

STAYING THE COURSE: THE PERSISTENCE OF AFRICAN AMERICAN
BIOLOGY MAJORS AT A PREDOMINANTLY WHITE INSTITUTION

by

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ABSTRACT

MICHELLE B. PASS. Staying the course: the persistence of African American biology majors at a predominantly White Institution. (Under the direction of Dr. CHANCE W. LEWIS)

Increasing the number of African Americans graduating with STEM degrees and entering the STEM workforce has been the focus of countless political reports and educational studies for decades; however, African Americans continue to experience waning graduation rates and mounting attrition rates in STEM disciplines while remaining vastly underrepresented in STEM fields. This study differs from previous studies that have focused on African Americans in STEM utilizing a deficit-based approach. This qualitative, phenomenological study examined the experiences of African American students who were successfully navigating the biology major at a predominantly White institution. This study sought to identify the factors that support the persistence of African American students in the biology major at a predominantly White institution, and to describe how these factors support their persistence in the biology major. Data were collected through in-depth interviews with six African American undergraduate biology students and analyzed using phenomenological analysis. Findings revealed that although the students were successful in the biology major, the lack of support from professors and peers within the biology major, adversely affected their academic and social experiences. Four themes emerged from the analysis of interview data. The themes are: self-determination, peer-support, independence, and adaptation. Recommendations for educational stakeholders and future research are discussed.

DEDICATION

This dissertation is dedicated to my beloved late father, Miland “Mike” Boone, who truly believed I could do anything, and to my late brother, Michael Jeffrey Boone. I never imagined you would not be here to celebrate the completion of this work. I hope I’ve made you proud!

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CHAPTER 1: INTRODUCTION

Innovations in science and technology have positioned the United States as a leader in the global economic market. However, the United States is at risk of losing its global ranking as it is projected that by 2027, it will encounter a deficit of one million science, technology, engineering and math (STEM) graduates prepared to enter the science and technology workforce (Anderson & Kim, 2016; Chen, 2013; Darling-Hammond, 2010; Eagan et al., 2010; Espinosa, 2011; Graham et al., 2013).

The STEM degree completion rate is less than 50% for the more than three million students of any race who pursue a STEM degree in the United States (Benish, 2018; Graham et al., 2013). Table 1 shows the trend in bachelor's degree attainment in 2016-2017. Of the two million bachelor's degrees awarded in 2016–17, the largest number was awarded in business fields (381,000), while the number of degrees awarded in biological and biomedical sciences (117,000) and engineering fields (107,000) was significantly lower (de Brey et al., 2019). Degree attainment statistics illuminate the disparity in the number of degrees awarded in STEM fields compared to the number of degrees awarded in non-STEM fields (Table 1). The number of STEM degrees awarded is simply not sufficient to provide a STEM workforce large enough to satisfy the demand for STEM workers in the United States.

If the number of students graduating with STEM degrees continues to decrease, the United States will be unable to compete with countries such as China and India that are vastly out producing the United States in educating and training its citizens in STEM fields (Lancaster & Xu, 2017).

Table 1*Bachelor's Degrees Awarded by Field: 2016–17*

Field	Degrees Awarded
Business	381,000
Health Professions	238,000
Social Sciences and History	159,000
Psychology	117,000
Biology and Biomedical Sciences	117,000
Engineering	107,000

NOTE: The fields shown are the six programs in which the largest number of bachelor's degrees were conferred in 2016–17. Data are for postsecondary institutions participating in Title IV federal financial aid programs. Adapted from Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS), Fall 2001 through Fall 2017. Retrieved from <https://nces.ed.gov/pubs2019/2019038.pdf>

Without an adequately trained workforce, U.S. companies will be forced to either relocate to foreign countries that can supply a steady stream of qualified workers or increase the number of non-native born STEM professionals employed within the United States (Lancaster & Xu, 2017). Relocating U.S. companies to foreign countries would have a devastating effect on the nation's domestic markets and economic power (Lancaster & Xu, 2017). The National Academies (2006) predicts that 90% of science jobs will be lost to workers in foreign countries by 2027. To avert a STEM crisis and to maintain its position as a leader in the global marketplace, the United States must increase the number of native-born students graduating with degrees in STEM fields and entering the STEM workforce (Lancaster & Xu, 2017). However, changes in the nation's

racial demographics will require the United States to broaden its focus to include students of color in its endeavors to resolve the STEM crisis.

Throughout this paper, I will use the terms African American and Black, and Hispanic and Latino interchangeably. The number of White students enrolled in K-12 public schools has decreased from 28.4 million in 2003 to 25.2 million in 2013; and is projected to fall to 23.5 million by 2025 (NCES, 2015). The decreased enrollment of White students in public schools is reflective of the larger population. According to the U.S. Census Bureau's 2014 National Projections, non-Hispanic Whites are currently the largest racial and ethnic group in the United States, and by 2044, over 50% of Americans will be classified as non-Hispanic Whites (Colby & Ortman, 2015). By 2060, non-Hispanic Whites will comprise only 44% of the nation's population at which point the United States will become a "majority minority" nation (Colby & Ortman, 2015). Although non-Hispanic Whites will remain the largest single group in the United States, no single racial or ethnic group will make up the majority of the nation's population (Colby & Ortman, 2015). The Hispanic population is expected to increase 115% as the population of Hispanics increases from 55 million in 2014 to 119 million in 2060 (Colby & Ortman, 2015). According to the U.S. Census Bureau's 2014 data, only 52% of children under age 18 are non-Hispanic Whites (Colby & Ortman, 2015). Within the next two decades, White students will account for less than 50% of the total enrollment in K-12 public schools (Colby & Ortman, 2015). In contrast, the number of African American and Hispanic students enrolled in K-12 public schools are projected to exceed the number of White students over the next decade (Darling-Hammond, 2010). African American and Hispanic students represent a plausible resource for increasing the STEM workforce

and lessening the STEM crisis, however racial and ethnic minorities have not received a fair and equitable education through state-funded K-12 schooling, and subsequently are unprepared for the challenging curricula in STEM disciplines (Anderson, 1988; Carter & Welner, 2013; Darling-Hammond, 2010; Dubois, 1903; Kozol, 2006; Ladson-Billings & Tate, 1995; Landsman & Lewis, 2011).

The need to increase the number of African American students pursuing STEM majors and graduating with STEM degrees is well documented and has been the focus of research studies for more than two decades (Anderson & Kim, 2016; Chen, 2013; Chen & Solder, 2013; Coleman & Kozol, 1992; Darling-Hammond, 2010; Domingo et al., 2019; Eagan et al., 2010; Espinosa, 2011; Graham et al., 2013; Hrabowski & Henderson, 2017, 2019; Hurtado et al., 2007; Hurtado et al., 2010; Lancaster & Xu, 2017; Lewis et al., 2011; Maton et al., 2000; Rice et al., 2016; Riegle-Crumb & King, 2010; Russell & Atwater, 2005; Russell et al., 2018; Toldson, 2018). Research on African Americans in STEM reveals a correlation between inadequate K-12 education and high attrition rates in STEM majors (Anderson & Kim, 2016; Chen 2013; Espinosa, 2011; Rice et al., 2016). If the aim is to have an adequately trained STEM workforce to circumvent the proposed STEM crisis, then emphasis must be placed on bolstering K-12 education, particularly in math and science for African American and Hispanic students, (Chen, 2013; Darling-Hammond, 2010; Espinosa, 2011; Hrabowski & Henderson, 2017; Palmer et al., 2011; Pascarella & Terenzini, 2011; Russell & Atwater, 2005). Without the K-12 academic preparation needed to pursue STEM majors and graduate with STEM degrees, African American and Hispanic students are unable to secure high-paying STEM jobs thereby

limiting their earning potential and ability to transcend their social status (Bottia et al., 2016).

The unequal distribution of wealth among Whites and people of color in the United States has created communities and schools that are largely segregated along racial boundaries. In 2017, the median household income was \$70,642 for non-Hispanic Whites, \$51,450 for Hispanics, and \$41,361 for Blacks (Semega et al., 2019). In 2018, the poverty rate was 8.1% for non-Hispanic Whites, 17.8% for Hispanics, and 20.8% for Blacks (Semega et al., 2019). As a result, African American and Hispanic students tend to be concentrated in high poverty, low-income, urban schools plagued with fewer educational resources, less qualified teachers, and less challenging curricula than in higher-income, largely White suburban schools (Ladson-Billings, 2016; Vivian, 2017). In 2016-2017, 45% of Hispanic students and 44% of Black students attended high poverty schools compared to just 8% of White students (NCES, 2018). Darling-Hammond (2010) characterizes schools with large numbers of low-income students of color as apartheid schools, and argued that “apartheid or racially segregated schools with large numbers of African American and Hispanic students have crumbling, overcrowded buildings, poor libraries and few materials, old and dilapidated texts so scarce that students must share them in class and cannot take them home for homework, and a revolving-door teaching force with little professional expertise” (p. 83). Moreover, students of color who attend racially segregated schools are more likely to experience disparities in academic achievement than their White counterparts due to “differences in access to key

educational resources that support learning at home and at school: expert teachers, personalized attention, high-quality curriculum, good educational materials, and plentiful information resources” (Carter & Welner, 2013, p. 77).

A 2018 report by The U.S. Department of Education (Nov 2018) refers to mathematics as the “language” of STEM and affirmed that mathematics provides the necessary foundation for students’ to succeed in STEM courses. Enrollment in Algebra I in 8th grade is critical to students’ ability to enroll in higher level math and science courses in high school, and as such, Algebra I serves as a gatekeeper course preventing students without it from enrolling in the courses needed to pursue STEM majors in college (U.S. Dept. of Education, 2018). The inequitable distribution of resources and quality teachers in K-12 schools prevents some students from having access to Algebra I in 8th grade, while other students with access to Algebra I do not enroll in it. The percentage of 8th grade students enrolled in Algebra I in 2015-2016 varied by race/ethnicity (CRDC, 2015-2016). Although 80% of 8th graders in the United States had access to Algebra I, 24% of White students enrolled in Algebra I in 8th grade, while just 12% of Black students enrolled in Algebra I in 8th grade (CRDC, 2015-2016). Students who do not take Algebra I in the 8th grade, are unlikely to take college preparatory math and science courses in high school (CRDC, 2018).

Schools with large populations of African American and Hispanic students are less likely to have college-preparatory courses, while schools with large populations of White students are more likely to have college-preparatory courses (Cokley et al., 2017). Even when African American and Hispanic students attend desegregated schools, they may experience segregation within their classes due to “tracking” (Vivian, 2017). Vivian

(2017) describes tracking as “the difference between being in an advanced placement (AP), a college preparatory course, or not” (p. 8). Tracking in public schools begins as early as elementary school through state mandated assessment testing. Scores on 5th grade assessment tests dictate the math courses students will take in middle school, and the math courses taken in middle school will determine the math and science courses taken in high school. The effects of tracking is seen as early as middle school with White students making up the majority of students in upper level courses. This trend continues into high school as Black students are placed in lower level or remedial courses while White students are placed in advanced placement (AP) and honors courses which are categorized as “college preparatory “courses (Cokley et al., 2016; Vivian, 2017).

Enrollment in AP courses provides an opportunity for high school students to take college-level courses in 38 different subjects while in high school, and to earn college credit or placement credit for the AP courses they take if the required score is earned on the qualifying AP exam (College Board, 2019). The College Board (2019) reports that Black students enroll in fewer AP courses than any other racial group. Vivian (2017) asserts that it is not only teacher expectations that are lower for Black students in remedial courses, but their White classmates perceive them as being less capable since they are not enrolled in similar classes. The assumptions and biases brought on by racial stratification in classes have a profound effect on the attitudes of Black students towards school (Burris, 2014).

K-12 schools in low socioeconomic areas tend to be staffed with teachers who lack the education and training to provide students with challenging curricula in math and science. (Chen, 2013; Coleman & Kozol, 1992; Darling-Hammond, 2010; Espinosa,

2011; Graham et al., 2013; Wiggan & Walton, 2014). Vivian (2017), argued that “teacher quality is inversely related to the number of African American students in a school, and the more African American students there are at a school, the more teacher quality deteriorates” (Vivian, 2017, p.6).

In addition to an underrepresentation of qualified teachers in public K-12 education, there is an overrepresentation of White teachers in public K-12 schools. Over 80% of K-12 teachers in the United States are White women who have had few interactions with students of color and who bring their privilege, biases and deficit views towards students of color into the classroom (Landsman & Lewis, 2012). Goldberg (2014) refers to the ratio of White teachers and non-White students as a “racial mismatch” and pointed out that White teachers teach from a white, Eurocentric perspective without including the cultures of their students in their pedagogical practices. Culturally sustaining pedagogy includes teaching practices that recognize and support the diverse cultures of students. Science lessons provide an ideal opportunity for educators to incorporate students of color in the curriculum and to teach about diversity and the relationship between genetics and race. Providing science lessons that are inclusive and affirming to students of color can be used to encourage greater interest in science and other STEM subjects.

The disparate conditions in low-income schools resulted in the under-performance of racial and ethnic minorities on standardized assessments creating what the U.S. Department of Education refers to as an “achievement gap” between White students and students of color in K-12 education (Darling-Hammond, 2010; Kozol, 2006).

The Department of Education refers to differences in the academic performance of White and Black students as an “achievement gap”, however the narrative of an achievement gap questions the ability of African American students to achieve at the same academic level as White students without accounting for inequities within the education system (Coleman & Kozol, 1992; Darling-Hammond, 2010; Espinosa, 2011; Graham et al., 2013). Milner (2013) argued that the “achievement gap” discourse focuses on students from a deficit perspective. A more accurate term for the disparity in academic performance between these groups of students is an “opportunity gap”. Milner (2013) declared that students’ performance on achievement tests is not reflective of their ability to learn, but instead reflects their opportunities to learn.

