self-motivation. Tina felt her natural drive to be successful has not only benefited her throughout her academic career, but she was also confident that it will benefit her once she reached the workforce where she expects the setting to mirror the PWI.

Tina felt that improvements should be made in order to better support Black women in STEM as they work to establish their sense of belonging. She noted:

We need more Black faculty, Black tutors, and Black staff in general. I don’t feel well represented. I also don’t like seeing the one token Black person. There are times I want to engage in campus activities, but I also don’t like being the sore thumb that is sticking out.

Tonya

I joined other organizations outside of STEM to meet new people and see where I belong. I have to join other organizations like NSBE and other groups to meet people who look like me because I am usually the only Black female in the classroom.
Tonya is a junior majoring in Chemical Engineering. Raised by two highly educated parents who always wanted the best for her in terms of her educational aspirations, she used their success as a motivator. Tonya’s interest in engineering began in elementary school after her parents enrolled her in STEM camp. This interest persisted once she reached middle school where she continued to seek out STEM camps. Attending a predominantly White high school came with its challenges. She explained, “I was treated differently and often overlooked but I was very independent, so I decided to pursue my own interests.”

Upon arriving at college, Tonya considered her academic advisor to be very encouraging and she felt that she was provided with the necessary information and resources to be successful. Tonya reflected, “it is easy to schedule and meet with her. I also feel like she understands me because she is a Black female with a STEM degree.” Conversely, Tonya described her experience with some of her professors as problematic. She disclosed that she had to seek out mental health support, however, her professor was not empathetic towards her despite being provided documentation. Tonya believed he was there simply to fulfill the minimum job requirements.

Tonya described some negative interactions with her peers but also felt that some students were really enjoying college. She explained, “It just depends on the circles that you are in.” She has decided to not focus heavily on peer interactions within her major in order to feel like she belongs. Tonya relied on envisioning the future she wanted to have in the long run to help her navigate through what she considered to be a temporary time.

While Tonya felt that she was represented in programming activities, she also felt that Black students need access to the same resources and job opportunities as the rest of the students. According to Tonya, “this would feel like a fairer place for all of us to belong.”
Chapter Summary

The purpose of this chapter was to introduce the reader to the 23 Black female STEM students who participated in this study. All of the students displayed pride in being a Black female in STEM. There were also various commonalities shared among the participants. As indicated in Table 4, 70% of students attended predominantly White high schools. These students shared how being exposed to that type of setting gave them an indication of what to expect at a PWI. However, despite their precollege experiences, only 48% of students felt that they were prepared both socially and academically to attend a PWI.

The majority of students were products of two parent, middle class households. Their interest in STEM began as early as middle school, and their parents were a key element of their persistence, regardless of whether their parents attended college or not. Additionally, the majority of students relied on their involvement with groups, such as NSBE or groups outside of STEM, to assist them with establishing a sense of belonging. Their reasons for persisting mainly consisted of their faith in God, family encouragement, considerations for future success, and self-motivation.

Experiences with faculty, both as professors and academic advisors, varied. Some students felt that their interactions with faculty positively contributed to their feelings of belonging, while others acknowledged potential hindrances from their experiences. Likewise, the experience with peers also varied. Based on responses, students who were in their junior and senior years cared less about gaining the approval of their peers. The majority of students also took advantage of other opportunities outside of the classroom to make connections. In describing their experiences, students shared feelings of isolation in the classroom, both as a minority and of being overlooked.
While student had unique experiences, with both positive and negative occurrences, they made it clear during their interviews that they would not trade their experiences because it is preparation for the workforce. Chapter 5 will discuss the findings of this study. Four themes emerged, with associated findings, as having played a significant role in students establishing a sense of belonging: decision to pursue a STEM major, method to thrive, big picture mentality, and simply surviving. Each theme will be discussed in depth, illustrating the relationship with the research questions, and will be presented within the anti-deficit achievement framework informed by CRF, which guided this study.
CHAPTER 5

FINDINGS

This chapter will present the findings from this research study. Findings were derived from basic qualitative research which produced four different themes related to the primary research questions guiding this study: (a) How do Black undergraduate women describe the early influences regarding people, places, and experiences that influence their early interest in STEM majors? (b) How do Black undergraduate women describe their sense of belonging at a PWI? (c) How do Black undergraduate women majoring in STEM cope or persist at a PWI? and (d) How do Black undergraduate women describe their experiences with faculty, academic advisors and peers that cultivate their sense of belonging in a STEM major at a PWI? Utilizing the anti-deficit achievement framework to frame the questions allowed the discovery of how some Black females have managed to be successful in their pursuit of STEM majors.

As illustrated in Table 5, the themes that emerged from this study are: decision to pursue a STEM major, method to thrive, big picture mentality, and simply thriving. Themes are presented in the context of the research questions and include corresponding findings. Findings are connected to the themes that demonstrate participant experiences. Additionally, the questions were framed utilizing an anti-deficit achievement framework approach which allowed them to provide counternarratives that related to their resiliency and persistence in their respective STEM major. The table also displays the participants’ perspective through the lens of the CRF framework.
### Table 5

**Emerging Themes with Research Questions and Corresponding Findings**

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<td>1. How do Black undergraduate women describe the early influences regarding people, places, and experiences that influence their early interest in STEM majors?</td>
<td>Decision to Pursue a STEM major</td>
<td>Understanding the “Why” Exposure to STEM Parents’ Influence</td>
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<td>2. How do Black undergraduate women describe their sense of belonging at a PWI?</td>
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<td>4. How do Black undergraduate women describe their experiences with faculty, academic advisors and peers that cultivate their sense of belonging in a STEM major at a PWI?</td>
<td>Simply Surviving</td>
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### Decision to Pursue a STEM Major

Participants were eager to share what led to their decision to pursue a STEM major. They each also seemed to share fond memories of how their interest first began. All participants credited early influences that took place prior to college for stimulating their interest in STEM. Beyond selecting their majors as early as middle school, many also felt it was very important to understand why they had chosen this major. The “Why” served as a motivator as they persisted...
Once arriving to college. Another common finding regarding their decision was the amount of exposure students had to STEM course work at very young ages. This exposure came in many forms including camps, teacher recommendations for class work, college visits, and meeting other professionals of color in the STEM field. The final and most widely described influences that contributed to their interest in STEM were their parents. There were 57% of participants attributed their early interest in STEM to the influence of their parents. Influence came in several forms and primarily evolved around their parents’ recognition of their initial interest or curiosity for the subject. While parents who were working in the STEM field had a direct influence, parents who also did not have any college experience encouraged participants to pursue it.

Consistent with CRF theory that Black women’s experiences are different from White women and men of color, several of the participants described being marginalized in their middle and high school classrooms and within their predominantly White communities. This marginalization manifest through microaggressions, stereotypical labels, and racial biases. They experienced disadvantages in their classrooms prior to college mainly because they were identified as loud, overly aggressive, and more mature than their age. These descriptors are also consistent with the literature findings.

Understanding the “Why”

Janet recalled an early experience with a faculty member who came to a college fair at her high school:

As a sophomore I went by the university’s table and declared to the faculty person standing there that I wanted to be a Chemical Engineer. Without hesitation, he asked me why I chose that major. I could not answer him. He told me to go back and figure out
why then come to see him the following year because that “why” would be my reason to persist once I reached college.

Janet expressed how profound that conversation was for her and the impact that the faculty member had on her. She took his advice and spent time while still in high school deciding why she wanted to pursue the major she had chosen. Like Janet, several other students described the importance of understanding why they were pursuing their majors. For them, this is particularly important during challenging times when a sense of motivation is needed. For instance, Betty relied on a negative experience that her mother had when she was very young as a motivator when she felt like giving up because classes were too difficult. She recalled:

I think about my mother’s experience of when her illness was not considered as severe as it was, and how I almost lost her. I have to allow this early influence to drive my interest because we need more people in this field of study that look like me.

Additionally, Pam described how she understood her “why” at a very early age and recalled pointing out to her family members the importance of recycling and engaging in other initiatives to save the planet. The desire to make these changes has grown significantly as she has progressed through college, and she has used these aspirations as motivators for her persistence. For students who described the importance of understanding their “why,” they all shared the understanding that the reason was greater than them and significant enough to sustain their persistence throughout college.

**Exposure to STEM**

Several participants attributed their decision to pursue a STEM major to their exposure to STEM in middle school in the form of STEM camps and extracurricular STEM clubs. Additionally, they credited advanced placement STEM course work coupled with motivation
from teachers, early college course work, and interactions with successful Blacks in the profession for their decision to continue their pursuit of STEM once they reached high school. Consequently, middle and high school teachers who had degrees in STEM particularly ignited the interest of several participants. As Tasha, a Biology major, described:

   My Biology class, which included travel outside of the country, opened my mind to a world of possibilities. I am grateful to my Black high school science teacher who pushed me to expose myself to opportunities, and once I did, I fell in love with the field.

   STEM camps were beneficial to participants who felt that they needed exposure beyond the classroom to learn more about the field in order to make an informed decision about their future academic trajectories. As Eve, a Mechanical Engineering major, explained:

   Although I was homeschooled, my mother made sure that she exposed me to science and engineering camps as early as middle school. Once she recognized my interest to learn more about them, she continued that exposure through high school which made all of the difference for me.

Participants also took advantage of opportunities to join STEM-related extracurricular clubs to connect with other students with similar interests and to discover the ways in which STEM could be fun. Stacey, a Computer Science major, highlighted the awareness of her teachers who recognized what interested her and how their efforts motivated her.

   I would seek out coding and science clubs, and my 9th and 10th grade teachers at the private school that I was attending realized my love for it and made me aware of opportunities and encouraged me to stick with it. Their encouragement meant everything.
Furthermore, being in the advanced placement classes introduced participants to high achieving peers and gave them the courage to consider STEM. As Delora, a Mechanical Engineering major, described:

Even though I was the only Black female in my computer science classes in high school, I was not intimidated because I was more interested in learning to code. I also knew that being in these classes would help me once I reached college.

Claire, a Chemistry major, emphasized the difference that her advanced placement Chemistry class made, and she also explained that the more she learned, the more she realized that it was necessary to have more people that looked like her in this field of study. For Anna, an Architectural Engineering major, having an advanced placement calculus teacher who was also an Aerospace Engineer and willing to share his experiences, helped her to envision future possibilities.

Moreover, having the opportunity to take college courses while in high school allowed some participants to be exposed to STEM course work at the college level and solidified their interest in it. Lisa, a Chemical Engineering major, drew parallels in the enhancement of her study and time management skills as a result of her early college course work, “the focus of my high school’s college exposure to STEM was the promotion of HBCUs; however, I wanted to prove to myself that I could be successful at a PWI.”