The opportunity gap between Black students and White students in science is evident on 4th, 8th, and 12th grade NAEP science assessments taken from 2009 to 2015 as displayed in Table 2. Black students consistently scored lower on 4th, 8th, and 12th grade science assessments than all other racial groups tested (NCES, 2016). The average NAEP science score increased by four points from 2009 (150) to 2015 (154) for 4th grade and 8th grade students across the United States (NCES, 2016). According to McFarland et al. (2019), the slight increase in NAEP science scores for Black students implied the achievement gap was narrowing. Despite the small gain in Black students’ NAEP science scores, 4th grade White students scored 33 points higher on the science assessment than did 4th grade Black students, and 8th grade White students scored 34 points higher on the science assessment than did 8th grade Black students (NCES, 2016). Closer examination of the science assessment data reveals that over a six-year period, from 2009 to 2015, the White-Black science score gap decreased by three points for 4th grade students and by

two points for 8th grade students. Therefore, few gains were made in decreasing the gap in 4th and 8th grade science assessment scores among Black and White students. Twelfth grade science scores further reflect the gap in science scores. The average NAEP science score for twelfth grade students was 160 for White students, 125 for Black students, 136 for Hispanic students, and 167 for Asian students (NCES, 2016). The number of 12th grade students taking science courses increased from 53% in 2009 to 57% in 2015, however there was no change in the average science scores of 12th grade students from 2009 (150) to 2015 (150) (NCES, 2016). Because there were no significant changes in science scores within each racial group, the average science score of 12th grade Black students remained lower than the average science score of White students and all other racial/ethnic groups (NCES, 2016). Graham et al. (2013) attributes African American students' deficiencies in science to inadequacies in the K-12 science curriculum provided in public schools. Although considerable attention is given to the "opportunity gap" and the fact that White students score higher than Black students on national science assessments, there is less attention given to international assessments that show all U.S. students lagging behind students around the world in science.

Table 2

Average National Assessment of Educational Progress (NAEP) Science Scale Scores by Grade Level and Race/Ethnicity of Student: 2009, 2011, and 2015

	4 th Grade			8 th Grade			12 th Grade		
	2009	2011	2015	2009	2011	2015	2009	2011	2015
Race/Ethnicity									
White	163	---	166	162	163	166	159	---	160
Black	127	---	133	126	129	132	125	---	125
Hispanic	131	---	139	132	137	140	134	---	136
Asian/Pacific Islander	160	---	167	160	159	164	164	---	166
American Indian/Alaska Native	135	---	139	137	141	139	144	---	135

NOTE: In 2011, only 8th-grade students were assessed in science. From U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2009, 2011, and 2015 Science Assessments.

The 2015 Trends in International Mathematics and Science Study (TIMSS, 2015) reports that the average science score of U.S. 4th-graders (546) was lower than the average science score in seven countries. The countries that scored higher than the United States on 4th grade science assessments were Singapore, the Republic of Korea, Japan, Russian Federation, Hong Kong, Chinese Taipei, and Finland. The average science score of U.S. 8th-graders (530) was lower than the average score in seven countries. The seven countries that outperformed the United States in 8th-grade science were Singapore, Japan, Chinese Taipei, the Republic of Korea, Slovenia, Hong Kong, and the Russian Federation. In addition, the TIMSS report conveyed there was no significant difference in 4th grade science scores from 1995 to 2015, and 8th grade science scores showed no significant difference from 2003 to 2015 (Provasnik et al., 2016).

African American and White students enter college with similar aspirations regarding declaration of a major in a STEM field, however lack of access to college preparatory and advanced placement (AP) courses in biology, chemistry, physics, and calculus while in high school, negatively affects the likelihood that African American undergraduate students will persist to the point of declaring the STEM major (Eagen et al., 2010; Hurtado et al., 2007; Riegle-Crumb & King, 2010). Graham et al. (2013) argued that African American students enroll in college considerably behind their White counterparts in science and are therefore less likely to major in STEM. African American students who do major in STEM are twice as likely as White students to leave the major before graduation (Graham et al., 2013; Hurtado et al., 2007; Bottia, Giersch, Mickelson, Stearns, & Mkmoller 2016). If the United States is to maintain its position as a leader in science and technology, it will have to focus on closing other gaps in education including “the teacher quality gap; the teacher training gap; the challenging curriculum gap; the school funding gap; the digital divide gap; the wealth and income gap; the employment opportunity gap; the affordable housing gap; the health care gap; the nutrition gap; the school integration gap; and the quality childcare gap” (Irvine, 2010, p.xxi).

The need to increase STEM graduates has diffused beyond the ivory walls of academia and has prompted government agencies and political officials to incorporate the STEM crisis as part of their agenda. The *Educate to Innovate* campaign launched by the Obama Administration in 2009 addressed the need to increase the number of U.S. students in STEM fields (NCES, 2013; Seadler, 2012). The President’s Council of Advisors on Science and Technology (PCAST) issued an appeal to colleges and universities to increase the number of students graduating with STEM degrees. In its

2011 report to congress, the National Academies of Sciences, Engineering, and Medicine warned that if the United States is to remain successful in a globalized economy, it must produce and maintain a sufficient STEM workforce (Hrabowski & Henderson, 2019). *The Crossroads Report*, “urged the country to invest in the success of students of all backgrounds in STEM from preschool through graduate school and on into early careers” (p. 68). Increasing the STEM workforce has become a national initiative (Chen, 2013; Graham et al., 2013). The President's Council of Advisors on Science and Technology (PCAST, 2012) suggested that colleges and universities could prevent a STEM crisis in the United States by increasing the number of STEM graduates over the next decade, however Rice et al. (2016) declared that the current situation regarding African Americans in STEM has already reached the crisis level. If the United States is to have an adequately trained workforce prepared to take on the technological jobs of the 21st century, then it must identify the factors that support the persistence and retention of African American students in STEM majors (Graham et al., 2013).

The decline in students pursuing STEM majors and graduating with STEM degrees is not reflective of overall college enrollment rates in the United States. College enrollment rates have increased steadily from 2000 to 2017 for students of all races/ethnicities (de Brey et al., 2019). The enrollment rate for White students increased from 39% to 42%, and the enrollment rate for Black students increased from 31% to 36% (de Brey et al., 2019). Despite an increase in college enrollment rate for Black students, White students continue to earn considerably more bachelor's degrees than Black students. The National Center for Education Statistics (2018) reports that in the 2016-

2017 school year, White students earned 64% of all bachelor's degrees, while Black students earned only 11% of all bachelor's degrees (de Brey et al., 2019).

The disparity in the number of bachelor's degrees earned by Black students is also reflected in the number of bachelor's degrees earned by Black students in STEM fields (de Brey et al., 2019; Lancaster & Xu, 2017). A recent report by the National Center for Education Statistics (2018) on bachelor's degree completion rates in STEM fields revealed the vast majority of STEM degrees earned in 2016-2017 were earned by White students. Table 3 shows the percentage of bachelor's degrees awarded in STEM fields by race/ethnicity with White students earning 63% of STEM degrees and Black students earning 7% of STEM degrees (de Brey et al., 2019).

Table 3

Percentage of Bachelor's Degrees Earned in Science, Technology, Engineering, and Mathematics (STEM) by Race/Ethnicity of Student: 2008-09 through 2016-17

Year	White	Black	Hispanic	Asian	Pacific Islander	American Indian/ Alaska Native
2008-09	71.6	7.6	7.0	---	---	0.7
2009-10	71.3	7.5	7.3	---	---	0.7
2010-11	69.8	7.3	7.8	13.0	0.2	0.6
2011-12	69.1	7.4	8.2	12.8	0.3	0.6
2012-13	67.9	7.5	8.8	13.0	0.3	0.6
2013-14	67.0	7.2	9.5	12.8	0.3	0.5
2014-15	65.8	7.1	10.2	12.9	0.2	0.4
2015-16	64.6	7.0	10.9	13.3	0.2	0.4
2016-17	63.5	7.0	11.6	13.6	0.2	0.4

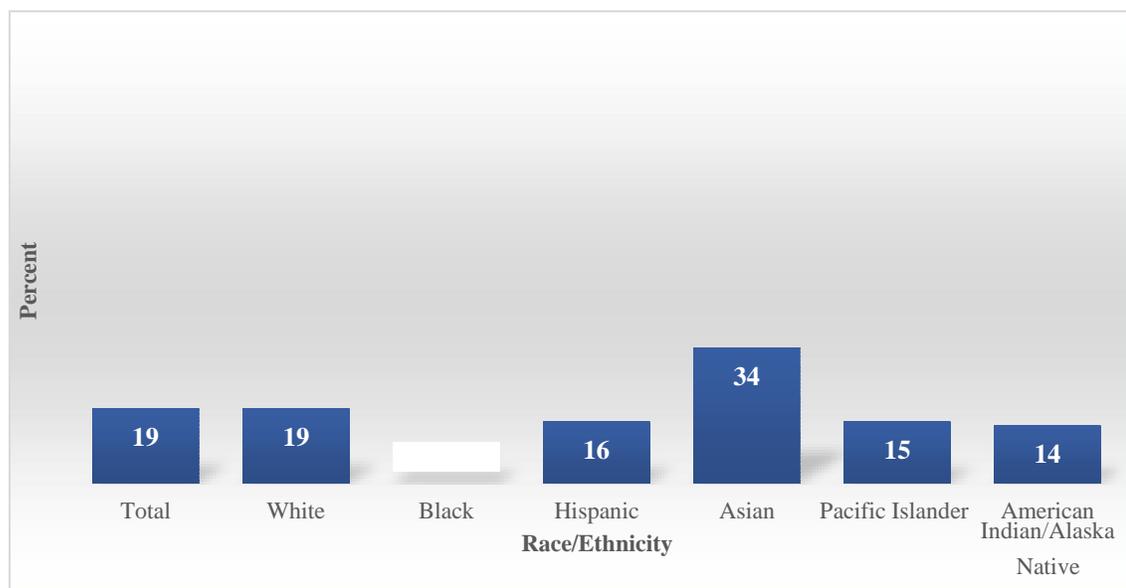
Note: Data are for postsecondary institutions participating in Title IV federal financial aid programs. STEM fields include biological and biomedical sciences, computer and information sciences, engineering and engineering technologies, mathematics and statistics, and physical sciences and science technologies. From U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS), Fall 2009 through Fall 2017, Completions component.

The disparity in STEM degrees awarded to Black students is further illustrated in the number of bachelor's degrees earned by Black students compared to all bachelor's degrees earned by Black students. Figure 1 illustrates that of all the bachelor's degrees earned by Black students, just 12% were in a STEM field.

The trend in STEM degrees earned by Black students is particularly concerning considering the rapidly changing racial demographics in the United States. Changing demographics in student populations are not limited to K-12 schools but are also reflected in higher education enrollment (Salazar et al., 2018).

Figure 1

2016-2017 Percentage of Bachelor's Degrees Awarded in Science, Technology, Engineering, and Mathematics (STEM) Fields, by Race/Ethnicity



Note. From U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS), Fall 2017, Completions Component.

The American Association of Colleges and Universities referred to the rapidly increasing population of underrepresented minority students (URMs) attending institutions of higher learning in the United States as “the new majority” (as cited in Salazar et al., 2018). The number of URMs enrolled in colleges and universities in the United States has surpassed the number of White students, however URMs comprise only 11% of the STEM workforce (Chubin et al., 2005). The number of Blacks and Hispanics in STEM is not reflective of their proportion of the U.S population (Palmer et al., 2011). The rapidly expanding population of URM students pursuing higher education represents a potential pool of STEM graduates; as such, URMs have become the focus of an extensive body of research seeking to identify the factors that contribute to URMs’ underrepresentation in STEM majors and STEM careers (Anderson & Kim, 2006; Chen, 2013; Darling-Hammond, 2010; Espinosa, 2011; Graham et al., 2013; Palmer et al., 2011)

According to Smith et al. (2019) “the reasons for students leaving STEM are well documented and include academic, institutional, individual, social, as well as other external obstacles that are not as easily generalized” (p. 292). If increasing graduation rates among URMs in STEM majors is the desired outcome, then researchers must position their focus on identifying the most effective methods and strategies to support their persistence and retention in STEM majors, rather than ascertaining the myriad reasons URMs leave STEM majors at higher rates than their White counterparts.

Broader research has focused on African American students in STEM from a deficit perspective, attributing African American students’ deficiencies in science and math to inadequate K-12 education and the low socioeconomic status of their families

and communities (Chen, 2013; Coleman & Kozol, 1992; Darling-Hammond, 2010; Espinosa, 2011; Graham et al., 2013). Despite the inequities in K-12 education in schools with large numbers of racial and ethnic minorities, 12% of STEM degrees awarded in the United States are awarded to African American students who “stay the course” regardless of the academic, social, and structural obstacles they encounter, and successfully complete the STEM major (NCES, 2016). Table 4 illustrates the trends in STEM degree attainment for African American students from 1996 to 2016. The data shows the percentage of African American students attaining bachelor’s degrees in STEM fields decreased or was unchanged from the previous year in all fields except biological sciences.

The absence of programs and practices which have been shown to provide support for African Americans in STEM majors means the United States will be unable to provide the STEM graduates needed to meet the workforce demands of a scientifically and technologically advanced society. Considerable attention, research, and funding has focused on increasing the numbers of African Americans in STEM so as to maintain the status quo of the United States as a global leader; however, there has been little focus on identifying the practices and strategies utilized by the African Americans who earn 12% of the STEM degrees in the United States, or the nation’s ethical responsibility to provide African Americans with the skills necessary to succeed and flourish in a technological society.

Table 4

Science and Engineering Bachelor's Degrees Earned by Blacks or African Americans, as a Percentage of Degree Field, by Field: 1996–2016

Year	Biological Sciences	Computer Sciences	Mathematics and Statistics	Physical Sciences	Engineering
1996	5.28	9.89	7.13	5.54	4.75
1997	5.45	9.58	7.98	5.63	4.93
1998	5.83	9.65	7.99	5.75	4.96
1999	NA	NA	NA	NA	NA
2000	6.24	9.50	7.72	6.14	5.16
2001	6.44	10.04	7.06	5.81	4.88
2002	6.44	10.17	6.88	6.01	4.92
2003	6.56	10.50	6.14	5.47	4.85
2004	6.71	10.44	5.70	5.65	4.99
2005	6.46	10.65	5.77	5.45	4.85
2006	6.48	10.99	5.53	5.39	4.70
2007	6.53	10.77	5.35	5.32	4.63
2008	6.50	10.31	5.02	5.34	4.44
2009	6.46	10.05	5.19	5.43	4.39
2010	6.39	10.14	4.95	5.11	4.14
2011	6.23	10.14	4.56	5.02	3.97
2012	6.22	10.10	4.86	5.42	3.86
2013	6.23	10.66	4.71	5.05	3.99
2014	6.16	9.75	4.60	5.05	3.83
2015	6.30	9.53	4.39	4.78	3.86
2016	6.51	8.68	4.15	4.64	3.86

Note: Data not available for 1999. Biological sciences includes agricultural sciences. Physical sciences include earth, atmospheric, and ocean sciences. Data are for U.S. citizens and permanent residents only. Adapted from “National Science Foundation, National Center for Science and Engineering Statistics, special tabulations of U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey. Retrieved from <https://nces.ed.gov/pubs2019/2019038.pdf>

Moreover, innovations in science, medicine, and technology require the skills and knowledge of a diverse group of thinkers bringing their differing perspectives to the table (Salazar et al., 2018; Thompson & Taylor, 2016). African American students’ cultural experiences and backgrounds should be viewed as assets to the STEM field (Salazar et al., 2018). According to Thompson and Taylor (2016):

Heart disease, hypertension, obesity, diabetes, infant mortality, stroke, asthma, breast cancer, and other diseases continue to disproportionately affect African Americans. A large part of the solution, as reported by the Institute of Medicine and others, is to diversify the health professions workforce. (p. 31)

Despite the extensive research and national attention directed at increasing underrepresented minorities (URMs) in STEM, the number of African Americans completing STEM degrees remains the lowest of all racial/ethnic minorities (de Brey et al., 2019; Graham et al., 2013; Lancaster & Xu, 2017). If the United States is to meet its goal of having an adequately trained workforce to offset the proposed deficit of one million STEM graduates by 2027, further research is needed to determine the factors that support the retention of African Americans in STEM (Domingo et al., 2019).

Prior research has shown that early intervention strategies are the most appropriate methods to promote interest and engagement in STEM (Palmer et al., 2011). Retention strategies, such as undergraduate research and faculty mentoring, have been shown to positively impact students' self-confidence and self-efficacy (Cavnar & Stanny, 2018; Cole & Griffin, 2013; MacPhee et al., 2013). African American students participating in faculty mentorships have been shown to have higher grade point averages, graduate from science and engineering majors at higher rates, and have higher rates of admittance to graduate school (Cavnar & Stanny, 2018). African American students participating in undergraduate research do so under the tutelage of a faculty member and as a result have more interactions with faculty, have greater technical and presentation skills, and tend to express added self-confidence (Palmer, et al., 2011).

Statement of the Problem

Although there is significant research exploring the positive impact of early intervention strategies and retention strategies on increasing persistence and retention of African American students in STEM majors, there is limited research focusing on the lived experiences of successful African American STEM majors in general. There are African American students who persist in the biology major without the benefit of an undergraduate research experience or a faculty mentor, particularly if they attend a predominantly White institution (PWI). This research identifies the factors that support the retention and persistence of African American undergraduate students in a STEM major. This study explores the experiences of African American students who at minimum have completed the first year of coursework in the biological sciences major at a predominantly White institution. Qualitative methodology is utilized in the form of open-ended interview questions to better understand the experiences of undergraduate African American students majoring in biology at a PWI and to identify factors that contribute to their persistence in the major. The data collected in this study can be used to identify programs and practices to support the persistence of African American students in STEM majors and can ultimately be used to increase the number of African American students graduating with STEM degrees.

Purpose of the Study

This study explores the academic and social experiences of African American undergraduate students enrolled in the biology major at a PWI, to identify recurring themes in their academic and social experiences, and to determine how those experiences contribute to their persistence in the biology major. Biology was selected as the STEM field to examine in this study because as shown in Table 4, biological sciences is the only

STEM field that has shown an increase in the percentage of African American students earning bachelor's degrees from 1996-2016. In addition, biology is the major chosen most often by students whose intended post-baccalaureate goal is to pursue a health-related program such as medical school, dental school, or pharmacy school (de Brey et al., 2019).

This study seeks to determine common themes that emerged from interviews with African American undergraduate students who are persisting in the biology major at a predominantly White university in the southeastern United States. Students interviewed recounted their lived experiences as African American biology majors attending a PWI. Data was analyzed to identify recurring themes in the interview data. The themes that emerged can provide a template for the development of programs and practices to support African American undergraduate STEM majors.

Theoretical Framework

Critical Race Theory (CRT) and Tinto's Theory of Persistence and Retention are the theoretical frameworks that guide this research study. A key tenet of CRT is "storytelling" and "counter-storytelling". CRT calls on those "whose voice and perspective-whose consciousness- has been suppressed, devalued, and abnormalized" to reflect on their experiences, to give meaning to their experiences, and to speak their reality (Delgado & Stefancic, 2000, p. 60). Critical race theorists emphasize the importance of narratives and counter-narratives or "storytelling" in constructing reality. Storytelling can be used for community-building and to share cultural mores and norms, however counter-storytelling can disrupt the status quo by countering the narrative put forth by those in power (Delgado & Stefancic, 2000). Delgado (1989) declared that

reality is not fixed, but is socially constructed through conversations, therefore storytelling can be used to give meaning to lived experiences. According to Delgado (1989), people of color use storytelling to share experiences of racism. Furthermore, storytelling can also be used to change mindsets by allowing people of color to provide counter-narratives to the stories conveyed by those in power.

CRT “challenges the dominant discourse on race and racism as it relates to education by examining how educational theory and practice are used to subordinate certain racial and ethnic groups” (Solorzano and Yosso, 2001, p.2). Critical race theorists emphasize the insertion of the voices of oppressed and marginalized groups to add a counter-narrative to deficit-based discourses (Milner, 2007).

CRT provides a guiding framework for this study by positioning the voices of the African American STEM majors as the central point of the study. CRT provides an opportunity for African American students to speak about their experiences as biology majors at a predominantly White university. Through the framework of CRT, this study provided a space for African American students to voice their experiences as students of color persisting in a space in which they are historically underrepresented. Participants’ experiences will be used to counter the narrative of African American students as unsuccessful in STEM majors, and to identify structural inequities that may hinder the persistence of other African American students in biology. The experiences of the participants were analyzed to identify factors that contribute to their persistence in the biology major at a PWI, to challenge the dominant ideology of African American students as inept in math and science as depicted in the “achievement gap”, and to provide success strategies for other African American students to navigate this space.

Tinto (1975) produced a theoretical model of attrition and persistence to explain the interactions between individuals and institutions of higher education that caused some individuals to drop-out of the institution. Tinto's persistence theory includes the following tenants: a) pre-entry attributes (prior schooling and family background); b) goals/commitment (student aspirations and institutional goals); c) institutional experiences (academics, faculty interaction, co-curricular involvement, and peer group interaction); d) integration (academic and social); e) goals/commitment (intentions and external commitments); and f) outcome (departure decision—graduate, transfer, dropout). Persistence theory suggests that students' commitment to their educational goals and their commitment to remain at an institution are shaped by their motivation, academic ability, and ability to integrate into the institution's academic and social community (Tinto, 1975).

Tinto's seminal theory on student persistence is rooted in social psychology and economics and incorporates components of one of Durkheim's theories of suicide (Metz, 2004). Durkheim's egotistical suicide model asserts that "suicide can be attributed to the individual's lack of social and intellectual integration into the social life of his or her society" (Aljohani, 2016, p. 3). Similarly, persistence theory posits that students enter college with certain expectations and if these expectations are not met, students become unmotivated and disengaged, which in turn hinders their academic and social integration, and ultimately alters their institutional goals and commitments. College experiences can either enhance or diminish a students' academic self-confidence which in turn affects their academic performance and persistence (Zimmerman, 1995). The persistence theory framework categorizes learning and professional identification as determinants of

persistence (Tinto, 1975). Tinto states "there appears to be an important link between learning and persistence that arises from the interplay of involvement and the quality of student effort." According to Tinto (1975), "involvement with one's peers and with the faculty, both inside and outside the classroom, is itself positively related to the quality of student effort and in turn to both learning and persistence" (p. 71).

Tinto's persistence theory, although widely regarded as providing the most salient explanation of undergraduate student persistence in higher education, received considerable criticism for failing to recognize cultural and familial associations as support systems for minority students (Guiffrida, 2006; Hunn, 2008; Kuh et al., 2007; Lancaster & Xu, 2017; Pascarella & Terenzini, 2005). Tinto (1993) proposed that students' level of commitment to completing their degree is dictated by their integration into the academic and social communities of the institution, and students' integration in the institution is contingent on their ability to "break away" from past associations. A major point of contention for Guiffrida (2006) and Hunn (2008) is Tinto's assertion that persistence requires students to disconnect from their families, cultures and communities and to fully integrate themselves in the academic and social community of the institution. Guiffrida (2006) stated that "minority students' cultural backgrounds often differ from the Eurocentric frameworks upon which the norms and values at PWIs are based" (p. 451).

Tinto (2006) conceded that earlier models were simplistic and did not consider all the factors that influence students' persistence and attrition. Tinto stated that "much of the early work was drawn from quantitative studies of largely residential universities and students of majority backgrounds. As such it did not, in its initial formulation, speak to

the experience of students in other types of institutions, two- and four-year, and of students of different gender, race, ethnicity, income, and orientation” (Tinto, 2006, p.3). According to Tinto (2006), early studies regarding student retention did not consider the role institutions played in students’ retention or attrition:

Student retention or the lack thereof was seen as the reflection of individual attributes, skills, and motivation. Students who did not stay were thought to be less capable, less motivated, and less willing to defer the benefits that college graduation was believed to bestow. Students failed, not institutions. This is what we now refer to as blaming the victim. (p.2)

Tinto’s persistence theory has undergone several iterations as the model has been adapted to include additional factors regarding family, culture and community that have been found to largely affect the persistence of minority students beyond those indicated in his original model. Tinto (2006) wrote:

Where it was once argued that retention required students to break away from past communities, we now know that for some if not many students the ability to remain connected to their past communities, family, church, or tribe is essential to their persistence. (p. 4)

Although Tinto’s theory regarding persistence has been revised, he maintains that students need to feel some level of social connection with on-campus peers, faculty, advisors, and service staff to persist in college (Tinto, 2006).

Dissertation Overview and Guiding Research Questions

This phenomenological research study utilizes qualitative methodology in the form of face-to-face interviews consisting of semi-structured, open-ended questions to explore the experiences of African American undergraduate students who are persisting in a STEM major at a predominantly White university. Using critical race theory as a guiding framework, this study integrates the voices of African American students who are successfully navigating a STEM major at a PWI. Using an asset-based approach, this study focuses on factors that contribute to the persistence of this group of students. Students selected for this study were pursuing a BS or BA degree in the biology major at the time of the study. The study explores students' experiences as undergraduate biology majors to determine the factors that support the persistence of this group of students in the biology major. The findings of this study revealed a positive relationship between support systems that contribute to students' overall sense of belonging, personal traits that provide a selective advantage in an unfavorable environment, and the likelihood that African American students will complete their undergraduate degree in a STEM major and pursue a STEM career. The data collected in this study can be used to further explore methods to increase the persistence and achievement of African American students in STEM majors, to grow the number of African American students graduating with STEM degrees, to increase the number of African American students attending graduate and professional programs in STEM, and to expand the pool of African American faculty members in higher education STEM.

This study used data collected from face-to-face, semi-structured interviews with African American students enrolled in the biology major at a four-year, predominantly White university in the Southeastern United States. National data on student

demographics and graduation rates was obtained from the National Center for Education Statistics (NCES). Data pertaining to the University of North Carolina at Charlotte (UNCC) was obtained from the UNCC Office of Institutional Research.

The methodology was intended to provide greater understanding of the factors that contribute to African American students' persistence and success in a STEM major at a PWI. Previous studies have documented the disparity in the number of African American students pursuing STEM majors and graduating with STEM degrees. Research examining STEM graduation rates has indicated that the number of African American STEM graduates is particularly disproportionate to White STEM graduates at predominantly White colleges and universities. This study intends to build upon previous studies by exposing the sources of support beyond undergraduate research that contribute to African American undergraduate students' retention in STEM (Maton et al., 2000; Stolle-McAllister, Domingo, & Carrillo, 2011). This study is unique in that it is conducted by a researcher who is an African American faculty member in the biological sciences major at a predominantly White university. This study is written for researchers, administrators and faculty, however, the researcher believes that STEM faculty will particularly benefit from a greater understanding of the experiences of African American undergraduate students in a STEM major. The guiding research questions for this study were: what are the factors that support the persistence of African American undergraduate students majoring in biology at a predominantly White university in the southeastern United States, and how do these factors contribute to African American undergraduate students' persistence in the biological sciences major at a predominantly white university in the southeastern United States?

This dissertation consists of five chapters. This chapter provided an introduction to the research study. It provided demographics and data to support the disparity that exists in the enrollment and graduation rate of African Americans in STEM majors. It substantiates the need to focus on the experiences of African American students majoring in STEM and the factors that support their persistence at PWIs. Chapter Two presents an overview of the literature juxtaposing African American students in STEM majors at PWIs. Chapter Two also presents the theoretical frameworks that were used to provide a lens for examining the factors that contribute to the persistence of African American STEM majors. Chapter Three outlines the study's methodology using thematic analysis to uncover recurring themes in the experiences of African American students majoring in biology. Chapter Four provides the results of the study which are used to answer the research questions. Chapter Five provides an overview of the study. It positions the study within extant literature on retention and persistence of African American undergraduate students in STEM majors by presenting key findings of the study, their significance, and recommendations for policies and practices which can be implemented by PWIs to support African American STEM majors. This chapter ends with limitations and recommendations for future studies.