The decision to pursue a STEM major was also fueled by exposure to successful Blacks in the profession. This exposure made some participants feel that they could accomplish the same level of success or greater. As Kelly, a Chemistry major described:

After my immediate family’s experience with healthcare, I knew that I wanted to become a doctor. However, it wasn’t until I had the opportunity to meet a successful Black
doctor in high school and he shared his experience with me that I knew that I could achieve this goal.

As revealed in the next section, some participants did not have to look far for inspiration because the successful Black professionals in STEM were in their respective families.

**Parents’ Influence**

Whether they attended college or not, several parents had a profound influence on some participants and greatly influenced their early interests, leading to their decision to pursue STEM. As Denise described, having a father who was an Electrical Engineer was beneficial because she had the opportunity to see the application of STEM skills by visiting him at work from a very early age. Additionally, participants like Eve had a parent who was an alumnus of a PWI. Consequently, the importance of her pursuing STEM, despite being the minority, was heavily reinforced. Delora noted that the success of her mother as a Computer Science major also influenced her interest in the field while in high school. Hearing about her mother’s experience also motivated Delora to create a program that would benefit other Black female STEM students with an interest in coding.

Similarly, parents who had no prior college experience positively influenced students’ early interest in STEM. As a first generation college student, Harper was influenced by the encouragement of her mother despite having very limited resources and access.

She did not initially suggest Computer Science for me because she did not understand it. Once she realized that I was interested in it in high school, she encouraged me and allowed me to take the necessary steps to gain the knowledge I needed, including staying late in the afternoons because we did not have wi-fi at home.
As Monica, a Mathematics major, expressed, having both parents with master’s degrees increased the likelihood that she would attend college; however, they also encouraged her to sincerely pursue her own interest at an early age. Nicole, an Aerospace Engineering major, had parents who did not attend college; however, the knowledge her father gained from trade school greatly influenced her pursuit of STEM beginning in middle school.

The support and influence of parents came in different forms based on parents’ own experiences as well as the tools they felt were necessary for their children to thrive. While Felicia had the support of her father who was a Mechanical Engineer to guide her interest in Environmental Science, she credited her mother for raising her to be independent as the source of her early interest in STEM. Participants like Tina, an Environmental Science major, credited the structure and discipline her mother established at a very early age for allowing her to successfully manage her time and seek out opportunities in STEM prior to college.

Having all of the resources at her disposal, Pam, an Environmental Science major, recognized the significant influence of her parents during her early years. She was confident that she would not have pursued STEM without their encouragement. For Christy, a first generation college student coming from a predominantly Black high school, she recognized the disadvantages of the low-performing school; however, her mother helped her strategize ways to learn coding on her own in order to be successful as a Computer Science major once she entered college.

Participants who had to relocate often as a result of their parents changing jobs or military obligations were particularly resilient and felt confident in their decision to pursue STEM. These participants were not intimidated by changing to predominantly White classroom
settings. Once the decision was made to pursue a STEM major, the next theme that emerged from the interviews was the method utilized to thrive.

**Method to Thrive**

Germane to the research question of how Black undergraduate women describe their sense of belonging was the emerging theme of method to thrive. Findings associated with this theme included faith in God; belonging through association with peers, clubs, and groups; and the ways in which family influences everything. Despite the challenges and obstacles experienced by some participants, the majority of them successfully derived a method that allowed them to thrive, which contributed to their sense of belonging.

From the perspective of the CRF lens, the method to thrive was rooted in methodical teaching from family members on effective ways to combat racism and oppression both inside and outside of the classroom setting. These lessons began with the encouragement of their acceptance of their identity as Black women in a minority position. Several participants described their family members sharing their negative experiences, inequalities, and feelings of inferiority because of their race and gender when pursuing their degrees. Recalling blatant acts of racism and sexism that their family members experienced served as a defense mechanism and allowed them to develop a method to effectively thrive.

**Faith in God**

As illustrated in Table 4, 39% of participants indicated that their faith in God contributed to their sense of belonging and ultimately resulted in their reason for persisting. Participants considered their faith as a guiding source of strength and motivation to persevere regardless of what may have been perceived as an insurmountable goal. Several participants recognized the value of prayer, attending a local church, reading their Bible, and listening to Christian
broadcasts in order to maintain their faith, which they felt was paramount to their success. The participants’ sentiment aligned with this biblical scripture:

To have faith is to be sure of the things we hope for, to be certain of the things we cannot see. It was by their faith that people of ancient times won God’s approval.

Hebrews 11:1-2 Good News Translation (GNT)

While experiences varied, the common theme of faith as a spiritual force that transcends all social and academic issues was consistent among students. For Laura, a Mechanical Engineering major, reading her Bible daily was necessary to strengthen her faith in God. She felt it has become more essential as she continued to progress through college. Also, as a first generation college student, she was driven by the desire to make her parents proud and decided to rely on the values they instilled in her at a very early age.

Similarly, Kelly is active in her faith and made deliberate efforts to strengthen her faith on a daily basis by listening to inspirational music and broadcasts. She believed that her faith allows her to remain grounded in her purpose while blocking out distractions. Additionally, Harper, who arrived at college feeling disadvantaged due to limited resources, believed that her faith has grown exponentially during her time in college. Since Monica felt like she was never a part of the campus community, she credited her faith in God for sustaining her and allowing her to reach her senior year. She chose to rely on the academic success of her parents as motivation then placed her trust in God that she would also succeed. For Christy, it was simple:

Coming from the high school that I attended, I knew that I had to rely on something greater than myself to get me through this college experience. I stay in God’s word, reading scriptures, and praying. I am confident that is how I have persevered.
Janet, a senior Mathematics major, believed that the Christian foundation that her parents established for her at a very early age carried over into her college experience. She was able to gain inspiration through those early experiences to remind her that she did not have to change who she was in order to belong. Janet felt that it was up to her to establish her own feeling of belonging which contributed to her persistence and her faith would be the catalyst for this. In addition to faith, many participants relied on their association with their roommates, clubs, and campus organizations in order to establish a feeling of belonging.

**Belonging through Association**

One method to successfully thrive for some participants was derived from their association with their peers through living arrangements, extracurricular clubs, or student organizations that catered specifically to Black females in STEM. For participants with engineering majors, regardless of the specific area, NSBE was the student organization that was the main source of belonging. NSBE has been described as a safe haven where participants can connect with other students who look like them and share similar majors. It has also been described as an organization equipped with resources to foster academic and career development through student engagement with Black professionals active in the workforce through conferences, career fairs, and seminars.

For majors outside of engineering, participants relied on their connections through other student organizations including student unions, student government, first year experience groups, sororities, and first generation programs to establish a sense of belonging. No one group was referenced as a source for guidance and connection. Betty, a Biology major, considered herself “lucky” because she was able to establish belonging through her roommates who are STEM majors. Felicia and Kelly relied on the sisterly bonds that developed through their sororities to
help them feel like they belonged and could make a difference on campus. Some participants, like Tina, sought out their own group of friends when they arrived on campus; however, these friends were not STEM majors which made it difficult to share experiences. Claire described her experience at tailgates as a unifying connection that gave her an overwhelming feeling of belonging since there was an absence of judgment or isolation and everyone was in this festive environment for a common reason. Additionally, participants such as Pam and Janet, who considered themselves to be self-motivated, still recognized the value in connecting with like-minded peers in order to establish a feeling of belonging. Participants who relied on their connections with their roommates also sought out other opportunities to belong by working as resident assistants and joining other clubs that allowed space to meet and make connections. While these associations were valuable, the feelings instilled by family including parents, siblings, uncles, and aunts, served as successful methods that participants utilized to thrive while in college.

**Family over Everything**

Participant families restored confidence, encouraged, inspired, and motivated participants to persist and do what was necessary to establish a feeling of belonging in order to successfully thrive. Since Denise’s mother did not complete her college journey, she was keenly aware of the challenges that Denise would face and worked to ensure that she did not make the same mistakes. Denise recalled her mother explaining to her the importance of establishing a feeling of belonging and surrounding herself with like-minded peers in order to thrive. Additionally, Delora described watching her mother be successful in her career as a Computer Scientist and in their home life while being a single parent. This example reminded her of the tenacity and resolve she had to display in order to thrive in college.
The support of parents was undeniable, however, there were other key family members who encouraged several participants to seek out belonging and thrive. Tonya, a Chemical Engineering major, utilized the academic success of both her parents as motivation to attend college, but it was the success of her uncle as an engineer that ignited her desire to persist. In addition to her mother, Eve’s sister was also an alumnus of the university she was attending. Eve relied on her sister’s insight and advice more heavily when it came to building relationships on campus. Kelly used an image of her grandmother suffering from Alzheimer’s disease as motivation to thrive, and she valued her connections for contributing to her belonging on campus. Claire credited her godmother who was also a pharmacist as her source of strength that contributed to her ability to thrive. She also described conversations with her godmother to guide her through experiences in order to determine where she belonged. For Stacey, having several family members with engineering majors made it to feel natural for her to pursue STEM. She also felt that she was equipped with the support she needed to thrive. Participant families were highly regarded as primary sources of encouragement, guidance, and support. The value placed on family contributed to students’ ability to thrive and establish a sense of belonging.
Big Picture Mentality

The third theme that emerged from participant interviews was related to the research question regarding the way Black female STEM students cope or persist at a PWI. As indicated in Table 4, the majority of participants relied on their considerations of the big picture to enable them to cope and persist. As seen in Table 5, the findings related to this theme included self-motivation, the PWI benefit to future employment, and envisioning the future lifestyle they would like to live. As Janet described,

I think about where I came from, and where I ultimately want to end up and I am able to persist because the benefit of the lifestyle I hope to have exceeds the struggles that I face. Placing everything in perspective makes all of the difference.

Through the lens of CRF, participants shaped their ability to cope and persist by embracing the identity of strength which also allowed them to focus on the bigger picture. While several participants described negotiating multiple identities, being considered strong both inside and outside of the classroom has consistently been a label placed upon them. The consequences of this perceived strength caused some participants to further mask their true identities while others felt it necessary to embrace it. Appearing passive or weak in any circumstance was perceived by several of the participants as a permanent hinderance that was difficult to overcome.

Self-motivation

Participants who were driven by their inner strength and fortitude during their precollege and college experiences credited their internal drive and self-determination as keys to allowing them to stay focused on the big picture of ultimately graduating. These individuals exuded confidence and tenacity. Participants like Tina described their natural drive to be successful. For
Tina, this occurred as early as age 13 when she suffered the loss of a parent. Despite the loss, Tina was confident that she had been equipped with enough guidance and support from her family to be able to search deep within herself to stay motivated and finish her college journey.

Similarly, Mary and Myra, both Aerospace Engineering majors, relied on their self-motivation to persist. The big picture for Mary was ultimately working for NASA, a long-standing goal she had since high school. Mary described her self-motivation as the key to pursuing this major given that she felt that resources were significantly limited at her predominantly Black high school. For Myra, who also lost a parent before the age of 10, being in this field has been a life-long dream. She said that she was always keenly aware of how she presented herself, particularly to faculty. As a result, she believed that her self-confidence had grown since she began her college journey.