Limitations and Delimitations of the Study

There are several factors that limited the generalizability of this study. Limitations to this study included the use of a small sample size. Although the number of participants was within the acceptable range for a qualitative research study, the findings of his study may have differed with a larger sample size. The study was also limited to students who

self-identified as African American and who were biology majors were selected for this study. Students who did not meet the study criteria were not included in the study.

The study was delimited by intentionally excluding certain variables from the study that may have influenced the study. The study was limited and delimited by using a single population of African American students, majoring in one specific STEM major, and enrolled at one predominantly White university in the southeastern United States. The study was also limited and delimited by using one data collection method. Semi-structured interviews were used to collect data on participants' experiences as biology students at a PWI.

The study was delimited by excluding from the study the narratives, opinions, and perceptions of faculty and administrators. The study focused on the students who experienced the phenomenon of interest in the study, and therefore all other voices except for the researcher's voice were excluded. The researchers' voice was included only to provide her positionality and to prevent the researcher's preconceived notions and biases from factoring in the study. Although there were limitations and delimitations to the study, the findings of this study provide further insight into the factors that support the persistence of African Americans in the biology major.

Significance Statement

This study provides national science assessment data for 4th, 8th, and 12th grade students, and it provides statistics on enrollment rates and graduation rates of African American students in STEM majors at historically Black colleges and universities, and at predominantly White colleges and universities. The inclusion of these quantifiers is not unique in education research as the use of statistical data to demonstrate disparities in the

academic performance of African American students is routinely found in deficit-based research studies, particularly when exploring the “achievement gap” among African American and White students in K-12 education, and when examining the disproportionate attrition rates of African American students in STEM majors. Given the minimal amount of asset-based research focusing on the persistence of African American undergraduate students in STEM majors, this study fills a gap in education research by focusing on African American students who are successfully navigating the biology major at a PWI. Moreover, by using CRT as the guiding framework of this study, the voices of African American students are incorporated in this study to provide firsthand descriptions of the experiences of African American undergraduate students who are majoring in biology and explores how these experiences contribute to their persistence in the biology major. The purpose of this study is not to highlight African American students’ failures in STEM majors, but to emphasize the factors and experiences that have provided them with the support to necessary to succeed in a STEM major.

Key Terminology

The following key terms and concepts used within this study are defined as follows:

Academic Integration: Refers to the degree to which students feel they have established a relationship and connection with faculty members (Foltz et al., 2014).

African American/Black: African American or Black refers to a person having origins in any of the Black racial groups of Africa. The terms African American and Black are used interchangeably. (de Brey et al., 2019).

Biology Major: Students who have completed the introductory sequence of biology and chemistry courses and have been approved by the Biology Department to declare the biology major.

Bracketing: A method used in qualitative research which requires the researcher to set aside biases or assumptions they have regarding a phenomenon of interest in order to experience it from a fresh perspective (Tufford & Newman, 2012).

Counter-Narrative: Also referred to as “counter- storytelling”, provides an alternative narrative to the narrative conveyed by those in power (Delgado & Stefancic, 2000).

Critical Race Theory (CRT): A theoretical framework that challenges the status quo on race and racism in education. CRT adds the voices of marginalized groups to speak about their experiences and their reality (Delgado & Stefancic, 2000).

Epoché: A method used in qualitative research which requires the researcher to clear their mind of any knowledge of a phenomenon of interest in order to experience the phenomenon from a fresh perspective as research participants experiencing it (Moustakas, 1994).

Hispanic/Latino: Hispanic or Latino refers to a person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin, regardless of race. The terms Hispanic and Latino are used interchangeably (de Brey et al., 2019).

Hispanic Serving Institution (HSI): A college or university is identified as a Hispanic Serving Institution if at least 25% of its full-time, undergraduate student enrollment consists of Latinos/as (Gasman et al., 2008).

Historically Black College and University (HBCU): A college or university founded after the American Civil War, with the primary mission to educate Black students, and to

train Black teachers under the control of White missionaries and philanthropists (Allen, & Jewell, 2002).

Minority: A person belonging to any racial group in the United States other than non-Hispanic White (Colby & Ortman, 2017).

Minority students: Includes students who are native-born African Americans, Alaskan Natives, American Indians, Hispanic Americans, Native Hawaiians, and Native Pacific Islanders ((Foltz et al., 2014).

Persistence: Is described as enrolling in college and staying until completion of a degree (Foltz et al., 2014).

Persistence Theory: A theoretical framework that posits a relationship between students' academic and social integration in higher education and their persistence in higher education (Tinto, 1993) .

Phenomenon: Is defined as an object of human experience (Van Manen, 1990).

Pre-Biology Majors: Students who are enrolled in introductory biology and chemistry courses in preparation for taking higher level biology courses. Pre-biology students have not been approved by the Biology Department to declare the biology major.

Predominantly White Institution (PWI): A college or university with a student population consisting of more than 50% White students.

Retention: Is described as enrolling in college and staying until completion of a degree (Foltz et al., 2014).

Sense of Belonging: Refers to students' sense of being accepted, valued, included, and encouraged by others including teachers and peers in an academic setting (Rainey et al., 2018).

Science Identity: Is described as possessing meaningful knowledge and understanding of science content and being motivated to understand the world scientifically. Science identity incorporates competence with scientific practices including the use of scientific instruments, scientific talk and ways of acting in scientific settings. In addition, science identity includes recognition by self and others as a *science person* (Carlone & Johnson, 2007).

Social Integration: Refers to the degree to which students believe they have established significant relationships with peers and the campus community (Foltz, et al., 2014).

STEM: The disciplines of science, technology, engineering, and math (Palmer et al., 2018). STEM fields include biological and biomedical sciences, computer and information sciences, engineering and engineering technologies, mathematics and statistics, and physical sciences and science technologies (de Brey et al., 2019).

STEM Careers: Include computer scientists, mathematicians, engineers, architects; life, physical, and social scientists; medical professionals; and managers of STEM activities (de Brey et al., 2019).

STEM Intervention Program: A program designed to increase diversity in the Science, Technology, Math and Engineering (STEM) major and workforce (Lancaster & Xu, 2017).

Undergraduate Students: Describes students registered at an institution of postsecondary education who are enrolled in a baccalaureate degree program or other formal program below the baccalaureate, such as an associate degree, vocational, or technical program.

Underrepresented Minority (URM): Refers to women, racial, and ethnic minorities who are underrepresented in STEM majors (Graham et al., 2013)

White: Refers to a person having origins in any of the original peoples of Europe, the Middle East, or North Africa (de Brey et al., 2019).

Assumptions

This study makes the following assumptions:

1. The data reported by colleges and universities to the National Center of Education Statistics is assumed to be an accurate representation of racial/ethnic demographics and graduation statistics.
2. The data reported by the South Eastern University Office of Institutional Research is assumed to be a factual representation of student demographics, matriculation, and graduation statistics.
3. Study participants' narratives are assumed to be authentic accounts of their experiences as biology students.

CHAPTER 2: REVIEW OF THE LITERATURE

The purpose of this chapter is to review extant literature on the academic and social experiences of African American students in STEM majors. According to Tinto's revised model of student integration (Tinto, 1993), academic and social integration within the campus community are essential for students to persist and graduate from college. Tinto (1993) characterizes academic integration as academic achievement and interaction with faculty, while social integration is characterized as extracurricular activities and interaction with peers (Tinto, 1993). Further, students' sense of academic and social belonging is determined by their academic and social experiences within the campus community. Positive campus experiences are associated with increased academic and social integration and negative campus experiences are associated with decreased academic and social integration (Tinto, 1993). Increased academic and social integration encourage student commitment to their STEM major and persistence to graduation (Foltz, et al., 2014).

This research study focuses on African Americans as a singular racial/ethnic group as opposed to an amalgam of racial/ethnic groups designated as URMs. Much of the existing literature regarding African American students in STEM situates them within the larger category of URMs, ignoring the unique cultural backgrounds and experiences that separate African Americans from other racial/ethnic groups that are categorized as URMs including Latinxs, Native Americans/Alaska Natives and Pacific Islanders (Chen, 2013; Chubin et al., 2005; Espinosa, 2011; Hurtado et al., 2007; Hurtado et al., 2010). In addition, there has been minimal research focused on the biological sciences major despite the large number of African American students who pursue biological sciences

degrees, the majority of which pursue them at PWIs. The misrepresentation of URM students as one homogenous group and the lack of research on African Americans in the biological sciences major speak to the focus of this study which is to explore the experiences of African Americans majoring in biological sciences at a PWI.

Previous studies on African Americans in STEM have utilized a deficit approach, emphasizing socioeconomic status and disparities in K-12 education particularly in math and science as the most salient factors governing the underrepresentation of African Americans in STEM fields (Darling-Hammond, 2010; Espinosa, 2011; Hurtado et al, 2007; Riegle-Crumb & King, 2010). This chapter challenges the status quo by rejecting a deficit narrative and focusing on the experiences of African American students who are navigating a STEM major. The asset-based approach to this study focuses on the practices and strategies utilized by African American students who are successful in the biology major. This study emphasizes matriculation not attrition of African American biology majors at a PWI.

Tinto (2006) argued:

It is one thing to understand why students leave; it is another to know what institutions can do to help students stay and succeed. Leaving is not the mirror image of staying. Knowing why students leave does not tell us, at least not directly, why students persist. More importantly it does not tell institutions, at least not directly, what they can do to help students stay and succeed (p. 6).

The chapter begins with a discussion of HBCUs and their proclivity for producing African American STEM graduates. The focus then turns to African American STEM majors attending PWIs, and their perceptions of the institution's social and academic

climate. A connection is then depicted between African American students' perceptions of the social and academic climate at PWIs and their persistence in STEM majors. The focus then narrows to a specific STEM major as the literature review transitions to extant literature on African American biological sciences majors at PWIs. As the experiences of African American STEM majors at HBCUs and PWIs are explored in this study, the factors that are most impactful to their retention in STEM majors are revealed. This chapter concludes by detailing STEM initiatives implemented at colleges and universities throughout the United States in response to a national call to increase the number of African Americans graduating with STEM degrees. This chapter reveals the variability that exists in producing African American STEM graduates among institutions classified as historically Black or predominantly White.

HBCUs: Primary Producers of STEM Graduates

In 2016–2017, there were 4,360 degree-granting institutions in the United States, including 102 Historically Black colleges and universities (HBCUs) (de Brey et al., 2019). According to the Higher Education Act of 1965, HBCUs are colleges and universities established before 1964 whose primary purpose was to educate Black Americans (Anderson, 1988; Eagen et al., 2010). Harper (2019) asserted that from the late 1800's to the mid 1900's, HBCUs enrolled more than 90% of Black students who attended colleges and universities in the United States.

The enrollment of Black students at HBCUs has decreased steadily since the Civil Rights Act of 1964, while the enrollment of Black students at PWIs has increased by 40% (Harper, 2019). Title VI of the Civil Rights Act of 1964 required predominantly White colleges and universities to implement initiatives aimed at recruiting and retaining

African American students (Harper, 2019). By 1976, only 18% of Black students enrolled in colleges and universities in the United States were enrolled at HBCUs, and by 2016, just 9% of African American students were enrolled at HBCUs (de Brey et al., 2019; NCES, 2018). As the enrollment of African American students at HBCUs decreases, the number of African American students matriculating to PWIs increases. Despite the decreased enrollment of African American students at HBCUs over the last two decades, HBCUs continue to produce a significant percentage of African American undergraduates (Harper, 2019).

HBCUs represent just 4% of all four-year colleges/universities in the United States, but award over 21% of the undergraduate degrees earned by African American students (Rice et al., 2016; Wilson-Kennedy et al., 2018). In addition, 15% of African Americans who earned bachelor's degrees in a science or engineering field were enrolled at an HBCU, and 25% of African Americans who earned doctoral degrees in agricultural, earth, atmospheric, and related sciences, mathematics and statistics between 2013 and 2017 earned their undergraduate degrees from HBCUs (NCES, 2018; Carter-Johnson et al., 2018; Lewis et al., 2011; Thompson & Taylor, 2016; Wilson-Kennedy et al., 2018). The top schools from which African Americans with PhDs earned their undergraduate degrees were: Howard University; Spelman College; Florida A&M University; Hampton University; Xavier University; Moorehouse College; Morgan State University; North Carolina A&T State University; Southern University A&M College; Tuskegee University; and University of Maryland, Baltimore County. Listed among the HBCUs that are top producers of undergraduate students who subsequently earn PhDs is just one PWI. Carter-Johnson et al. (2018) reported that University of Maryland, Baltimore

County (UMBC) was the only PWI listed among the top schools from which African American PhDs earned their undergraduate degrees.

HBCUs represent a small percentage of colleges and universities in the United States and enroll a smaller percentage of African American students than do PWIs, however HBCUs produce more African American STEM graduates than do PWIs (Toldson, 2018). HBCUs' proficiency in producing African American STEM graduates has not gone unnoticed. Corporations such as Apple, Verizon, and Glaxo-SmithKline have committed themselves to supporting diversity in STEM fields and recognize the essential role HBCUs play in producing STEM graduates (Thompson & Taylor, 2016; Wilson-Kennedy et al., 2018). Apple, Verizon, and GlaxoSmithKline provide much needed financial support to HBCUs at a time when government and private donor support is limited and many HBCUs are struggling to remain open (Thompson & Taylor, 2016).

PWIs have also recognized the success of HBCUs in graduating African Americans in STEM majors and seek to better understand the methods used at HBCUs to support and retain African American students in STEM disciplines. The question that must be asked is "What are HBCUs doing to support African American students in STEM majors that PWIs are not?" (Hurtado et al., 2010; Lewis et al., 2011; Salazar, et al., 2018).

What Are HBCUs Doing to Support African American Students in STEM?