**PWI Benefit to Future Employment**

Participants who noted that they would not exchange their journey at a PWI for anything described the benefits of this type of setting as related to the big picture. From a big picture perspective, they felt that this academic setting was preparing them for the workforce. Many participants were graduates of predominantly White high schools, which prepared them for what to expect in college. Attending a PWI, with a very limited number of Black females in their academic disciplines, also gave participants an idea of what their future work environment might be like.

Furthermore, some participants recognized the benefit of being able to thrive while being the only Black female in the room. Betty considered her future and the big picture, which included fulfilling her dreams of helping people who look like her. She was grateful for her PWI experience and felt that it was equipping her to confidently accomplish her goal of diversifying
the medical field. Tonya also recognized the career she wanted after she graduates and believed that she was benefiting by attending this PWI. She voluntarily disclosed, “even with my mental health challenges, I have found resources and I am benefiting from my experience here.”

Additionally, the temporary negative interactions that some participants had with their peers had not deterred them from the overall benefit of attending a PWI. Setting long-term personal goals very early in their academic journeys allowed participants to remain focused on the big picture as well as the ways that they could use these experiences to their advantage in the future.

**Future Lifestyle**

Future lifestyles included living as comfortably as their parents did, gainful employment, and the success of completing the degree; these findings related to the big picture mentality for 39% of participants. The middle class upbringing of the majority of the participants resonated with them when they considered their reasons for persisting. Several women described being fortunate enough to have resources and tools necessary to be successful prior to arriving at college due to the financial position of their parents. These participants allowed these early experiences to influence the ways in which they coped and persisted.

Additionally, the independence that accompanied the future lifestyle was also a reason participant credited for their persistence. Delora and Janet both described the benefit of their cooperative education experience (co-op) which allowed them to experience independence and adulthood. Anna recalled how her parents made sure all of her needs were met and how they deliberately ensured that she experienced the same as her peers. She wanted to ensure that her children would enjoy a similar or better experience in the future. She kept those thoughts at the forefront of her mind in order to persist. Tammy shared that as a senior, she had already secured
a job and apartment. She advised that the fulfillment of finally achieving these goals made her dreams throughout college a reality.

Nicole described researching the salary ranges associated with her major and considering her future lifestyle as motivators that contributed to her ability to cope when she faced a difficult time on her college journey. For Monica, the end goal of graduating was the satisfaction that allowed her to persist. Stacey considered the freedom to accomplish greater personal goals and aspirations as her main source of big picture thinking. Felicia envisioned the comfortable life her father had created as a result of his success as a Mechanical Engineer, and used his experience to focus on the big picture by coping and persisting. While many students were able to rely on their considerations of the big picture, some students cultivated their experiences with faculty, academic advisors, and peers to simply survive.

**Simply Surviving**

The fourth theme that emerged from participant interviews was related to how Black female STEM students cultivated their sense of belonging through their experiences with peers, faculty, and academic advisors. This theme was the culmination of how participants “simply survive” and included findings regarding their interactions in the classroom and their relationships with faculty as professors and academic advisors. An additional finding within this theme was *code switching* or a way in which participants altered their behavior or masked their identity to conform to their surroundings.

As illustrated in Table 5, through the lens of the CRF framework, some participants felt that their identity as Black females contributed to them being overlooked by their faculty and peers. Consequently, when faculty did not acknowledge or engage with them, their peers were also described as mirroring those negative interactions. Feeling invisible within the context of the
classroom was a common description provided by several of the participants. They also described having their ideas and suggestions ignored by their peers. In order to survive and cultivate a sense of belonging, several of the participants described suppressing their true identity to hide vulnerabilities and fears.

**Coping in the Classroom**

The majority of participants were able to effectively cultivate relationships with peers outside of the classroom setting. These relationships, which greatly contributed to their sense of belonging, were mainly with peers who looked like them. Within the context of the classroom, interactions with peers were strained. Participants found ways to cope in order to manage these experiences. As Laura described, Black students tend to assemble together in the classroom as a coping mechanism; however, as they advance through college, the number of Black students in the classroom drastically reduced, which erased that feeling of a safe haven.

While Eve described feeling excluded each time she entered the classroom, Tonya, felt like she was never excluded in the classroom because her peers all realized the challenges of the subject matter and tried to work together. Students like Anna, Pam, and Stacey found it easy to connect with peers in the classroom, and credited their precollege experiences at predominantly White high schools for preparing them to engage with peers who did not look like them. Additionally, Delora concluded that her peers could sense that she was from a predominantly White high school and were therefore more accepting of her.

Negative experiences were the result of peer interactions in the classroom, especially as it related to group work. These negative experiences consisted of microaggressions, participants being overlooked, and students being belittled. Claire, Mary, and Myra felt that that their abilities were constantly questioned by their peers simply because they are Black. Claire coped by being a
resource for Black females and felt a connection with them but was no longer seeking belonging. Harper described the limitations of her speech, which further hindered her ability to connect with her peers because they assumed that she was not capable and often overlooked her. Monica recalled being belittled by her peers and having them opt to complete the entire group assignment themselves because they felt that she was incapable of completing her portion.

Betty believed that positive experiences could take place with peers, but it required Black students to boldly take the first step. For Tammy, who lives with social anxiety, this suggestion was a significant challenge. Tina highlighted the advantages of relationships that had formed among peers through their experiences with the process of joining a sorority, which took place before they entered the classroom. These pre-established connections among White students made it difficult to build any rapport or feeling of belonging with peers. As Kelly progressed through college, she made deliberate efforts to connect with other Black females in the classroom as well to make them feel like they belonged. Interactions with professors and academic advisors contributed to and hindered the sense of belonging among some participants.

**Relationships with Faculty**

Relationships with professors and academic advisors were both positive and negative. There were 61% of participants who considered the majority of their interactions with faculty, both professors and advisors, as positive. Participants attributed these positive experiences, which also cultivated their sense of belonging, to professors who showed interest in their academic growth, those who took initiative to get to know them, and those who recommended resources and opportunities for them. Participants with positive experiences also recognized their role in building rapport with their professors and actively seeking out opportunities to engage with faculty members, including during their office hours and by actively participating in class.
Furthermore, Janet, Tasha, and Denise regretted not putting forth more of an effort to build relationships with their professors.

Participants with negative experiences with professors reported instances when they felt overlooked in class, belittled, or felt that a lack of empathy was shown. Pam and Christy both recalled several experiences in which their hands were raised in class, however, they were never acknowledged by their professors or their responses were not accepted. These negative experiences also included microaggressions, which several students described as hindering their feeling of belonging. Being placed in a position in which they felt the pressure to speak on behalf of all Black women or having every word more heavily scrutinized than peers made several students question their existence in the classroom. Additionally, 65% of participants felt that their race influenced the way faculty, both professors and advisors, interacted with them.

While several participants reported the constant change of academic advisors, which made it difficult to build relationships, participants had positive experiences that contributed to their sense of belonging. Advisors with whom they were able to relate, easily scheduled meetings. Advisors who had an understanding of the course curriculum and were willing to share resources were recognized as positive influences. Negative interactions resulted when participants felt that academic advisors were not concerned with assisting them and a mutual feeling of trust was lacking. Participants like Mary and Nicole considered their relationship with their academic advisor as neutral because there were not any contributions or hindrances to their academic success. Several participants also questioned the training of some of their advisors and their ability to effectively assist them with their course selection.
**Code Switching**

Participants like Janet and Felicia, vividly described code switching, which involved them deliberately switching dialects based on who they were interacting with. Beginning with her attendance at a predominantly White high school, Felicia experienced the rejection of her Black peers who described her as “acting White” and her White classmates who considered her “ghetto.” To combat these feelings once she reached college, she adjusted her vernacular based on who she was attempting to engage with, intentionally being less formal in her conversations with her Black peers. Felicia, as well as several other participants, felt that engaging in code switching was necessary in order to effectively adapt and establish a sense of belonging. Janet also described students being more willing to get to know her if she presented herself in a manner they considered to be acceptable and better aligned with the norms of the classroom.

Betty, Delora, and Felicia, who were raised in a military family, described the benefit of being able to thrive in different environments as a result of having to relocate several times prior to college. Engaging in code switching for these participants became less difficult with each new school they entered as they worked to establish a sense of belonging. Janet believed that her experience warranted the hiring of more faculty of color in an effort to help students engage more authentically without masking their identity since she considered code switching to be a necessity. Despite their behavior being altered, these participants recognized the benefit of engaging in code switching in order to cultivate a sense of belonging.
Chapter Summary

This chapter highlighted the themes that emerged from this research study and their relationship to the research questions. Four themes were presented along with corresponding findings. The essence of interviews were captured with parallels drawn between participants with similar experiences. Through the presented themes, this chapter provided a greater understanding of what led to participants’ decision to pursue a STEM major; the ways in which they persisted once they arrived at college; their considerations for success; and their experiences with faculty, academic advisors, and peers that contributed to their sense of belonging. The next chapter will include implications for practice and policy. The implications are beneficial for higher education administration including academic advisors, faculty, and staff. The chapter will also include recommendations for future research and conclude with my final reflections and thoughts.
CHAPTER 6
DISCUSSION, IMPLICATIONS, AND CONCLUDING THOUGHTS

This study focused on understanding Black undergraduate women in STEM sense of belonging at a PWI to more accurately describe their specific experiences, accounting for their race and gender, and provided recommendations to contribute to their persistence.

In terms of college, sense of belonging refers to the students’ perceived social support on campus, a feeling or sensation of connectedness, and the experience of mattering or feeling cared about, accepted, respected, valued by, and important to the campus community or others on campus such as faculty, staff, and peers. (Strayhorn, 2012, p. 4)

Through qualitative research, 23 participants’ experiences were examined and highlighted. The following section presents the relationship of findings to the research questions and utilizes relevant literature to highlight similarities and differences. The discussion is centered on the four themes that emerged from this study. Implications for policy and practice of higher education administrators is provided. The chapter concludes with recommendations for future research followed by my final thoughts regarding this research journey.