Duplicating the methods used at HBCUs begins with modeling the academic and social climate that exists at HBCUs. The academic and social climate have been found to be a key factor in bolstering the retention of African American undergraduate students, particularly in STEM disciplines (Harper, 2019; Salazar, et al., 2018). According to

Harper (2019), HBCUs are more successful in awarding undergraduate degrees to Black students because they provide students with a supportive culture for learning, which research has shown is an important factor in African American students' academic achievement. Harper (2019) argued that, "the time has come for historically Black colleges and universities to receive the respect and support they deserve" (p. 110).

Carter-Johnson et al. (2018) attributed African American students' success in earning PhDs in science and engineering to "the undergraduate faculty and their emphasis on teaching, research and mentoring" (p. 32). Johnson (2007) pointed out that African American STEM majors attending HBCUs reported feeling supported in their academic pursuits and recounted having positive interactions with faculty members.

The analysis of survey data collected from universities participating in the Minority Male STEM Initiative (MMSI), indicated that "students at HBCUs are significantly more likely than students at PWIs to have better relationships with faculty and to have a higher sense of belonging" (Toldson, 2018, p. 96). The shared cultural experiences and mutual understanding of race and oppression by African American students and African American faculty, and the sociocognitive benefits of having African American faculty, has been shown to support African American students' success in STEM majors at HBCUs (Toldson, 2018). Additionally, HBCUs' implementation of policies and practices to provide early support in the form of mandatory tutoring, and critical thinking training to students "with less academic preparation and resources" have been instrumental in retaining African American students in STEM (Toldson, 2018, p. 96).

Rice et al. (2016) reported that academically gifted students pursuing STEM majors at HBCUs indicated the most salient factor in their success was their relationship with STEM faculty. Findings from the study revealed four institutional factors that contributed to students' success in STEM: faculty support, financial support, smaller class size, and involvement in student organizations. Moreover, broader research suggests that HBCUs provide the support systems necessary to recruit and retain African American students in STEM (Hurtado et al., 2007, 2009; Rice et al., 2016; Toldson, 2018).

African American STEM Majors at PWIs

African Americans are largely underrepresented in STEM majors at PWIs. A myriad of variables associated with K-12 education have been shown to contribute to the disparity in African Americans pursuing STEM degrees including under-funded and under-resourced high-poverty schools; inadequate pre-college preparation in math and science; lack of access to advanced preparatory courses in math and science, and an underqualified, predominantly White teaching force in predominantly Black schools (Darling-Hammond, 2010; Espinosa, 2011; Graham et al., 2013). Racially and ethnically discriminatory practices within K-12 education have crippled many African American students rendering them emotionally and academically unable to meet the academic demands of STEM majors at PWIs (Darling-Hammond, 2010; Espinosa, 2011; Graham et al., 2013).

Park et al. (2019) acknowledged the significance of pre-college preparation on student retention in STEM, but posited that additional factors play a critical role in student retention in STEM, such as “the experiences students have on campus including

academic performance, selection of classes, and relationships with faculty and peers” (p.3). In addition, Park et al. (2019) affirmed that the retention of African Americans in STEM is impacted by “the campus racial climate, experiences of tokenization and stereotyping, students’ perceived sense of belonging and institutional support, opportunities for research involvement, and the development of students’ scientific identity and self-efficacy” (p. 3).

Favorable interactions with faculty outside the classroom have been shown to contribute to African American students’ persistence in STEM majors; however, African American students are less likely to experience favorable interactions with faculty because of “racism, discrimination, and chilly climate, within STEM disciplines” (Park, et al., 2019). Black students interact more often with faculty than their White peers but are more likely to experience negative interactions with faculty (Carlone & Johnson, 2007; Hurtado et al., 2007; Hurtado et al., 2010).

Hurtado et al. (2007) used a qualitative research design to study the first-year experiences of minority students in the behavioral and biomedical sciences at a PWI. In this study, Hurtado et al. (2007) explored the factors that support or hinder Black students’ ability to adapt to college life on a predominantly White campus. Further, Hurtado et al. (2007) studied students’ sense of belonging within the overall campus community and more specifically within academic environments. Hurtado et al. (2007) described the atmosphere for Black students at PWIs as “hostile” with Black students expressing they felt devalued, unimportant, and excluded on predominantly White campuses.

Palmer et al. (2018) explored the academic and social experiences of eight African American STEM majors enrolled at a PWI. Palmer et al. (2018) identified three main factors that supported this group of students in the STEM major: peer group support, involvement in STEM related activities, and strong high school preparation. Students stressed the importance of having peers who also wanted to be successful in their STEM major. Peer group members provided an important academic and social network for African American students in STEM. The peer group was validating and supportive for African American students who struggled with fitting in at a PWI. Students described how participation in STEM related organizations and extracurricular activities, particularly ones for minority students, contributed to their sense of belonging at a PWI.

Hurtado et al. (2010) conducted a qualitative study of the lived experiences of sixty-five URMs persisting in STEM majors at four institutions across the United States: the Massachusetts Institute of Technology, a PWI; the University of Texas, San Antonio and the University of New Mexico which are Hispanic Serving Institutions (HSIs), and Xavier University, an HBCU. Students at all four universities reported experiencing various forms of social stigma associated with them being an underrepresented minority in a STEM major. In addition, all students described some level of competitiveness among their STEM peers. Students at Xavier, the only HBCU in the study, were the only students who reported having a supportive and collaborative science environment that allowed them to develop their science identities while maintaining their racial identities. Students at Xavier did not perceive the competitive environment in the STEM major

negatively, but instead found the competition among same-race peers to inspire them to do better.

Winkle-Wagner and McCoy (2016) affirmed the importance of qualitative studies to better understand how to support students of color in STEM disciplines. According to Winkle-Wagner and McCoy (2016), “Most of the STEM studies focus on quantifiable outcomes relative to campus or disciplinary climate. Much less is known about students of color lived experiences within STEM programs across institutional types” (p. 594). Winkle-Wagner and McCoy (2016) suggested that persistence in STEM disciplines is influenced by the “campus climate” or how welcoming students of color perceive the college campus to be. In their 2016 qualitative study on the experiences of students of color in STEM disciplines at HBCUs and PWIs, Winkle-Wagner and McCoy reported that students of color at PWIs expressed feelings of alienation, isolation, and “culture shock” as the only Black students in their classes. One student expressed feeling like an alien because of the lack of diversity in her STEM classes. Students felt they had to prove themselves academically in order to dispel any preconceived notions and assumptions their White peers held regarding their academic abilities. Students expressed that although there were numerous discussions regarding “diversity” on their campuses, they did not feel they were genuine. Students also described a lack of academic support within their STEM programs. Winkle-Wagner and McCoy (2016) maintained that “the way students of color perceive the campus climate could have important implications for their retention in STEM programs” (602). Winkle-Wagner and McCoy (2016) suggested that PWIs refer to HBCUs for best practices as “there are lessons that can be garnered from the HBCU in order to help students feel more supported at the PWIs” (p. 602).

Persistence of African American Biology Majors at PWIs

Matsui (2018) revealed that African American students who entered the University of California, Berkeley (UC Berkeley) with lower high school grade point averages (GPAs) and lower Scholastic Aptitude Test (SAT) scores than the majority population at UC Berkeley, graduated with biology degrees at the same rate as the majority population and with comparable GPAs as the majority population. Matsui (2018) pointed out that lower high school GPAs and SAT scores are generally viewed as deficits; therefore, students with lower scores are believed to be less prepared to succeed in a STEM major than the majority population. Matsui (2018) presented compelling evidence that “so-called less qualified students can succeed in the biology major in a proper academic environment” (p. 2).

Matsui (2018) developed the Biology Scholars Program (BSP), an undergraduate diversity program at UC Berkeley for underrepresented students intending to major in biological sciences. BSP’s aim is to develop “undervalued talent” (Matsui, 2018, p. 1). BSP, provides African American students with the academic support needed to succeed in biology, while also recognizing the significance of their culture and communities in their lives. Selection of students for BSP is based on two key concepts: “starting point, which is where students start in life in terms of their available resources, opportunities, and challenges, and distance traveled, which is what they did to leverage their good fortune and overcome their hurdles” (Matsui, 2018, p. 2). Matsui (2018) proposed personal attributes such as persistence and resilience are better predictors of African American students’ success in biology than their high school GPA and SAT scores. He admonished institutions to abandon traditional meritocratic principles and to move

towards a more democratic restructuring of STEM programs to ensure that a STEM education is accessible to all students who choose to pursue one. Moreover, Matsui (2018) beseeched institutions to examine the inclusivity of their STEM programs and to refrain from blaming underrepresented students for the lack of diversity in their programs. As Matsui (2018) mentioned, “we must reconceptualize our practices and policies in terms of how they affect our students’ perceptions and experiences of kindness, dignity, and belonging” (p. 4).

According to Wilton et al. (2019), classroom-social belonging plays a critical role in the academic performance and retention of African American students in STEM majors. In a 2019 study of variables that promote retention in the biology major, Wilton et al. (2019) revealed the importance of instructor-student interactions in promoting a sense of belonging in African American students enrolled in the biology major. The study involved two sections of Introductory Biology. Each section differed in the format used for delivering course material. In the traditional section, course material was delivered using a traditional lecture format combined with limited active learning opportunities. The intervention section utilized an increased structure format with increased peer-peer interactions through peer-led team-based learning (PLTL) sessions and increased instructor-student interactions. Increased final exam scores in the intervention section were believed to be related to increased peer-peer interactions and peer-led tutoring sessions as previous studies have suggested that student-student interactions positively affect students’ sense of belonging. In addition, Wilton et al. (2019) revealed that increased final exam scores fostered a greater sense of belonging among African American students in the intervention course relative to African American student in the

traditional course. African American students who possess a greater sense of belonging in Introductory Biology are more likely to persist in the biology major. Wilton et al. (2019) affirmed that increased sense of belonging “positively impacted student retention into the subsequent course” (p.10). Students in the intervention section and traditional section were surveyed at the conclusion of the course on perceived peer support, perceived faculty support, and perceived classroom comfort. Survey results revealed that African American students in the intervention section expressed a significantly higher sense of belonging than African American students in the traditional section. Further, African American students’ perceptions of faculty support and classroom comfort were considerably higher in the intervention section, however the perception of peer support was negligible. According to Wilton et al. (2019), “the increase in student–instructor interactions arising during the collaborative problem-solving portion of the active-learning classroom, in which there are more casual interactions with students, may have fostered stronger instructor–student relationships and a more comfortable classroom climate” (p.8). Findings from this study revealed the importance of faculty interactions in building sense of belonging and retention in African American students in the biology major.

Introductory Biology is the first biology course taken by students pursuing a biology degree, and success in it is critical to building students’ sense of belonging in the biology major. In their research study on the academic performance of White students and underrepresented students in undergraduate biology classes, Jordt et al. (2017) argued that despite the implementation of proven pedagogical practices to counter inadequate pre-college preparation, there continues to be an achievement gap between

White students and African American students. Jordt et al. (2017) attributed much of the achievement gap to negative classroom climate. Classroom climate is defined as “the intellectual, social, emotional, and physical environment in which students learn” (Jordt et al., 2017, p. 2). Jordt et al. (2017) contended that changing classroom climate to one that is supportive and encouraging to African American students is challenging as it requires instructors and peers to change their thoughts and actions toward African American students. They declared that time is better spent heightening students’ self-worth to lessen the psychosocial threat of being stereotyped. Stereotype threat is described as the fear that one will be judged based on stereotypes generally associated with the group one identifies with, or that one’s actions will substantiate stereotypes associated with one’s group (Jordt. et al., 2017).

Jordt et al. (2017) revealed that “stereotype threat” negatively affects the academic performance of African American students in introductory biology classes resulting in lower academic performance than their White peers. Moreover, failure in introductory biology classes leads some African American students to abandon their STEM major and career goals. In their study, Jordt et al. explored the use of “values affirmation” exercises to strengthen African American students and other URM students against stereotype threat in introductory biology classes. A comparison of biology exam scores among students in the same biology class with the same cumulative GPA, showed that students who were given values affirmation exercises increased their biology exam scores by an average of 3%. Jordt et al. (2017) asserted that values affirmation increases students’ sense of belonging that can be used to increase persistence of African American students in STEM, and it further reduces the achievement gap. According to Jordt et al.

(2017), by lessening “stereotype threat, “we may be able to reduce barriers to achievement and empower a student’s sense of self-value to encourage retention in STEM” (p. 9).

Studies by Matsui (2018), Wilton et al. (2019), and Jordt et al. (2017), demonstrate the myriad methods used to increase the persistence and retention of African American students in the biology major at PWIs. The methods used have been found to increase African American students’ academic performance in their biology classes, but more importantly, the methods used significantly increased their self-worth and sense of belonging in their biology classes. Bolstering students’ self-worth and sense of belonging in biology has been shown to increase persistence in the biology major (Jordt et al., 2017; Matsui, 2018; Wilton et al., 2019).

Many colleges and universities throughout the United States have answered the call to increase the number of students graduating with STEM degrees, prepared to enter the STEM workforce. Increasing the number of underrepresented students completing STEM degrees has been shown to be crucial to having an adequate STEM workforce. This has lead colleges and universities to implement initiatives aimed at increasing the retention of URM students in STEM majors.

Initiatives to Support African American STEM Majors

Like many states in the southeastern United States, the state of North Carolina has experienced a transformation from a largely agricultural economy with a workforce composed of low-skilled, low-wage workers to an economy requiring competencies in science, technology, engineering, and mathematics (STEM). In 2012, North Carolina developed the NC STEM Center as an online portal to make STEM resources accessible

to teachers, parents, students, and businesses across North Carolina. The NC STEM Center functions to expand STEM literacy and to increase the number of STEM graduates in North Carolina, to attract companies to the state, and to improve the economy (NCSTEMCenter). The STEM Score Card for North Carolina highlights the STEM Pipeline and the interlocking principles of engagement, development, and persistence. Student engagement in STEM begins in kindergarten to develop students' interest in STEM. Interest and engagement in STEM should continue to develop through K-12 curriculum and extra-curricular activities, with students entering post-secondary programs with the skills and knowledge to persist in STEM majors, to join the STEM jobs of the future.

National attention on diversifying the STEM workforce and increasing interest and persistence in STEM disciplines among URMs, has prompted colleges and universities in North Carolina to find innovative ways to promote STEM fields. PWIs and HBCUs within the UNC System of colleges and universities have implemented a variety of initiatives aimed at increasing the number of URMs pursuing STEM majors and graduating with STEM disciplines.

Santisteban et al.'s (2016) study examined the "Creating Opportunities for Students in Science (COMPASS) Scholarship Program" at the University of North Carolina at Pembroke (UNCP). UNCP is one of the 16 UNC System universities and is in the most impoverished county in North Carolina, with 88% of its students receiving some form of financial assistance. UNCP has a largely diverse student population consisting of 59% URMs. African Americans are the largest single racial/ethnic group (32%) at UNCP, and Native Americans are the second largest racial/ethnic group (16%)

at UNCP. The COMPASS Scholarship Program provides financial assistance, mentoring, tutoring, research internships, and professional development to student participants.

Twenty-seven students with a minimum GPA of 3.0, were recruited from STEM departments (Biology, Biotechnology, Chemistry, and Environmental Science) at UNCP. Nine faculty members were selected from the Biology and Chemistry Departments to serve as COMPASS mentors and to assist in community building activities. The goals of the COMPASS program are to recruit URM and first-generation STEM students who are excelling academically, and who need financial assistance, and to prepare them to enter the STEM workforce or to attend graduate/professional programs. According to Santisteban et al. (2016), “belonging to a support group to which they can turn to for advice, study, and simply friendship is a major plus for COMPASS students” (p. 6). Moreover, when COMPASS students were asked to share the best aspects of the program, having their own mentor and being a part of a learning community were indicated most often. The COMPASS program has proven to be a rewarding experience for student participants who are graduating with honors, presenting at professional conferences, and have been selected for summer programs.

UNC Chapel Hill, the first public university in the United States with the third largest enrollment of the 16 universities in the UNC System, adopted the widely successful MSP model of made popular at the University of Maryland, Baltimore County (UMBC) as part of the Chancellors Science Scholars Program (CSS). UNC Chapel Hill experienced similar trends in STEM student success as UMBC (Domingo et al., 2019). GPAs and retention rates of CSS program participants increased. The average GPA of non-CSS STEM students was 3.22 and the average GPA of CSS-STEM students was

3.59 (Domingo, et al., 2019). The retention rate for non-CSS STEM students was 80% and the retention rate for CSS STEM students was 94%.

In 2010, North Carolina A&T State University (NC A&T), a UNC System school, and the largest HBCU in the United States, brought faculty and administrators together to develop a plan to advance STEM research and education on campus (Wilson-Kennedy et al., 2018, p. 1). Stakeholders from all levels within the university were tasked with the single mission to transform NC A&T into a “premier research institution of higher education with a STEM focus” (Wilson-Kennedy et al., 2018, p.1). A key component of the strategic plan was the creation of a STEM Center of Excellence for Active Learning (SCEAL). Wilson-Kennedy et al., (2018) noted that SCEAL was funded by the North Carolina GlaxoSmithKline (NC GSK) Foundation to “attract and support the success of high-achieving students who go on to STEM careers and diversify the STEM workforce” (Wilson-Kennedy et al., 2018, p. 2). In addition, NC A&T created an endowed Student Success and Faculty Development fund to promote STEM success. The fund was used to provide scholarships for the recruitment and retention of high-achieving students, and to provide students and faculty with opportunities to “attend society conferences, initiate research collaborations, and write scholarly manuscripts and proposals” (Wilson-Kennedy et al., 2018, p.2). NC A&T has also developed practices focused on specific STEM majors, such as biological sciences.

Smith et al.’s (2019) study examined the effects of a Life Mapping and Advising Center Model (LMAC) on increasing the persistence of undergraduate students majoring in biology at NC A&T. At the time of the study, the retention rate for first-year students in the biology major was 58.5%, which was 4.9% lower than the university-wide

retention rate. The LMAC model was implemented to address attrition of first-year biology students by facilitating relationships between students and faculty-advisors. The model consisted of six strategic pillars: “a) LMAC facility located within the Biology Department; b) faculty advisors; c) peer mentors and peer tutors; d) intrusive advising; e) life coaches; f) integration with the biology orientation student success course. Intrusive advising is defined as “deliberate, structured student intervention at the first sign of academic difficulty” (Smith et al., 2019, p. 297). In addition to discussing academic performance, advisors discussed any concerns students chose to discuss including issues with themselves, issues with family, financial concerns, and career goals. Smith et al. (2019) affirmed that the LMAC model enabled faculty to have authentic interactions with students and “promoted concern for the whole student” (p. 310). The goal was no longer “to just get the students through the curriculum, but for the faculty to recognize the students as individuals with the potential to be successful” (Smith et al., 2019, p. 310).

Fayetteville State University (FSU), a small, historically Black university in the UNC System, sought to encourage interest in STEM majors among incoming freshmen through the implementation of a STEM Learning Community (SLC). The SLC, a year-long program, was started in Fall 2008 to increase student retention, to improve student engagement and academic success, and to build a sense of community among incoming freshmen intending to major in STEM (Smith-Burton et al., 2016). SLC students are assigned to one of three clusters based on their STEM major: math, computer science, or chemical/biological sciences. Each cluster is assigned a STEM faculty member who serves as the SLC Team Leader and as the instructor for the freshmen seminar course. The number of freshmen participating in SLC has increased each year since its

establishment in 2008. Correspondingly, the number of SLC participants declaring the STEM major has also increased, with 33% of participants declaring the STEM major in 2008 and 81% of participants declaring the STEM major in 2012 (Smith-Burton et al., 2016). Smith-Burton et al. (2016) identified the extensive mentoring by SLC faculty as one of the key components of the SLC's success.

Initiatives to increase completion rates among African Americans pursuing STEM degrees are not limited to undergraduate students, but also encompasses African American graduate students as efforts are made to increase the number of African Americans completing STEM graduate degrees and matriculating to STEM faculty positions at PWIs and HBCUs ("N.C. A&T Faculty Research Diversity", 2018). As indicated in previous studies (Gumpertz et al., 2019; Hrabowski & Henderson, 2019; "N.C. A&T Faculty Research Diversity," 2018), the STEM professoriate is sorely lacking in African Americans. STEM faculty are a key component in the success of African American STEM majors; therefore, STEM faculty must be increased at HBCUs and PWIs (Gumpertz et al., 2019; Hrabowski & Henderson, 2019; "N.C. A&T Faculty Research Diversity," 2018). Espinosa (2011) declared that it is crucial for faculty to mirror the diversity present in student populations at colleges and universities across the country. According to Russell et al. (2018), students from underrepresented groups are frequently mentored by faculty from underrepresented groups, subsequently creating a more welcoming and supportive environment for underrepresented students.

NC A&T was awarded a five-year, collaborative research grant from the National Science Foundation (NSF) Alliances for Graduate Education and the Professorate (AGEP) program to study the underrepresentation of African American and Latinx

students in STEM majors (“N.C. A&T Faculty Research Diversity,” 2018). The “AGEP North Carolina Alliance” is an “institutional transformation model to increase minority STEM doctoral student and faculty success” (p. 1). The grant brings together faculty from NC A&T, North Carolina State University (NCSU) and the University of North Carolina at Charlotte (UNCC) “to develop, implement, and study a model to create institutional, department-level, and faculty change and promote doctoral completion and progression to faculty careers among historically underrepresented doctoral students in STEM disciplines” (p.1). Faculty members are instructed on “mentoring, the experiences of underrepresented minority students, and fostering change” (p.1). Additionally, NC A&T was among the recipients of an NSF STEM Leadership grant (“N.C. A&T Among Recipients of \$9M NSF Grant,” 2018). The grant was funded by the HBCU-Undergraduate Program at NSF will be used to examine how leadership at HBCUs has played a role in broadening the participation of African Americans in STEM (p.1). NC A&T, in collaboration with the University of the Virgin Islands, Fielding Graduate University, and the Association of American Colleges and Universities will develop best practices for leaders at PWIs and HBCUs to increase URM students in STEM disciplines (“N.C. A&T Among Recipients of \$9M NSF Grant,” 2018).

The STEM initiatives highlighted in this chapter represent only a portion of the initiatives aimed at increasing the number of African Americans graduating with STEM degrees, prepared to enter the STEM workforce. STEM initiatives aimed at African American students attending HBCUs and PWIs are funded by stakeholders including federal agencies and the private sector. Despite the increased attention and resources dedicated to increasing African American STEM graduates, HBCUs continue to produce

significantly more African American STEM graduates than PWIs, and the number of African Americans graduating with STEM degrees remains lower than all other racial and ethnic groups (NCES, 2018).

Summary

This literature review began by providing a theoretical basis for the relationship between student integration in the campus community and persistence to degree attainment. The review then highlighted the variability in the social and academic experiences of African American STEM majors at HBCUs and PWIs. Then, initiatives to increase the number of African American students in STEM disciplines were explored. Critical Race Theory was introduced to support the incorporation of African American students' voices in the study. To omit the voices of African American students who are persisting in a STEM major permits the master narrative to dominate the discourse surrounding African American students in STEM majors.

CHAPTER 3: METHODOLOGY

This chapter includes a review of the research purpose and research questions, a description of qualitative phenomenological design, and a justification for its use in this study. This chapter also includes a description of the research design and procedures used in this study. The research procedures include a detailed account of participant recruitment, data collection, data analysis, and strategies implemented to ensure the validity of the study.

The purpose of this qualitative, phenomenological study was to explore the experiences of African American undergraduate students who are persisting in the biology major at a predominantly White institution. This study sought to identify the strategies and practices utilized by successful African American biology majors. This work was intended to contribute to a growing body of research on African American students in STEM majors using an asset-based approach to identify strategies and practices that increase persistence in STEM. It was also intended to respond to requests to increase the number of underrepresented STEM graduates, thereby increasing the number of U.S. citizens who are adequately prepared to enter the STEM workforce.

Research Question

The following research questions guided this study:

- 1) What are the factors that provide support to African American undergraduate students persisting in the biology major at a predominantly White university in the southeastern United States?

- 2) How do these factors contribute to African American undergraduate students' persistence in the biology major at a predominantly White university in the southeastern United States?

Research Design

Qualitative research design was the most appropriate research design for this study because the research questions guiding this study required in-depth interviews with study participants and rich descriptions of their lived experiences as undergraduate students majoring in biology at a predominantly White institution.

Qualitative research

Qualitative research is used to study the lived experiences of research participants (Toloie-Eshlaghy et al., 2011). As explained by Creswell (1998), the qualitative research method is used when the researcher seeks to describe *how* and *what* is experienced by research participants. Creswell (2013) provided justifications for conducting qualitative research: (a) when exploration of a problem is needed, (b) to study a particular group of individuals, (c) to obtain a comprehensive description of the problem, (d) to better understand the setting in which the problem exists, (e) to empower individuals in the group to share their stories, (e) to convey stories in writing, and (f) to develop theories when existing theories for particular groups do not adequately detail the intricacies of the problem.

Unlike quantitative research which focuses on statistical/numerical data, qualitative research focuses on how people perceive their social reality. Creswell (2013) explained, "to level all individuals to a statistical mean overlooks the uniqueness of individuals in our studies (p. 48). Qualitative research allows researchers to study social

and cultural phenomena, and it enables the researcher to be directly involved in the research experience by interacting with research participants in the field (Toloie-Eshlaghy et al., 2011; Williams, 2005). Qualitative research encompasses a naturalistic approach to research. Mertens (2015), stated that “qualitative researchers study things in their natural settings, attempting to make sense of phenomena in terms of the meanings people bring to them” (p. 236).

The primary instrument in qualitative research is the qualitative researcher (Creswell, 2013). Qualitative researchers develop interview questions and collect data by engaging in face-to-face interactions with research participants. Interview protocols are frequently used in qualitative research design. Interviews “provide in-depth information pertaining to participants' experiences and viewpoints of a particular topic” (Turner, 2010, p. 3). Creswell (2013) affirmed that qualitative research is empowering and provides a voice for marginalized groups. In addition, Creswell (2013) declared that qualitative research should be inductive and emerging, and “it should contain an agenda for reform that may change the lives of participants, the institutions in which they live and work, or even the researchers' lives” (p. 22).

Phenomenology

Phenomenology is a qualitative research approach that seeks to describe how human beings experience a phenomenon (Creswell et al., 2007). German philosopher and mathematician, Edmund Husserl is credited with the founding of phenomenology as a qualitative research approach (Creswell, 1998; Moustakas, 1994; Neubauer et al., 2019). Van Manen (1990) defined a phenomenon as “an object of human experience” (p.163).

Husserl defines phenomenology as “a descriptive philosophy of the essences of pure experiences” (as cited in Van Manen, 2014, p. 89).

Phenomenologists begin their research study by identifying the phenomenon of interest. The phenomenon of interest in this research study was African American students who are persisting in the Biology major at a predominantly White institution of higher education. Phenomenologists seek “to understand a phenomenon from the participants’ point of view” (Leedy & Ormrod, 2001, p. 157). Phenomenologists collect data from research participants who have experienced the phenomenon of interest.

Phenomenological data is typically collected through in-depth interviews which allow the researcher to collect data using the participants’ own words (Williams, 2007). Interviews provide the researcher with rich descriptions of what the participants experienced and how they experienced it (Moustakas, 1994). The research participants in this study are African American students majoring in biology at a PWI. The research participants described their academic and social experiences as they successfully navigated the biology major. Phenomenologists do not develop their own theories from the participants’ views of the phenomenon but seek to describe commonalities among those who have experienced the phenomenon (Creswell et al., 2007). Commonalities among participants’ experiences are combined to form a description of the essence of the phenomenon (Creswell et al., 2007).