Overview of Findings Related to Existing Literature

The four major themes that emerged from this study were the decision to pursue a STEM major, including early influences during the precollege years, method to thrive once arriving at college, including formulation of a sense of belonging, big picture mentality that allowed participants to cope or persist, and simply surviving, including experiences with faculty, academic advisors, and peers that cultivated belonging. The findings also support the intent of Harper’s (2010) anti-deficit achievement framework which accounts for the understanding of what stimulates these students to persist and overcome challenges. A discussion of findings
related to themes is presented in the context of the research questions, as seen in Chapter 5 (Table 5):

- Decision to Pursue a STEM Major – Understanding the “Why,” Exposure to STEM, Parents’ Influences
- Method to Thrive – Faith in God, Belonging through Association, Family over Everything
- Big Picture Mentality – Self-motivation, PWI Benefit to Future Employment, Future Lifestyle
- Simply Surviving – Coping in the Classroom, Relationships with Faculty, and Code Switching

**Decision to Pursue a STEM Major**

As identified by Harper (2010), the anti-deficit achievement framework accounts for the pre-college socialization that contributes to readiness by recognizing the ways in which parents shape and nurture interests in STEM. Additionally, the framework acknowledges the K-12 forces including the influences of teachers and overall achievement in the classroom. The out-of-school programs in which participants described their involvement in also contributed to their STEM identity and college readiness.

In the transition from K-12 to higher education systems, much of the published literature to date has emphasized adequate preparation at early and secondary levels of education as most integral to sustaining Black women STEM scholars in higher levels of academia. (Charleston et al., 2014, p. 276)

As revealed by participants, preparation included early influences of people, places, and experiences that created opportunities for exposure which broadened their interest in STEM. Early interactions in middle and high school through STEM-related camps, trips, and communication with Black professionals in the field allowed participants to envision the
possibilities. Additionally, a clear understanding of their reason for pursuing academic majors gave participants the motivation to persist. External and internal influences contributed to these women’s perceptions of their abilities. They were capable of creating positive experiences and overcoming negative experiences that dictated their future pursuit of STEM (Collins et al., 2020). Several participants credited the preparation they received from their AP classes as a key contributor to their academic success once they arrived at college. Students who did not take AP classes or those who attended predominantly Black high schools, however, did not feel that they were academically or socially prepared for the college experience. These students also found it more challenging to establish a sense of belonging. Furthermore, Black females who were steered away from more rigorous advanced STEM classes in high school were more likely to question their abilities and potential success in their respective fields of study in college (McGee & Bentley, 2017).

As Iruka et al. (2020) described, socioeconomic status based on family’s education, income, and occupations, was directly related to cognitive ability and level of achievement. This concept was consistently expressed among the participants. Participants from middle and upper middle class families consistently felt that they had all of the necessary resources to be successful. Having parental examples both in education and occupation influenced their perceptions of their abilities at very early ages which continued into their college experiences. Being financially secure also provided greater exposure to extracurricular opportunities related to STEM. Several participants described gaining knowledge of these opportunities through their White high school peers, and the deliberate actions of their parents to ensure that they had the same level of exposure. The career success of their parents was also a tangible reminder and motivator of why they wanted to achieve similar levels of success or greater.
Consistent with the literature, parents who had no formal education or career in STEM still had a profound influence on participants’ early interest in the discipline. As Shahid et al. (2018) described, regardless of educational level, parents encouraged their children to attend college, partly because they also wanted them to perform better academically than they initially did. Some parents had actually been motivated to return to college to complete their degrees as a result of their children inspiring them. Janet vividly described that she also saw this occurrence among several of her peers. Findings associated with this theme were consistent with literature regarding early influences that contributed to student interest in STEM.

**Method to Thrive**

In describing their sense of belonging at a PWI, methods in which participants thrived emerged. This theme was consistent with Harper (2010) anti-deficit achievement framework relation to out of class engagement which accounts for campus resources and student organizations. Framing the questions under the guise of this framework allowed participants to share the methods by which they thrive including their faith in God, the feeling of belonging through their associations with groups and peers, and the significance of their family.

Patton and McClure (2009) reported that African American women enrolled at a PWI often depended on spiritual beliefs to cope with feeling overlooked, racially isolated, misrepresented, and misunderstood. In turn, spirituality provided motivation and empowerment for Black female college students by protecting and strengthening their psychological well-being. (Shahid et al., 2018, p. 8)

Participants who credited their faith in God as a meaningful contributor to their ability to thrive viewed their religion as a belief in a Higher Power that sustained their daily life (Graham, 2016). Reliance on their faith in God gave these participants the fortitude to cope and successfully thrive in a predominantly White setting, ultimately aiding them in establishing a sense of belonging.
From a CRF lens, the majority of participants’ responses suggested a general understanding of the challenges present in a predominantly White settings, and they recognized the positive influence of their faith and religion. As Patton and McClure (2009) described, religion is a way in which some people choose to practice their spirituality. Several participants relied on strengthening their faith in God by attending local churches, praying, reading their Bibles daily, and listening to Christian music. Furthermore, as Burt, Williams, and Palmer (2019) research concluded, spirituality can serve as an effective mechanism to shape identity and combat stress, ultimately aiding in persistence. Exercising their religion was considered as a key element in helping them to establish a sense of belonging due to the confidence, peace, and persistence it gave them. Based on their responses, this spiritual foundation, while shaped in college, would likely be present after graduation.

Furthermore, being associated with student groups, both STEM and non-STEM related, was considered a necessary level of involvement in order to establish a sense of belonging for many participants. As Leath and Chavous (2018) described, the feeling of inclusion with groups that they identified with by race and gender lessened stress levels and gave participants the ability to more confidently address academic challenges. Participants who were not able to connect with other Black females through student organizations, including sororities, were able to establish belonging through interactions with their roommates and peers with whom they were able to identify. Black student organizations served as safe places where open dialogue could be exchanged and thoughts expressed without the feeling of judgment (Griffith et al., 2019). This socialization contributed to persistence and gave students the assurance to thrive.

CRF helped frame the experiences in STEM of Black females while also considering the role of the family (Evans-Winters & Esposito, 2010). As important to establishing belonging was
the influence of family members, extending beyond parents. Several participants recognized at early ages the impact of their family members, including older siblings, aunts, and uncles, who worked in STEM-related fields. They later used their admiration as motivation once they reached college. Participants also relied on advice and encouragement from family members who previously pursued STEM majors to guide them.

Leveraging their families’ experiences allowed participants to successfully navigate college and persist. As Porter et al. (2020) described, the identity formation shaped by parents served as the foundation to persistence particularly in college. This was evident in participant responses in this study. In describing a sense of belonging, the methods participants utilized to thrive were salient in their responses. To further understand the ways in which they coped and persisted, the theme involving their views on the big picture emerged.

**Big Picture Mentality**

As Morton and Parsons (2018) described, “Faith is a process of discovering and creating connections among experiences and events; the process of trying to find meaning and make sense of the ‘big picture’ and establishing a sense of purpose” (p. 44). The big picture mentality that was present among several participants largely stemmed from their faith that allowed them to think more deeply about future possibilities. This mentality placed the focus on their self-motivation: the benefit of attending a PWI as it related to future employment settings and the future lifestyle they would like to lead, including financial stability.

This theme was consistent with Harper (2010) consideration of college achievement that accounts for the underrepresentation within the context of STEM courses. The feedback shared by participants included the ways in which they negotiate predominantly White spaces. Black female students who considered strength as a key element of their self-definition were more
equipped to face challenges and obstacles associated with their race and gender at a PWI (Robinson et al., 2013). As described through the lens of CRF, several of the participants chose to embrace the persona of strength assigned to them. Arriving at college with an inner drive that had been shaped during their precollege years was advantageous. While resiliency for some was evident as soon as they begin to recall their experiences, there were others who described their motivation stemming from the need to mask their identity and appear strong even when they were not. These participants considered their self-efficacy as necessary but also exhausting because they felt they had to exhibit this confidence at all times in order to successfully cope. As Thomas et al. (2009) described, self-efficacy acts as a buffer to resist academic stress and maintain confidence which leads to persistence.

Despite the challenges highlighted by participants, they were equally willing to acknowledge the benefit of the PWI to their future employment. As Hannon et al. (2016) noted, some Black women view the PWI as an opportunity to change the negative assumptions of others and prepare for future spaces in which they are the minority. Several participants recognized the importance of being able to cope in a predominantly White environment and how their persistence would serve them in the workforce.

Additionally, Lewis et al. (2013) discussed ways in which Black females are able to successfully cope and manage microaggressions which are beneficial to their persistence both in the short- and long-term. Despite the threat of racial battle fatigue from the college experience, these participants also wanted to serve as mentors and examples in the workforce (McGee & Bentley, 2017). Several participants described their understanding of the field in which they have entered. The limited number of Black women in STEM professions prompted them to
acknowledge the long-term benefits of engaging with their peers, establishing belonging, and ultimately persisting at a PWI.

Several participants described the success of their parents as a motivating influence on their persistence that allowed them to envision their future lifestyles, which included financial stability. As Haynes (2019) described, many Black women in STEM consider their experience at a PWI as a gateway to future professional and financial opportunities. Furthermore, Johnson (2012) noted that succeeding with confidence at PWI in the face of academic and social challenges facilitates belonging and reinforces anticipated future lifestyles. Considering the future beyond their present state allowed these participants to focus on the big picture, thereby persisting.

**Simply Surviving**

Participants’ experiences with their peers, faculty, and academic advisors shaped their sense of belonging and the ways in which they existed or survived at a PWI. This theme is consistent with Harper (2010) anti-deficit achievement framework which accounts for classroom interactions including response to racism and finding value in peer interactions in order to effectively cope. Through the lens of CRF, participants were able to describe the ways in which their identity was compromised.

In addition to living in two worlds, many of the participants described their two worlds as a double job—living as a Black student at a PWI and having to exist as a Black student within the Black community on campus. Some participants went a step further and recognized that gender added even more rules and burdens. (Hannon et al., 2016, p. 658)

Coping in the classroom consisted of navigating microaggressions, overcoming negative peer interactions, and rising above isolation at times. Consistent with participant descriptions, Johnson (2012) described exclusion from peer groups, avoidance in labs, and dismissal of project contributions as diminishing influences for belonging. Some participants relied on reflecting on
their high school experiences and the encouragement from their academically-experienced family members to assist them with deleterious interactions with their peers.

Several participants also described having positive experiences with the faculty. Johnson et al. (2019) articulated that positive interactions often related to faculty whom students felt had a vested interest in their success. Faculty who recommended resources, acknowledged their contributions, and did not prejudge their capabilities before giving them an opportunity were particularly appreciated. On the other hand, negative experiences, similar to those described by Lewis et al. (2013), consisted of microaggressions and being overlooked in the classroom. As Russell and Russell (2015) described:

> More often than not, the instructor is “unapproachable” and makes comments relative to who will “survive” the class. This can be very intimidating and discouraging for students who may not have a support system to encourage their persistence. Furthermore, students tend to form their own study groups which may either intentionally or unintentionally exclude Black Americans. (p. 115)

Participants who experienced undesirable exchanges with their faculty or peers within the classroom chose to channel that experience positively as a coping strategy which contributed to their persistence.