Wertz (2005) articulated that, “phenomenological research requires an attitude of wonder—it must be approached as if the researcher has never experienced the phenomenon before and has no knowledge of it” (p. 40). Moustakas (1994) described this approach to phenomenological research as *transcendental*. As stated by Moustakas

(1994), transcendental phenomenology means "everything is perceived freshly, as if for the first time" (Moustakas, 1994, p. 34). Transcendental phenomenology requires the researcher to transcend prior assumptions in order to view the phenomenon from a new perspective (Creswell, 1998; Moustakas, 1994). Husserl proposed two methods to reach a state of suspended assumptions: epoché and bracketing.

Epoché and Bracketing

Moustakas (1994) described epoché as the process of clearing one's mind. Epoché requires the researcher to dismiss any prior beliefs regarding the existence of the phenomenon in order to experience the phenomena as it is lived by the participants.

Tufford and Newman (2012) defined bracketing as "a method used in qualitative research to mitigate the effects of preconceptions that may taint the research process" (p. 1).

Bracketing requires the researcher to be open and honest about their "pre-existing thoughts and beliefs" regarding the phenomenon (Starks & Trinidad, 2007, p. 1376). The researcher begins the study by describing their experiences with the phenomenon (Creswell, 2007). The researcher sets aside their biases or assumptions regarding the phenomenon so they can focus on those who have lived the phenomenon from a fresh perspective (Moustakas, 1994). Bracketing provides an opportunity for the researcher to "reach deeper levels of reflection" (Tufford & Newman, 2012, p. 2).

Transcendental phenomenology requires the researcher to clear their mind of any knowledge of the phenomenon through the process of epoché and to bracket any pre-existing assumptions regarding the phenomenon so they can focus on the views of the study participants who are experiencing the phenomenon (Creswell, 1998; Moustakas, 1994). Moustakas (1998), declared that the process of removing all conscious and

unconscious thoughts, presumptions, and biases regarding a phenomenon is rarely achieved; however, continuously engaging in epoché and bracketing helped me to view the phenomenon more objectively, allowing me to be open-minded and able to receive new information regarding the experiences of African American biology majors at a PWI. It is therefore important that I share my subjectivity as it relates to my interest in the study and my personal experiences with the phenomenon in the study. My background is similar to the background of the participants in this study. I am African American, and as an undergraduate student, I also pursued a degree in biological sciences at a large, predominantly White university in the southeastern United States. I am currently a faculty member in the biology department where this study took place. I have witnessed firsthand the struggles of many African American students in the biology major which led some students to leave the major completely, while others endeavored to complete their biology degree but with GPAs too low to realize their dreams of medical school or some other professional health program. I have also encountered African American students, albeit a lesser number, who have successfully navigated the biology major, graduating with GPAs that made them competitive applicants for graduate programs and professional health programs. I became interested in the dichotomy that existed among African American biology majors. I questioned why so many African American students experienced difficulties in the biology major, while others abounded.

I engaged in bracketing to exclude my personal biases and preconceptions from the study. I bracketed my subjectivity by acknowledging my positionality as a researcher and my experiences with the phenomenon being studied. Bracketing enabled me to more deeply engage with the participants without taking my own experiences into account. By

bracketing I was able to ensure that the voices of the participants were exclusively heard in the study.

Subjectivity

This dissertation is relatable to me to as an African American faculty member in the department of biological sciences at a large, predominantly White university in the southeastern United States. This study is significant to me because for more than ten years I was the only African American faculty member in the biological sciences department at my university, and as such, I had the opportunity to form meaningful and lasting relationships with African American students who were either assigned to me for academic advising, were enrolled in my classes, or who sought me out because of our shared racial and cultural backgrounds. I have witnessed firsthand the struggles faced by many African American students in the biological sciences major, but I have also observed the resilience and determination displayed by African American students who overcame personal and academic obstacles as they matriculated through the biological sciences major.

My ability to relate to this study stems from my personal experiences as an African American faculty member in the Biological Sciences Department at a large, predominantly White university in the southeastern United States, and as an African American undergraduate student who pursued a biological sciences major at a large, predominantly White university in the southeastern United States. The experiences of the participants in this study are synonymous with my own experiences as an African American undergraduate student persisting in the biological sciences major at a PWI.

I grew up in a small, predominantly Black community (70% African American) in a rural county in the eastern region of North Carolina. The demographics of my community created an environment for me that was familiar and safe. Everyone knew everyone in my hometown. My mother was an educator as were many of my family members, and my father was a business owner. My mother and father came from large families, which provided me with a substantial network of supporters. Despite the low-socioeconomic status of the region, my parents instilled in my siblings and me the importance of a college education and told us that education was key to financial stability.

My high school graduating class consisted of 92 students, 89 of whom were Black. I was number three in my graduating class and I was one of the highest achieving students at my high school. I did not have to study very hard and I always earned the highest grades in my classes, particularly in science and math. I was actively involved in academic and social clubs at my high school, and I played the flute in the orchestra and the marching band. I possessed a keen sense of self-efficacy, self-confidence, and self-determination. I had no doubt I would become a medical doctor which is what my parents, relatives, and friends told me I would be. I did not realize that graduating number three in a class of 92 students from a small high school in a rural town in North Carolina without AP, IB or Honors courses meant I was likely inadequately prepared to succeed in a STEM major at a large predominately White university.

I entered North Carolina State University confident that my secondary education was adequate to ensure my success at NCSU. I soon realized that my secondary education had inadequately prepared me for the rigors of a STEM major, particularly at a

PWI. My peers who were mostly White, seemed to spend the first weeks of school nodding their heads in agreement with the lectures given by my professors in calculus, biology, chemistry, and physics classes. It was apparent that the lectures at the beginning of the fall semester were a review of the material my counterparts were taught in high school. I was overwhelmed by the vast amount of math and science material I was expected to have been previously taught, and the isolation I felt by not being able to join in class discussions because I lacked the foundation needed to grasp the course content. Besides, I didn't want my peers or my professors to know I didn't understand the course material.

The confident, highly motivated 18-year-old who just weeks before was sure she would excel in every aspect of her college experience had become a quiet, underachieving student who sat alone on the back row in her classes. My obvious disengagement in class and less than passing grades were largely unnoticed by my professors. No one contacted me regarding my lackluster academic performance or my withdrawn demeanor, and there were no recommendations made to me regarding resources or support systems on campus. In comparison, my twin sister attended an HBCU in the same city as me, however her academic experience was the antithesis of mine. She talked about her professors as if she really knew them, and she was sure they were concerned about her as a student and a person. A less than stellar grade on an assignment resulted in her being asked to come to her professor's office for additional tutoring. Poor academic performance did not go unnoticed and participation in class activities/discussions was required of every student. When visiting her campus, I observed congenial interactions between faculty and students not only within academic

buildings, but throughout the larger college campus. Interactions between faculty and students were at minimum, cordial and respectful greetings in passing.

I was hesitant to reveal my academic struggles to my sister or anyone else in my family because I was considered, “the smart twin” and I did not want to disappoint my family. Realizing that I would not graduate in four years as my twin sister would, left me with no choice but to reveal my academic struggles to my family. This was a turning point for me in my academic career. I was no longer struggling in silence but had the reassurance and support I needed from my family to persist in the major and graduate with a biology degree.

After completing my undergraduate degree at a PWI, I pursued a master’s degree in biology at another UNC school in the southeastern United States, however this time I chose to attend an HBCU. My graduate experience at an HBCU was the exact opposite of my undergraduate experience at a PWI. For the first time since High School, I was confident in my academic abilities. The faculty were supportive of me and encouraged my interest in microbiology. I was invited to join the research lab of a microbiologist in the graduate program. My graduate research was supported by a grant from the National Science Foundation (NSF), and early in my graduate studies, my research professor provided me with the opportunity to present my research at an NSF meeting in Washington, D.C. The confidence he had in my academic and research abilities was a turning point for me. The support and encouragement I received from the faculty and staff while in graduate school were tangential in my evolution as a scientist and educator in higher education.

My subjectivity statement provided me with an opportunity to acknowledge my experiences as an undergraduate student, and to recognize the support systems that were critical to my persistence in the biological sciences major. By giving a voice to my own experiences and bracketing them in the study, I allow the voices of the participants to be exclusively and clearly manifested in the study.

Research Site

The University of North Carolina at Charlotte (UNCC) is a large, predominantly White, urban research university in the southeastern United States. The Department of Biological Sciences requires undergraduate students to be co-enrolled in an introductory course in biology and the introductory chemistry course plus the introductory chemistry lab before declaring the biology major. Students who are currently not co-enrolled in the introductory sequences of biology and chemistry courses are classified as pre-biology majors. Students classified as pre-biology majors have not begun to take upper level biology courses and have not declared the biological sciences major. Students are eligible to declare the biology major the semester in which they are enrolled in the introductory courses in biology and chemistry and have a minimum overall GPA of 2.0 and a Biology GPA of 2.0. (UNCC Department of Biological Sciences, 2019).

It is reasonable that not all pre-biology students will persist to declare the biology major as some students will change to another major, while others will choose to leave the university. Table 5 shows data collected by the UNCC Office of Institutional Research on students classified as pre-biology majors in 2014-2015. The data shows there were 74 African American (AA) pre-biology students compared to 246 White pre-biology students beginning in Fall 2014-2015. Of those, 26 (35.1%) of the AA pre-

biology students and 105 (42.7%) of the White pre-biology students went on to declare the biological sciences major. Sixteen (21.6%) of the AA biology majors and 59 (24%) of the White biology majors persisted in the major and graduated with a biology degree. A smaller percentage of AA biology majors changed their major than White students (7.7%, 18.1% respectively), but a larger percentage of AA biology majors left UNCC without graduating (19.2%, 18.1% respectively).

Table 5

Overview of African American and White PBIO Student Progression: 2014-2015

PBIO Student Progression	African American		White		Overall	
	N	%	N	%	N	%
Student became BIOL	26	35.1	105	42.7	131	40.9
Graduated BIOL	16	61.5	59	56.2	75	57.3
Changed to different major	2	7.7	19	18.1	21	16.0
Currently enrolled	3	11.5	8	7.6	11	8.4
Left UNCC	5	19.2	19	18.1	24	18.3
Student never became BIOL	48	64.9	141	57.3	189	59.1
Changed to different major	27	56.3	68	48.2	95	50.3
Left UNCC	21	43.8	73	51.8	94	49.7
Overall PBIO students	74	100.0	246	100.0	320	100.0
Graduated BIOL	16	21.6	59	24.0	75	23.4
Changed to different major	29	39.2	87	35.4	116	36.3
Currently enrolled	3	4.1	8	3.3	11	3.4
Left UNCC	26	35.1	92	37.4	118	36.9

Note. PBIO = Pre-Biology Major. BIOL = Biology Major. Adapted from South Eastern University Office of Institutional Research.

Participants

Purposeful sampling was used to identify participants for this study. Purposeful sampling allowed the researcher to select study participants of any gender who met the following criteria:

- (1) Self-identifies as Black/African American;
- (2) Declared major in Biological Sciences;
- (3) Currently pursuing a BA or BS Degree in Biological Sciences.

The study focused on the experiences of African American students who a major in Biology and are currently persisting in the biological major. Persistence is best demonstrated by students who have successfully completed the introductory biology and chemistry courses that are required for declaration of the Biological Sciences major and are pursued a BS degree or BA degree in Biological Sciences.

Data collection began after receiving approval from the Institutional Review Board (IRB) at UNCC. The undergraduate coordinator in the Department of Biological Sciences at UNCC assisted in the recruitment process by providing the researcher with a list of names and email addresses of students who met the study criteria. Recruitment emails were sent to twenty-eight students who met the participant criteria. Six students responded to the email and expressed interest in participating in the study. Mertens (2013), recommended phenomenological research studies have a sample size of six to ten participants. The recruitment email provided an overview of the research study, a request for participation in the research study, and an attached letter of consent for participation in the study. The letter of consent was to be completed by each participant before participating in the research study. The letter of consent included the following information: purpose of the study, name of researcher, inclusion criteria, interview

format, and a list of potential risks and benefits to participants. Students were required to provide a signed letter of consent before participating in the interview.

Data Collection and Data Analysis

Data Collection

Data collection consisted of semi-structured interviews. Semi-structured interviews provided the researcher with the flexibility to probe the participants when further clarification/details of their responses were needed. Face-to-face interviews were not permitted during the time period when interviews were scheduled with participants due to the occurrence of a global pandemic involving the Coronavirus Disease 2019 (COVID-19). The highly contagious nature of COVID-19 prevented direct interaction with research participant. Interviews were conducted during an agreed upon day and time using WebEx, an online meeting application. Interviews were guided with open-ended questions that were intended to elicit thick descriptions of the participants' experiences as biology majors. The open-ended questions were used to guide the interview process; however, participants were permitted to elaborate and provide additional information when needed to clearly express their experiences.

Interviews lasted an average of 45 minutes and were audio recorded so the researcher could engage with the interview participant without the distraction of taking notes. In addition, the recordings provided a record of the interview that the researcher could listen to for clarification when transcribing interview data. Interview recordings were stored as audio files on the university's Google drive until they were transcribed.

Temi, an online transcription service, was used to transcribe audio recordings. After receiving the transcripts from Temi, the accuracy of the transcripts was verified by

reading each transcript while listening to the corresponding audio recording. Audio recordings and transcript files were stored on the university's Google drive until transcripts could be validated by member checking. Interview transcripts were provided to study participants to validate their accuracy. After validation, participants' names were replaced with pseudonyms on the transcripts, identifying data on transcripts were redacted, and all audio recordings were deleted from the university's Google drive. No identifiers were used in the data analysis and/or reports. Participants' names were listed only on the informed consent forms which were not matched with the completed transcripts. Transcripts and consent forms were stored separately on the university's google drive.