In some cases, experiences with academic advisors also cultivated a sense of belonging for students. While some participants described their interactions with their academic advisors as limited or unproductive, others were able to garner academic guidance and support. Consistent with findings by Sutton and Sankar (2011), participants sought insight on internship opportunities, instructors, and suggestions for mentors in their fields of study. Several participants also acknowledged the efforts of advisors who took initiative to reach out to them and make them aware of resources and other opportunities on campus. As Tinto (2017)
described, a sense of belonging is directly related to interactions with other students, faculty, and staff and the messaging that is conveyed.

Participants who described the *two worlds* they had to navigate also acknowledged the ways in which they engaged in code switching to be accepted by their Black friends and White peers.

Black students acknowledge a degree of code- and culture-switching, applying different behaviors within school (a predominantly White environment) and beyond (in their Black neighborhoods). Nonetheless, they strongly reify their racial-ethnic identities (in varying degrees in STEM spaces) by regularly and proudly identifying culturally, ancestrally, and in self-descriptors as Black or African American. (Basile & Black, 2019, p. 385)

Participants viewed code switching as a necessary tool for survival and belonging on campus. As Strayhorn (2012) described, the desire to belong influences human behavior, and some will do whatever it takes to achieve it, including altering expressions to conform to the setting. Belonging is of greater importance depending on the context and the value placed on it (Chickering & Reisser, 1993). As several participants described, being a newcomer to the previously established social groups within the classroom setting; they felt an increased interest in establishing a sense of belonging of their own. Engaging in code switching, building relationships with faculty and peers, and deriving effective ways to cope all contributed to survival and cultivating a sense of belonging.

**Research Questions**

Study findings related to the research questions are highlighted in this section. Research questions demonstrate themes that emerged and provide an understanding of the sense of belonging for Black women in STEM at a PWI. Additionally, participants shared the influences that shaped their academic trajectory and social interactions. The framing of protocol questions
using the anti-deficit achievement framework through the CRF lens allowed a greater understanding of participant experiences.

1. How do Black undergraduate women describe the early influences regarding people, places, and experiences that influence their early interest in STEM majors?

With a focus on the precollege years, participants identified various ways in which early influences including people, places, and experiences positively contributed to their interest in STEM. From the anti-deficit perspective, an understanding was gained on how Black undergraduate women utilize early influences to their benefit in their pursuit of STEM majors. As previously indicated in Table 4, 70% of participants attended a predominantly White high school. They collectively believed that this experience better equipped them both academically and socially to attend a PWI; however, several also acknowledged not being fully prepared. While participants described experiencing microaggressions in their high school classrooms, they were still grateful for that experience. Participants also described the feeling of being the only Black person in their class in high school, which gave them an indication of what to expect at a PWI. Participants who attended a predominantly White high school presented themselves as more confident than those who attended a predominantly Black or mixed high school. These students found it more challenging to adjust to the PWI and also described greater struggles with establishing a sense of belonging.

Early influences related to their exposure to Black people successfully thriving in the STEM profession was also a key element that contributed to participant interest. The majority of the participants were also positively influenced by STEM teachers, parents with STEM careers, and interactions with other professionals working in the field through career fairs and STEM-related functions. Influence from parents came in several forms, both directly and indirectly.
From an indirect perspective, 39% of participants utilized their parents’ experiences to focus on
the big picture of success after college including financial stability and comfortable lifestyles.

For the two participants who were home-schooled, exposure to places played a critical
role in their decisions to pursue a STEM major. They both described deliberate measures taken
by their parents to ensure that they traveled and visited science related museums while being
involved in extracurricular clubs with a STEM focus. Additionally, the three students with
parents who had military ties concluded that relocating to different schools positively influenced
their ability to successfully cope at a PWI. They also described being confident in their pursuit of
STEM majors as a result of their experience with relocating to different places.

Regardless of the makeup of their high school, participants described the benefit of their
advanced placement classes. They believed that these classes introduced them to academic
opportunities that would support their college journey in addition to giving them opportunities to
interact with peers who did not look like them. Several participants also highlighted the
attentiveness of their advanced placement teachers and their willingness to make students aware
of other STEM-related opportunities outside of class.

These findings are consistent with the literature. King and Pringle (2019) described
STEM interest beginning as early as middle school with influences through exposure and
teachers’ efforts assisting in students’ decision making. Furthermore, Tan et al. (2013) noted that
perception of science as early as middle school was a determining element of whether or not
students would continue their pursuit of STEM. Raines (2012) concluded “students who take
academically intensive mathematics courses in high school and succeed have higher graduation
rates in college” (p. 28), which further highlighted the significance of advanced placement
courses.
2. How do Black undergraduate women describe their sense of belonging at a PWI?

Anti-deficit framing provided an understanding of how Black undergraduate women foster a sense of belonging. Participants had several creative ways of describing their sense of belonging and the ways in which they thrived while attending a PWI. For 39% of participants, belonging for was rooted in their faith in God, which also allowed them to persist. These participants exercised their faith in God by reading their Bibles and prayer, which they described as sustaining them and providing peace. Participants also attended local churches which allowed them to build confidence and find belonging with the surrounding community.

Additionally, many participants found relationships through associations with both STEM and non-STEM-related student groups as relevant to their sense of belonging. Participants desired to connect with STEM-related groups in order to establish a sense of belonging. Students who were not able to connect with a STEM student organization such as NSBE, searched for groups outside of STEM because they recognized the value of connections in order to establish belonging. From my observation, it appeared easier for participants who were engineering majors to make connections and establish belonging due to the prominence and success of NSBE on campus. For non-engineering participants, there was a desire for a comparable organization where they could connect, find resources, and engage with people who looked like them.

Strayhorn (2012) explained:

> Characteristics of the social context – in this case STEM environments – influence the extent to which psychological needs are met. Satisfaction of such needs affects perceptions and behaviors. When belongingness needs are met, optimal functioning is possible and STEM students thrive... (pp. 102-103)

Regardless of whether they made campus connections, there was consensus among participants regarding the influence of their family, particularly family members who had college experience. Participants relied on their families to assist them with settling into campus and
navigating through their experiences, basically achieving belonging. A few participants described developing a sense of belonging through their relationships with their roommates who they felt fortunate to have, particularly if they were also STEM majors.

3. How do Black undergraduate women majoring in STEM cope or persist at a PWI?

The ways in which participants coped or persisted centered on their considerations of the bigger picture that extended beyond their present state. Despite using words such as “intimidating,” “cold,” “divided,” and “unwelcoming” to describe the campus environment, participants said they would not exchange anything for their journeys. Anti-deficit framing of the questions allowed participants to share how they manage to persist in spite of racism, sexism, and other negative forces. To effectively cope, participants relied on self-motivation, and envisioned how the PWI experience would benefit their careers in the long term. Several participants were content with finding ways to cope because they considered it as necessary in order to enjoy their future life beyond college that included financial stability. Based on responses, participants’ willingness to cope or persist increased as they progressed through college, with juniors and seniors being most interested in finding positive influences to contribute to their persistence.

Furthermore, four participants who credited their self-motivation and fortitude with establishing a sense of belonging described negative experience with their faculty and peers. They clearly illustrated their persistence and the desire to succeed which had been ingrained in them from very early ages. Viewing themselves as a source of their coping capabilities was apparent from the ways in which they recalled their pre-college experiences up to the present day. Self-motivated participants demonstrated tenacity and the ability to make connections.
These participants also had a keen awareness of their identity and the differences experienced because of their gender. As Charleston et al. (2014) revealed:

Participants indicated that though many experiences are familiar due to issues germane to Blackness and the Black race, another peer who is of the same race is not always a valuable source of support or collegiality. Gender, as well as the isolating and competitive nature of STEM fields themselves, promote and entirely new element. One participant summarized this sentiment like so: “Just cause there’s another Black brother [in class] doesn’t mean they want to work with you either.” (p. 284)

Another consistent finding was participants’ ability to cope and persist by recognizing the benefit of the PWI experience to their future careers. While several described negative encounters in the classroom, particularly as it related to peer interactions and faculty comments, they all seemed grateful for their experiences. They felt that microaggressions directed towards them, coupled with the isolation from group work and being overlooked for opportunities, were all preparing them to effectively thrive in predominantly White work environments. Additionally, participants who overcame some of these challenges looked for opportunities to assist younger Black women undergraduates in STEM cope and persist. Consequently, several participants acknowledged the strong Black woman persona they projected in order to cope, even in times when they found it hard to concentrate on the big picture. As Robinson et al. (2013) concluded:

The Strong Black woman continues to be a powerful, controlling image that is internalized as an “embodied armor” to be worn as a survival mechanism. Black women continue to experience gendered racism and oppression and therefore, like their mothers, grandmothers, and great grandmothers, may perform this unrealistic and at times debilitating role. Although this role is historically rooted in the Black female community and does serve some positive functions, it can also be an exhausting, unrealistic one-dimensional role that has psychosocial consequences. (pp. 67-68)

Mentally focusing on the big picture was a prominent theme among 39% of participants. Moreover, this finding was consistent with the future lifestyle these participants desired to have. Imagining their future stemmed from the success of their parents who were primarily middle and
upper middle class. The comfortable living and successful career outcomes of their parents fueled participants’ desire to persist. For a few students, who described living comfortably but lacking exposure due to their limited resources, their focus was to secure a future lifestyle that exceeded their experience. Winkle-Wagner et al. (2019) highlighted instances in which Black women were dissuaded from pursuing STEM majors. While these encounters were acknowledged by participants, they did not deter or prevent them from focusing on the future lifestyle they hoped to enjoy.

4. How do Black undergraduate women describe their experiences with faculty, academic advisors, and peers that cultivate their sense of belonging in a STEM major at a PWI?

Cultivating a sense of belonging through engagement with faculty, academic advisors, and peers was a key element to survival for many participants. While faculty interactions were described as both positive and negative, negative experiences typically occurred within the classroom setting and mainly involved participants being overlooked and belittled. While being the only Black female was acknowledged by many, it was not bothersome, and was expected, particularly for those coming from predominantly White high schools. Coping in the classroom was most difficult in terms of assigning and participating in group work. Participants consistently expressed feelings of isolation when faculty instructed the class to form into groups.

Approaches to managing this scenario were also consistent across participants. They would either form a group with the person closest to them or they would opt to work alone if possible. They each described being repeatedly rejected by their White peers who did not want to be in a group with them. While these experiences did negatively impact their feeling of belonging, they collectively described presenting the strong Black woman persona in these instances. Another consistency among participants was the feeling of being overlooked by group
members. To combat this, several participants described being more assertive and exuding confidence in their group discussions, both online and in-person. As Strayhorn (2012) stated:

Sense of belonging develops in response to the extent to which an individual feels respected, valued, accepted, and needed by a defined group. In STEM contexts, students have a basic psychological need or longing for belonging as a bona fide member of the STEM classroom, laboratory, or department, as well as a shared emotional connection with others like faculty, peers, and lab assistants. (p. 102)

Cultivating relationships with faculty both as professors and as academic advisors influenced participants’ sense of belonging. A sense of belonging was achieved with academic advisors when they engaged in dialogue that was relatable, when resources were proactively provided, and when students felt they could identify with them. Additionally, participants felt like they belonged when their professors acknowledged them, showed interest in their academic success, and recommended resources and opportunities to them.

To survive and successfully navigate college, engaging in code switching was necessary for some participants to solidify belonging both with peers who looked like them and those who did not. Given many participants’ experiences with predominantly White academic settings, they were familiar with effective ways to interact with peers who looked like them by relying on their commonalities. For peers who did not look like them, participants adjusted their behavior in a more formal manner to gain acknowledgment and respect. Racial battle fatigue was described as a common occurrence particularly as participants engaged with their White peers. Through the anti-deficit achievement approach, the collective insight provided by participants confirmed that maintaining or surviving a PWI required fostering relationships both inside and outside of the classroom on the journey to belonging.
Implications for Practice and Policy

This qualitative study allowed the voices of undergraduate Black women in STEM at a PWI to be effectively articulated through individual interviews of 23 participants. Findings from this study provide an understanding of their sense of belonging through their experiences at a PWI. Participants spoke openly and candidly about their individual experiences, collectively sharing the same goal of having their voices heard. While the pride and admiration for having the opportunity to attend Prospect Central University was undeniable, participants clearly demonstrated a strong interest in improving the experiences for Black women pursuing STEM majors. Reflecting on their experiences contributes to existing research. Utilizing the anti-deficit achievement framework through the lens of CRF, participants served as narrators of their individual journeys by outlining their experiences before and during college. The following section provides implications for practice and policy, allowing this knowledge to be applied to improving the sense of belonging for these students. The results of this study provide implications for positive social change. Recommendations for administration include:

1. Formation of a Black women in STEM multi-faceted student organization

2. Leveraging alumni and student leaders

3. Creation of gender-focused programming

4. Recruit and retain diverse faculty

5. Diversity and inclusion training for student organization leaders, faculty, and staff.

6. Implementation of academic advising accountability measures

These recommendations align with the institution’s strategic initiatives of fostering a diverse and inclusive environment that promotes all students’ abilities to thrive. To successfully execute
these recommendations, they should be viewed as institutional priorities that acknowledges previous unsuccessful attempts to address these issues. Addressing the needs of this subpopulation requires an examination of the institutional culture. As Kezar and Eckel (2002) described acknowledgement of organizational changes that do not align with cultural norms have to be considered due to the difficulty of implementing change that disrupt norms. Institutional barriers that prevent cultural awareness of Black women should also be identified.

Data from this investigation illuminated the need to improve opportunities for social interactions both in academic and non-academic spaces for Black female STEM students in order to effectively transition students from simply surviving to thriving. Regardless of their year of study, participants expressed a strong desire to make meaningful connections outside of the classroom, ultimately improving their in-class experiences. Participants reported negative racial climates and isolation among their peers which underscores the importance of institutional practices that promote ongoing inclusion and positive social interactions.

As Winkle-Wagner et al. (2019) described, customized programming designed to meet the specific needs of students with consideration for their race and gender have to be developed. Additionally, a greater emphasis on gender-focused programming and organizations would allow students to experience a more welcoming environment. For instance, engineering societies that were currently designed for all women were described by several participants as unwelcoming and left them feeling excluded when they made attempts to engage in the meetings. Making leaders of these organizations aware of the importance of inclusion of all races through ongoing direct communication regarding diversity is necessary.

As described in *The Chronicle of Higher Education* (Lawson-Borders and Perlmutter, 2020) special report on faculty diversity, there are practical sustainable approaches that should be
made to diversify the faculty. This should include deploying diversity and recruitment strategies among the hiring committee, engaging students of color in faculty searches, and promoting and ensuring longevity of the filled positions through mentoring and retention channels. Greater efforts should be placed on incorporating diverse faculty participation and representation in campus initiatives.

**Black women in STEM organizations.** While inclusion in national organizations is important, participants also described the importance of creating new organizations. The formation of student organizations and programming that focuses specifically on all Black women in STEM would allow all majors to have an opportunity to connect and engage. The desire for such an organization was strongly expressed and described by most participants. The Black women in STEM group would serve as a multi-faceted organization equipped with resources, mentoring opportunities, internship opportunities, and a safe place for Black women to engage with other students who look like them in STEM disciplines. Several participants praised the resources and opportunities that were available to them through NSBE, however, they also acknowledged potential missed opportunities for students who were not engineering majors.

**Leveraging student leaders and alumni.** Additionally, as part of the formation of the Black women in STEM organization, several juniors and seniors voluntarily shared their willingness to serve as a support system to students once they graduated through an alumni channel. Engaging the involvement of the alumni also creates a pathway for career opportunities for advancing students. Similarly, third- and fourth-year participants were very interested in a space where they could connect and serve as tutors and mentors to first- and second-year students. Students described their first years as the most challenging and lonely ones. They
intimately recognized the importance of incoming students establishing a sense of belonging with other students who look like them. Based on participants’ responses, leveraging the support of Black female upperclassmen would bolster new student confidence and overall self-efficacy.

**Gender-based study groups.** Most participants described the significant feelings of rejection and isolation in the classroom when group work was assigned. Creating more opportunities for students to engage through the formation of gender-based study groups along with more openly publicized study groups related to the subject matter would foster opportunities for connections to be made outside of the classroom. In turn, this has the potential to improve students’ in-class experiences. Once peers, who may be questioning the capabilities of Black women, recognize their dedication to attending study sessions, they may be more accepting of them as a group partner.

To further cultivate this approach, faculty should be trained to encourage opportunities for diverse study sessions. There must be more intentionality in prioritizing the discussion around the inclusion of Black women in STEM both in academic and social settings. While participants recognized the benefit of attending PCU, the challenging and difficult experiences they described on their journey to finding belonging are worthy of being address. The truths that they expressed should forge transformative practices of higher education administrators and leaders.

**Recruit and retain diverse faculty.** As Tinto (2017) noted, to improve outcomes, there must be an understanding of when support is needed to allow early intervention by faculty and staff prior to struggles impeding persistence or negatively influencing self-efficacy. A long-term, ongoing goal should include diversifying the faculty by increasing the number of people of color. Given the influence of institutional culture on shaping the change process (Kezar and Eckel,
diversifying the culture in all aspects must be a priority. Retaining diverse faculty also must be a priority. Derived from the institutional policy that fosters an inclusive campus, departmental policies should be developed to promote ongoing diversity and inclusion learning opportunities for faculty, staff, and students. Additionally, taking advantage of opportunities to recruit diverse, qualified faculty as budgets permit would address the needs of students to engage with faculty with whom they can identify. An environment has to be created that is conducive to communication that allows Black women in STEM to present their true selves, expose their shortcomings, and identify areas in which they need guidance or support. Given the study findings, it is suggested that the institution gain a deeper understanding of the academic and social needs of this population of students. Specifically, the perspectives of Black female STEM students must be more closely examined.

**Diversity and inclusion training.** The next policy recommendation involves diversity and inclusion training for faculty and staff that specifically includes a greater awareness of racial biases and the ways in which they manifest within the classroom. Also, modules on the implications of microaggressions with a specific focus on raising the level of racial consciousness of faculty and staff are needed. As concluded by Alexander and Hermann (2016):

> By understanding more about students from various cultures with whom they interact, PWI faculty might approach their relationships with, and mentoring, advising, and teaching of diverse populations from a more informed perspective. This might promote a more proactive, supportive, and genuinely empathic PWI campus environment. Such training could be transferred vicariously to all student populations in STEM programs and empower them to address issues of racism in the academic environment. (p.317)

It is also recommended that any current required training is made more visible to students to increase their level of awareness of the steps already being undertaken to ensure a clear understanding of the ways in which diversity is being prioritized. This added level of transparency will be informative to all students and reinforce the importance of diversity and
inclusion. Given that every participant interviewed, regardless of their perception of campus, recommended that faculty, including academic advisors, complete diversity training highlights the significance of this policy recommendation. In a reciprocal manner, this student population should also hold themselves more accountable with making meaningful connections both with their faculty and advisors. Several participants acknowledged that they needed to do a better job of building relationships with the faculty, and they recognized that it was not solely the faculty’s responsibility.

**Accountability measures.** Greater accountability measures should be put in place to ensure consistency in academic advising. These accountability measures must also extend to the faculty to identify implicit biases and behaviors that contribute to an unwelcoming environment. Several participants explained that they were often unable to successfully schedule time with their advisors, and there was consensus among non-engineering students that their advisors lacked adequate training and were therefore unable to effectively advise them. There were, however, many success stories of advising appointments that were described as beneficial because participants received assistance with scheduling, were provided with academic resources, were made aware of internships, and did not feel rushed during their appointments. There was a lack of consistency with positive occurrences among participants and advising.

According to participants, advisors who were more seasoned were described as most helpful. It is therefore recommended that the more experienced advisors provide additional training to the newer advisors on an ongoing basis. To ensure that advising experiences are improved, and increase the level of accountability, it is also recommended that surveys are distributed each semester utilizing a free university application such as Qualtrics™ to assess the level of satisfaction from STEM students. As Winkle-Wagner (2019) described, creating
opportunities such as these for students to express their opinions will not only aid them in persisting but also help them to thrive. Surveys should be distributed to all STEM students and include a section for them to offer suggestions regarding ways in which advising can be improved. As noted by Astin (1991), framing assessment by utilizing it as feedback can promote both equity and quality. Information gathered from assessment policies and practices must be utilized for institutional improvement.

**Future Research**

Due to the interpretative design of this qualitative research, there are opportunities for future research to further explore the findings. Given the limitations of this study including the single institution in one geographic region, and short-term field work, future research should include multi-institutional sites across geographic regions with comparative analysis of participant experiences based on institutional types. A longitudinal qualitative study would provide insight regarding belonging and the experiences of Black women pursuing STEM in multiple settings. Following participants over time would also help to identify areas in need of institutional interventions and improvements.

Furthermore, given that many participants’ early interests in STEM and their understanding of whether they belong in STEM-related spaces began in middle school, future research should be done to explore the implications of early interventions to influence the academic trajectory of potential Black female STEM students. Considerations should be centered on what academic and social engagements can be fostered to increase interest and help students envision themselves in the field. In addition to relationships in the classroom, an examination of places, people, and activities that cultivate belonging during those precollege years should also
be explored. A future quantitative study on the self-perception and value Black females place on STEM during the precollege years would be beneficial.

**Mental Health Challenges**

Several participants voluntarily shared their mental health challenges which have been amplified because of being a Black woman in STEM. A future qualitative case study should include an examination of the mental health of Black women in STEM majors at a PWI. Participants referred to anxiety, depression, and social anxiety, all of which they believed have been more intense since arriving on campus. As Hughes et al. (2015) described, internalizing their identity influences their mental stability. McGee and Bentley (2017) also noted that research focused heavily on grit and resiliency of Black women failed to account for anxiety and trauma associated with the rigor of pursuing a STEM major. Future research should consider the precollege influences as well as treatments for mental health in addition to pressures during college.

**Group Work Experiences**

One of the most persistent challenges in the classroom for participants in this study focused on group work. Future research on perspectives of Black female STEM students is warranted. Participants described the ways in which faculty could make the experiences better for them through proactively assigning groups, while some participants simply desired avenues to build rapport with students prior to group selection. As Haynes (2019) described, Black female STEM students are often the target of microaggressions, particularly in group settings. A future qualitative longitudinal cohort study should be conducted to gain a deeper understanding of how Black women in STEM navigate their group assignments from initial connection through project completion would be helpful in order to improve overall outcomes of the experience.
Concluding Thoughts

As described by Strayhorn (2012), sense of belonging, framed as a basic human need that has the capacity to influence behavior, is relational with the potential for a reciprocal benefit. Participants described the emotional context of belonging or the lack of connection related to both social and academic engagement. Charm, as a survival tactic once described by Sidney Poitier, has evolved into code switching. Some participants highlighted temporary negative emotions while others shared positive experiences where they felt included and welcomed on campus. The themes and findings that emerged are consistent with the literature identified in Chapter 2. Given a few of the harsher experiences by participants, the level of resolve and determination to focus on elements beyond their circumstances is to be commended.

CRF was the appropriate lens to examine this research study. As Evans-Winters and Esposito (2010) eloquently described:

Critical race feminism in education is beneficial to investigation and theory building around educational issues impacting Black girls in the following ways: Critical race feminism as a theoretical lens and movement purports that women of color’s experiences, thus perspectives, are different from the experiences of men of color and those of White women...Critical race feminism calls for theories and practices that simultaneously study and combat gender and racial oppression. (p. 20)

CRF provided a lens that allowed exploration of the intersection of race and gender, and the framing of the questions utilizing the anti-deficit achievement framework empowered the participants to narrate their stories. These 23 participants demonstrated that their experiences are different and unique to them as Black women. Sharing of their experiences has created opportunities to improve on practices. Salient findings include the importance of social interactions both inside and outside of the classroom with peers, faculty, and advisors to cultivate belonging. Given the technology-driven nature of this generation, it was surprising that none of
the participants considered social media as a refuge to assist them with establishing a sense of belonging. Regardless of their level of shyness, participants desired to be fully present when attempting to connect with their peers.

As a researcher, I must recognize and act on negative experiences of Black women in STEM that threatened their sense of belonging and ability to effectively thrive. I am confident that these proposed recommendations are a starting point to improve outcomes. I am also keenly aware of how highly participants regarded the university and their sincere desire to be a part of the solution. As I reflect on the privilege I had of interviewing 23 resilient women, I am confident that I learned the most from the one participant who felt like she had the least as compared to her peers both Black and White. One of the most profound statements that Harper made to me as she reflected on her position arriving on campus was “I felt like an outcast because I overheard students in orientation say that they had perfect ACT scores and here I was with a 21…imagine being a Computer Science major without a laptop arriving to campus.” Just as Strayhorn (2012) potently described, on the journey to belonging, basic human needs have to be met first. Harper’s experience was also a glaring reminder that establishing belonging begins from the moment one arrives on campus, and connections must be encouraged as early as orientation.

As I consider my niece, an incoming freshman and Black female STEM student, I wonder what her journey will entail. My concerns are silenced by encouragement when I consider the resiliency of these amazing 23 uniquely different, yet profoundly the same, women that I had the pleasure of getting to know. Their voices remind me of the possibilities that resiliency breeds. Where there was self-doubt, there was faith, where there was isolation, there was inner strength, where there was rejection, there was assertiveness, and where there were
microaggressions, there was survival. For all these reasons, I am confident that there is always hope on the perpetual journey to belonging. While many participants cultivated effective ways to thrive, there were those who were content with simply surviving.
REFERENCES


https://www.insidehighered.com/news/2020/06/02/higher-ed-leaders-address-protests-racial-tensions-and-killing-george-floyd


https://commons.emich.edu/mcnair/vol13/iss1/10

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APPENDIX A

FIGURE 2. LITERATURE MAP

- Family
  - Stage, Wells, & Williams (2014)
  - Breaux & Fisher (2012)
  - Shoah, Nelson, & Carriker (2018)
  - Iruka, Caren, Sims, Bithch, & Gardner (2000)

- Precollege Experience
  - Patton & McClure (2009)
  - Graham (2015)
  - Morton & Parsons (2016)

- Faith & Religion
  - King & Pringle (2019)
  - Russell & Russel (2015)

- Middle-School
  - McGee & Benkley (2017)
  - Rue & Brown (2014)

- High School
  - Meehan & Szech (2014)
  - Koenig, Schoen, Edwards, & Ison (2012)

- Critical Race Feminism

- Theoretical Framework
  - Avi-Doval Achievement Framework

- Gender

- Positive Interactions
  - Johnson, Zinc, & Kine, (2018)
  - Lash & Cavan (2018)
  - Gershenzon & Papageorge (2018)
  - Brittain, Sy, & Stokes (2009)

- Student Involvement
  - Leadership
    - Tims (2017)
    - Gummiream, Pfitzner, & Wahle (2016)
    - Huynh (2015)
    - Strayhan (2012)

  - Social Media
    - Stanton, Jerkil, Ward, & Avery (2017)
    - Preston-Stuck (2015)

  - Critical Race Feminism
    - Griffith, Hurt, & Hussain (2019)

- Faculty
  - Meehan & Szech (2014)
  - Koenig, Schoen, Edwards, & Ison (2012)

- Peers
  - Dunn & Patel (2017)
  - Meehan (2019)
  - Hannon, Woodside, Pollard, & Roman (2016)

- Campus Climate
  - Minority Students: Students of Color, Black Pirates

- Campus Culture
  - Harrison, Williams (1988)
  - Evans (2008)
  - Ong, Smith, & Kim (2018)

- Negative Interactions
  - Sabath & Sankar (2003)
  - Guffrida (2005)

- Self-efficacy
  - Social Media
    - Stanton, Jerkil, Ward, & Avery (2017)
  - Critical Race Feminism
    - Griffith, Hurt, & Hussain (2019)

- Masculinity
  - Shavers & Moore (2014)

- Resiliency & Grit
  - Jones & Day (2019)
  - Thomas, Love, Rusin-Bell, Tyler, Brown & Garrett (2009)

- Belonging
  - Tims (2017)
  - Gummiream, Pfitzner, & Wahle (2016)
  - Huynh (2015)
  - Strayhan (2012)

- Proposed Study:
  - An Examination of Black Women in STEM at a PWI
Date/Time:

Participant:

Hello this is Melinda Wallace, I’m a doctoral student in the Executive Ed.D. program here at the University of Alabama. Thank you so much for taking time out of your schedule to participate in this study! The purpose of this study is to examine the sense of belonging of Black women pursuing Science, Technology, Engineering, and Math (STEM) majors at a Predominantly White Institution or PWI. The interview will last approximately an hour and a half. Please note that we can take a break at any point that you want to, and you are not required to answer any questions that you do not want to. There are no right or wrong answers. You will be asked specifically about your experiences at a PWI to gain a deeper understanding of your feelings of belonging as a Black female STEM student. I will be recording our conversation on a portable recording device. This recording will not be shared with anyone. Also, please note that I may jot down notes during the interview to help me to remember what we cover. Do you have any questions or concerns that I need to address before we get started? Let’s begin, please state your name, your major, and your year of study.

<Interview Questions per the Interview Protocol, Appendix E, will be asked>

Conclusion

This concludes our interview. Do you have any questions or concerns? I would like to let you know what happens next. I will analyze the audio recording and transcribe it exactly as stated. Once I have transcribed the interview, I will code the interview according to your responses.
Your real name will not be used in the research narrative. I will use a pseudonym or fake name. I will contact you when I have completed the transcription to allow you the opportunity to check for errors. I sincerely appreciate you taking the time to participate in this study. Please don’t hesitate to contact me at mwallce@ua.edu or (205)348-6628 if you have any questions about the study. As a token of my appreciation for your participation in this study, I would like to compensate you with a $25 Amazon gift card, please confirm your email address.
APPENDIX C

RECRUITMENT EMAIL TO POTENTIAL PARTICIPANTS

<Date>

Dear <Insert Name>,

My name is Melinda Wallace, and I am a doctoral student at The University of Alabama. For my dissertation, I am focusing on the sense of belonging for Black women pursuing Science, Technology, Engineering, and Math (STEM) majors at a Predominantly White Institution to gain an understanding of the experiences that contribute or hinder their ability to persist.

My research begins this Spring 2021 with undergraduate full-time Black female students majoring in STEM disciplines. Based on this criterion, I believe you may qualify to participate in my research study. Participation consists of an estimated hour and a half confidential interview with me at a time and location that works best for you. This interview can take place in-person exercising social distance safety precautions, over Zoom video with your camera on or off, or over the phone. The interview will occur over the next two months.

If you are willing to participate, please respond with your major along with a date and time that you are available by <Date>. Twenty participants are needed for this study. Participants will be compensated with a $25 Amazon gift card.

Please do not hesitate to contact me at mwallace@ua.edu or (205)348-6628 with any questions you may have. I look forward to hearing from you soon.

Sincerely,

Melinda Wallace
Doctoral Student
Department of Educational Leadership, Policy, and Technology Studies
The University of Alabama
APPENDIX D

ZOOM INTERVIEW COMMUNICATION

Zoom Confirmation Email

Dear <participant name>,

Thank you for agreeing to participate in this study. Below is the Zoom link to join our meeting on <Date>. Your username on your Zoom account will be associated with your responses, however, I will not use your username or real name for the research narrative. I will use a pseudonym or fictitious name. I look forward to speaking with you, and as a reminder, you will be compensated with a $25 Amazon Gift Card for your time. Please contact me with any questions or concerns at mwallace@fa.ua.edu or (205)348-6628.

Zoom Script

Hello, I am Melinda Wallace, I’m a doctoral student in the Executive Ed.D. program here at the University of Alabama. Thank you so much for taking time out of your schedule to participate in this study! The purpose of this study is to examine the sense of belonging of Black women pursuing Science, Technology, Engineering, and Math (STEM) majors at a Predominantly White Institution or PWI. The interview will last approximately an hour and a half. Please note that we can take a break at any point that you want to, and you are not required to answer any questions that you do not want to. There are no right or wrong answers. You will be asked specifically about your experiences at a PWI to gain a deeper understanding of your feelings of belonging as a Black female STEM student. I will be recording our conversation on a portable recording device. This recording will not be shared with anyone. Also, please note that I may jot down notes during the interview to help me to remember what we cover. Do you have any questions
or concerns that I need to address before we get started? Let’s begin, please state your name, your major, and your year

<Interview Questions per the Interview Protocol, Appendix E, will be asked>

Conclusion

This concludes our interview. Do you have any questions or concerns? I would like to let you know what happens next. I will analyze the audio recording and transcribe it exactly as stated. Once I have transcribed the interview, I will code the interview according to your responses. Your real name will not be used in the research narrative. I will use a pseudonym or fake name. I will contact you when I have completed the transcription to allow you the opportunity to check for errors. I sincerely appreciate you taking the time to participate in this study. Please don’t hesitate to contact me at mwallce@ua.edu or (205)348-6628 if you have any questions about the study. As a token of my appreciation for your participation in this study, I would like to compensate you with a $25 Amazon gift card, please confirm your email address.
APPENDIX E
INTERVIEW PROTOCOL

Interview: One hour; 90 minutes maximum; Semi-structured

Interview Topic: Thriving or Simply Surviving? An Examination of Black Women in STEM at a PWI

Interview Questions Thematically Arranged:

Background: How would you describe your race and ethnicity?
Where did you grow up?

Family: Tell me about your upbringing and family?
Who raised you?
How has your family influenced your sense of belonging prior to entering college?

Precollege Experience: What motivated you to pursue a STEM major?
What person or event played a role in this decision?
Did you experience any educational disadvantages before college? If so, how did you overcome them?
Describe the community in which you were raised.
Were there any issues related to your ethnicity and academic performance? Please elaborate

College Persistence: Who or what influenced your persistence in STEM at a PWI?
As a Black female STEM student, what is your overall perception of your college experience?
How do you think your experience differs from that of other students?
Tell me about a positive or negative college experience that you attribute to being a Black female STEM student.
What specific activities, skills, resources (if any) contributed to your success in STEM before and during college?
Belonging: Tell me what you do, if anything, to establish a feeling of belonging or acceptance on campus.
Probe: Describe your experiences being engaged with student groups.
Probe: Please explain whether or not you feel like you fit in.

Faculty Influences: In what ways does interacting with faculty contribute to your academic success or hinder it?
Probe: How does faculty expectations influence you?
Probe: In what ways, if any, does the faculty interactions influence your feelings of belonging?

Does the race/ethnicity of faculty influence your experiences?
Probe: Please elaborate and provide an example.

Academic Advisors: In what ways does interacting with academic advisors contribute to your academic success or hinder it?
Probe: How does academic advisor interactions influence you?

Does the race/ethnicity of academic advisors influence your experiences?
Probe: Please elaborate and provide an example.

Campus Climate: How would you describe the campus environment?
Probe: In what ways does the campus environment influence your feelings of belonging?

Describe a time when you felt a part of the campus community.
Probe: What made you feel connected?

Describe a time when you felt excluded from the campus community.
Probe: What caused the disconnect?

Peers: Describe your experiences with peers in STEM at a PWI.
Probe: Describe what your experience is like inside and outside of the classroom.

How do your peers contribute to or hinder your sense of belonging?
Probe: Describe how they make you feel.

Self-Efficacy: How do you stay motivated?
Probe: What do you do for yourself to help you persist or continue on your college journey to graduation?
Campus Culture:  Do you feel you are represented in university programming, activities, and student engagement? Why or why not?

What changes (if any) should be made in order to improve Black women in STEM experience at PWIs?

Probe:  If you could make a suggestion to university administration to improve the sense of belonging for Black women in STEM what would you recommend?

Is there anything else you would like to share, or feel is relevant to our discussion?

Again, thank you for participating in this interview. I really appreciate it. I would like to schedule a follow-up to discuss the interview transcript with you next week. May I ask when are you available? I will be in touch by email to confirm the meeting. Have a great day!
APPENDIX F

INFORMED CONSENT

Study Title: Thriving or Simply Surviving? An Examination of Black Women in STEM at a Predominantly White Institution (PWI)

Please read this informed consent carefully before you decide to participate in the study.

CONSENT FORM KEY INFORMATION:

- You are invited to participate in a 90-minute research study titled “Thriving or Simply Surviving? An Examination of Black Women in STEM at a Predominantly White Institution (PWI)”.
- This research study is being conducted by Melinda A. Wallace, a doctoral degree candidate in the Higher Education Administration program at the University of Alabama. Mrs. Wallace is being supervised by Frankie Santos Laanan, Ph.D., who is the Department Head for Educational Leadership, Policy, and Technology Studies within the College of Education at the University of Alabama.
- No information will be collected that will connect your identity with the responses.
- You will receive a $25 Amazon Gift Card.

STUDY PURPOSE: The purpose of this study is to examine the sense of belonging or connectedness of Black women pursuing Science, Technology, Engineering, and Math (STEM) majors at a Predominantly White Institution or PWI.

PROCEDURE FOR THE STUDY: If you agree to participate in this research study, you will be asked to participate in a tape recorded, one-on-one interview with the researcher conducting the study. Participation consists of an estimated hour and a half confidential interview at a time and location that works best for you. It will consist of 30 open-ended questions. This interview can take place in-person exercising social distance safety precautions, over Zoom video with your camera on or off, or over the phone. Before commencing with the interview, the researcher will go over this informed consent form with you and answer any questions you might have about the study. Once you have signed the form, indicating your agreement to participate, the interview will commence. Once the taped interview has been transcribed, you will receive a copy of the transcript to review with a request to confirm the accuracy of it with the principal investigator. You will receive a copy of the consent form to keep for your records. If you agree to participate in this research study, there will be no cost to you except for your time in completing the interview.

TIME REQUIRED: The study will require about 1 hour and 30 minutes of your time.
Study Title: Thriving or Simply Surviving? An Examination of Black Women in STEM at a Predominantly White Institution (PWI)

RISKS OF TAKING PART IN THE STUDY: Participants may be uncomfortable when responding to some of the interview questions. In order to minimize risks, no unnecessary questions will be asked, and participants can proceed to the next question if feelings of discomfort arise. There are no particular risks to your physical, political, economic, or social well-being associated with taking part in this study. Although the interview protocol does ask for some personal, demographic information, all responses are confidential and there will be no legal or disciplinary consequences for you. Data collected will be kept in a secure location accessible only to the principal investigator.

BENEFITS FOR TAKING PART IN THE STUDY: There are no direct benefits to you for participating in this research study. The study may help us better understand the needs as it relates to belonging and persistence of Black women in STEM at a Predominantly White Institution.

CONFIDENTIALITY: The information that you give in the study will be handled confidentially. Findings will be summarized across participants in reports that will not identify individual participants. When responses from individual study participants are presented, those participants will be referred to by pseudonyms, thus protecting their anonymity. Interviews conducted by Zoom will not be recorded without the participants prior consent. All collected data will be kept in a secure location at the principal investigator’s office. At the conclusion of the study and the specified timeframe for recordkeeping, all copies of the interview transcripts, tapes, as well as written and electronic documentation related to the study will be destroyed.

VOLUNTARY PARTICIPATION: Your participation in this research study is completely voluntary.

RIGHT TO WITHDRAW: You have the right to withdraw from the study at any time without penalty. There are no consequences for leaving the study. Your audiotape will be destroyed if you decide to withdraw.

HOW TO WITHDRAW: If you want to withdraw from the study, tell the interviewer to stop the interview. There is no penalty for withdrawing. You will still receive full compensation for the study. If you would like to withdraw after your materials have been submitted, please contact Melinda Wallace at 205-348-6628 or mwallace@fa.ua.edu.

COMPENSATION/REIMBURSEMENT: You will receive a $25 Amazon Gift Card for participating in this study.
Study Title: Thriving or Simply Surviving? An Examination of Black Women in STEM at a Predominantly White Institution (PWI)

IF YOU HAVE QUESTIONS ABOUT THE STUDY OR NEED TO REPORT A STUDY RELATED ISSUE PLEASE CONTACT:

Name of Principal Investigator: Melinda A. Wallace
Title: Doctoral Candidate & Director of Enterprise Operations
Department Name: Enterprise Operations
Telephone: 205-515-8788
Email address: mwallace@fa.ua.edu

Faculty Advisor’s Name: Dr. Frankie Santos Laanan
Department Name: Educational Leadership, Policy, and Technology Studies within the College of Education
Telephone: 205-348-5811
Email address: laanan@ua.edu

IF YOU HAVE QUESTIONS ABOUT YOUR RIGHTS AS A PARTICIPANT IN A RESEARCH STUDY, WOULD LIKE TO MAKE SUGGESTIONS OR FILE COMPLAINTS ABOUT THE RESEARCH STUDY, PLEASE CONTACT:

Ms. Tanta Myles, the University of Alabama Research Compliance Officer at (205)-348-8461 or toll-free at 1-877-820-3066. You may also ask questions, make suggestions, or file complaints and concerns through the IRB Outreach Website at http://ovpred.ua.edu/research-compliance/prco/. You may email the Office for Research Compliance at rscompliance@research.ua.edu.

AGREEMENT:

☐ I agree to participate in the research study described above.

☐ I do not agree to participate in the research study described above.

☐ I agree to video and audio in the research study described above

☐ I do not agree to video (audio, photograph) in the research study described above.
Signature of Research Participant

Date

Print Name of Research Participant

Signature of Investigator or other Person Obtaining Consent

Date

Print Name of Investigator or other Person Obtaining Consent
APPENDIX G

HUMAN SUBJECTS APPROVAL

January 13, 2021

Melinda Wallace
Executive Ed.D. Cohort Program
The University of Alabama
Box 870390

Re: IRB # 20-12-4152 "Thriving or Simply Surviving? An Examination of Black Women in STEM at a PWI"

Dear Dr. Wallace:

The University of Alabama Institutional Review Board has granted approval for your proposed research. Your protocol has been given exempt approval according to 45 CFR part 46.104(d)(2) as outlined below:

(2) Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording) if at least one of the following criteria is met:

(iii) The information obtained is recorded by the investigator in such a manner that the identity of the human subjects can readily be ascertained, directly or through identifiers linked to the subjects, and an IRB conducts a limited IRB review to make the determination required by §46.111(a)(7).

Please provide the ORC with a copy of the approval from the UA Registrar’s Office once received. No research can begin until this information is provided for the IRB file.

The approval for your application will lapse on January 12, 2022. If your research will continue beyond this date, please submit the annual report to the IRB as required by University policy before the lapse. Please note, any modifications made in research design, methodology, or procedures must be submitted to and approved by the IRB before implementation. Please submit a final report form when the study is complete.

Please use reproductions of the IRB approved informed consent form to obtain consent from your participants.

Good luck with your research.

Sincerely,

[Signature]

Carpentato T. Myles, MSM, CIM, CIP
Director & Research Compliance Officer