Data Analysis

Data was analyzed using a modification of the Stevick-Colaizzi-Keen method (Moustakas, 1994). Before analyzing the data, I engaged in the first step of the modified Stevick-Colaizzi-Keen method by engaging in the bracketing process (Moustakas, 1994). To begin the data analysis process, all transcribed data was imported to NVivo, an online qualitative data management tool. I sought to obtain a state of objectivity by reading, rereading, and immersing myself in the data to experience it as the study participants experienced it. It was during this initial reading of the data that statements of significance, or horizons, were identified (Moustakas, 1994). In the next step of the Stevick-Colaizzi-Keen method, the statements of significance were grouped under specific codes, then organized into themes. The statements of significance and the themes were used to create textural descriptions of the participants' experiences (Creswell et al., 2007). Textural descriptions describe *what* the participants experienced with regards to

the phenomenon. The textural descriptions were combined into statements, and the statements were used to formulate a structural description of *how* each participant experienced the phenomenon (Creswell et al., 2007). Ultimately, textural and structural descriptions were combined to describe the essence of the phenomenon that was experienced by the study participants. Table 6 provides a summary of the data collection and data analysis procedures.

Table 6

Data Collection and Data Analysis Procedures

Data	Source	Method	Procedure
Thick, rich descriptions of participants' academic and social experiences as African American biology majors	African American students with a declared major in biology at a PWI in the southeastern United States	Semi-structured interview conducted via WebEx	<ol style="list-style-type: none"> 1. Create interview protocol 2. Create recruitment email 3. Secure student emails 4. Send out recruitment email 7. Send consent form to students willing to be interviewed 8. Obtain consent forms and schedule interviews 9. Conduct Interviews via WebEx 10. Transcribe interviews 11. Provide transcript to participant for a member check and to select a

Data	Source	Method	Procedure
			pseudonym 12. Import transcripts to Nvivo 13. Analyze and code data 14. Present emerging themes 15. Create textural and structural descriptions 16. Describe essence of phenomenon

Validity

Creswell (1998) provided eight methods for validation of qualitative research and suggested at least two of these methods be used to validate research study findings. This study was validated using three of the methods suggested by Creswell: member checking, research protocol, and thick description. Member checking, also known as “participant validation,” is a validation technique used to give credibility to qualitative research studies (Birt et al., 2016). In their seminal work, Lincoln and Guba (1985) recommended member checking be used to give rigor to qualitative research. Member checking eliminates the possibility of researcher bias by allowing interview participants to review their responses to interview questions, to make changes if needed, and to validate the authenticity of the transcribed data. Giorgi (1985) explained that keeping a research protocol increases the validity and reliability of the research study by providing a guide that the researcher will follow in the data collection process with all research participants.

Creswell (1998) suggested the use of thick, rich description of participants' experiences to verify the accuracy of the data. "With such detailed description, the researcher enables readers to transfer information to other settings and to determine whether the findings can be transferred" (Creswell, 1998, p. 203).

Summary

This chapter provided a detailed summary of the research design used in this study. A description of the qualitative research design and the phenomenological approach to qualitative research were included to provide a rationale for their use to explore the experiences of African American biology majors at a predominantly White university in the southeastern United States. Phenomenology was used to incorporate the voices of successful African American biology majors to counter the deficit narratives which have become the status quo regarding African Americans in STEM majors. The use of semi-structured interviews gave study participants the opportunity to provide firsthand accounts of their daily experiences in the biology major and to describe the success strategies they utilize to persist in the biology. The methodology used in this study can provide education researchers, university administrators, and faculty with a detailed account of the academic and social experiences of African American students who are persisting in the biological sciences major and can provide them with a greater understanding of the needs of this group of students. A detailed description of participant recruitment, data collection, and data analysis was provided. Data were collected through semi-structured interviews and analyzed using a modification of the Stevick-Colaizzi-Keen method to create themes to represent the essence of students experiences as they persist in the biology major. Validity was established through member-checking, the use

of thick description, and a research protocol. Findings from the study can serve as a template for the development of programs and practices to support the persistence of African American students and other marginalized students pursuing STEM degrees.

The next chapter adds the voices of African American biology majors attending a PWI to provide an authentic narrative of their social and academic experiences, and to provide a first-hand account of the factors that have contributed to their persistence in the biological sciences major. Moreover, adding the voices of successful biological sciences majors contributes to the discourse on how to increase the number of African Americans in STEM majors and careers.

CHAPTER 4: FINDINGS

This chapter presents the findings from the phenomenological study of the academic and social factors that support the persistence of African American students majoring in biology at UNCC, a predominantly White institution in the southeastern U.S. Guided by the methodology discussed in Chapter Three, this chapter incorporates the voices of six African American biology majors, presents the findings of the analysis of interview data, and responds to the research questions put forth in Chapter One.

This chapter is organized in two sections. The first section, titled participant profiles, introduces the participants by providing a brief background of each participant including their post-secondary goals, perceptions of the biology major, and the factors that have supported their persistence and success in the biology major. Information contained in the participants profiles was disclosed during the interview process. Participants names were replaced with pseudonyms selected by the participants. Table 7 includes an overview of each participant. The second section provides a list of the themes that emerged from the analysis of interview data and subthemes that are statements in the participants' own words that support the themes. As described in Chapter Three, phenomenological data analysis was used to develop the themes. Select phrases from the participants' interviews are presented to support and explain the themes. Four themes emerged from the data analysis. The emerging themes and subthemes address the research questions. The findings from this study are interpreted in Chapter Five using Critical Race Theory and Tinto's Persistence Theory.

Part I: Participant Profiles

Marcus

Marcus is a second-year biology major pursuing a BA degree in Biology. After completing his biology degree, he plans to enter the research field for two to three years before applying to medical school. His goal is to become a family physician. Marcus shared that his first semester at UNCC was difficult, but he was determined to remain in the biology major. Marcus attended an early college high school before coming to UNCC. He believes his early college education helped to prepare him for the demands of college-level coursework but did not prepare him for the life experiences at a predominantly White institution. He credits his success in the biology major to his high school biology teacher who instilled in him a love of biology, his peer group within the biology major at UNCC, his peer group that he maintains contact with from his Early College High School who are also pursuing the biology major at different colleges/universities, and his personal drive and determination to succeed in the biology major. He believes that a key contributor to his success in biology was that his two older brothers started as biology majors but did not persist in that major. The awareness that his brothers showed through switching from biology inspired him to continue in the biology major no matter how challenging it became. Marcus explained that just hearing that his brothers switched from the biology major really gave him the drive to not switch to a different major. He felt if he switched too, it would make it acceptable to give up on it, so he chose to persist in his pursuit of a biology degree no matter how many “obstacles or difficulties” he encountered.

Aubree

Aubree is a second-year biology major pursuing a BS degree in Biology. She plans to attend a Physician's Assistant Program after completing her biology degree. Aubree attended an early college high school before attending UNCC. She believes the early college program helped to prepare her for the rigors of college coursework and helped her to understand the importance of studying and time management; however, she does not believe the early college program prepared her for the lack of interaction and academic support from her professors in colleges. Aubree added that she does not feel a connection with her professors in biology as she did at the institution she attended for early college. Furthermore, she feels the biology department is disconnected and there is no sense of community within the department. Aubree attributes her success in the biology major to her family, social outlets on campus outside the biology major, and her own passion and ability to just push through the major. Aubree explained that you have to dive in on your own and do a lot of leg work yourself. She believes that being able to "get in and fit in" made her successful.

Brittany

Brittany is a second-year biology major pursuing a BA degree in Biology. Brittany is unsure of her plans after completing her biology degree but is considering a career in the ministry. Brittany stated that her desire for a career in biology has decreased since she has been in the biology major, and although she feels she has gone too far to change her major, she does not plan to pursue a career in biology after graduation. Brittany explained that although she sometimes likes the biology major and enjoys her classes, she does not feel as if she belongs in the biology major. Brittany also shared that her experiences with professors in classes outside the biology major have been more

supportive than her experiences with her biology professors. Brittany attributes her success in the biology major to her precollege preparation, family, faith, campus organizations that support minority students in STEM majors, and to the study groups she has participated in with her biology peers. She explained that the biology students in the study groups exposed her to different ways of studying which helped her academically, and they reassured her and encouraged her to continue in the biology major.

Rome

Rome is a third-year biology major pursuing a BA degree in Biology. Rome is a non-traditional student who completed a year of college to become a Licensed Practical Nurse (LPN) and served in the military before attending UNCC. He plans to attend a Physician's Assistant Program after completing his biology degree. Rome believes his "don't give up" attitude, which he attributes to his military background, and his myriad life experiences have contributed to his success in the biology major. Rome added that he has always liked biology and biology was his favorite subject in high school. He shared that he is studying biology now not just to earn a degree but because he finds it interesting. Rome admitted that although he has always excelled academically, he has found the coursework in the biology major to be "hard", and as a result he has relied on a variety of support systems to help him to be successful in the major. He emphasized that you cannot do it alone, and he stressed the importance of putting yourself out there and asking for help when you need it from your professors but mostly from your peers. He shared that he is very vocal in class, and has gone to professors' office hours, but has had few interactions with professors outside of class. His primary support in the biology major comes from his peers. He added that most biology students share a common end

goal which is to attend graduate school or a professional health program after completing the biology degree; therefore, most biology students try to help each other with the coursework. He explained that it is difficult for African American students to disclose to White faculty and White peers that they need help for fear that they will be looked down upon or seen as inadequate. He believes his willingness to put aside his pride and ask for help when he needs it has helped him to be successful in the biology major.

Rachel

Rachel is a first-year biology major pursuing a BA degree in Biology. After completing her biology degree, she plans to attend graduate school with a research focus in marine biology. Rachel attributes some of her success in the biology major to the pre-college education she received through the International Baccalaureate (IB) Program at her high school. Rachel shared that she was not always successful in the biology major at UNCC. She explained that her first academic advisor offered her little advice regarding which biology courses to take. She also added that she has had biology professors who have gone “above and beyond” to ensure she understands the course material, but she has also had biology professors who seemed uninterested or unwilling to provide her with the academic support she needed. She feels that poor academic advising and the lack of academic support from biology professors negatively affected her early progress in the biology major. The factors that had the most significant effect on her transformation to a successful Biology major are the connections she has made with people who look like her, particularly her African American academic advisor, African American faculty, and African American peers in the biology major. Rachel added that the African American students in her biology classes typically sit together starting on the first day of class, and

from that first interaction they form study groups and friendships. Rachel added that having people like her with the same dreams and goals as her really helped her as a biology student.

Katherine

Katherine is a third-year biology major pursuing a BA degree in Biology. She plans to attend a 12-month program to become a clinical laboratory scientist and her goal is to work in a hospital or laboratory setting after completing her biology degree. She added that she really wants to be in a lab setting because it is where she feels she belongs. Katherine stated that she does not like the biology major and has not felt welcomed in the major. She described the biology major as very competitive with everyone out for themselves. She explained that some of her White peers are resistant to participating in study groups with her because they assume that she is not interested in studying together, but actually wants to copy their work. Katherine shared that participating in study groups helps her better understand course material when she is struggling with it, and it gives her the opportunity to help someone else who may be struggling. Katherine has formed some friendships with her peers in biology but adds that her most family-like relationships have been with faculty and peers who look like her. She revealed that she has cried a lot in the biology major. There have been many times that her hard work in her biology courses has not resulted in the outcome she expected, and she expressed that it really hurt her feelings, but through the tears she has become stronger and more determined to not give up. Katherine attributes her success in the major to the support of family, friends, peers, and her own grit and determination to persist in the biology major.

Table 7

Participant Profiles for African American Students Majoring in Biology at a Predominantly White Institution

Name	Gender Identity	Pre-College Preparation	Years in Biology Major	Career Goal
Marcus	Male	Early College	2	Physician
Aubree	Female	Early College	2	Physician
Brittany	Female	AP, Honors, Dual Enrollment	2	Assistant Ministry
Rome	Male	LPN, Military	3	
Rachel	Female	AP, Honors	1	Physician Assistant
Katherine	Female	IB	3	Marine Biologist Clinical Laboratory Scientist

Part II: Emergent Themes

The second part of this chapter discusses the themes that emerged as factors that support the participants' persistence toward degree attainment in biology. As discussed in Chapter Three, phenomenological data analysis was used to describe the essence of participants' experiences as African American students majoring in biology at a predominantly White institution, to identify the factors that support their persistence in the biology major, and to determine how these factors support their persistence as biology majors. The factors supporting participants' persistence in biology were divided into the following themes with corresponding subthemes that are direct quotes captured during participant interviews. The use of direct quotes allows participants to speak for

themselves. The themes that emerged as factors that support African American students in the biology major were: (1) self-determination, (2) peer support, and (3) independence. The sub-themes within self-determination were: (1a) “let your passion push you forward” and (1b) “you’ve got to put the work in.” The sub-themes within peer support were: (2a) “you can’t do it alone” and (2b) “you’ve got to put yourself out there.” The sub-theme that emerged within independence was “you just have to dive in on your own.” The theme that emerged to describe how “peer support,” “self-determination,” and “independence” support the persistence of African American students in the biology major was (4) adaptation. The sub-themes within adaptation were: (4a) “build your own community” and (4b) “people who look like you.” The first, second, and third themes, (1) self-determination, (2) peer-support, and (3) independence answered the first research question: What are the factors that provide support to African American undergraduate students persisting in the biology major at a predominantly White university in the southeastern United States? The fourth theme, (4) adaptation, answered the second research question: How do these factors contribute to African American undergraduate students’ persistence in the biology major at a predominantly White university in the southeastern United States?

Table 8

Emergent Themes and Subthemes by Research Question

Research Questions	Themes	Sub-Themes
What are the factors that provide support to African American undergraduate students persisting in the biology major at a predominantly White university in the southeastern United States?	Self-Determination	<ul style="list-style-type: none"> • “Let your passion push you forward” • “You’ve got to put the work in”

	Peer-Support	<ul style="list-style-type: none"> • “You can’t do it alone” • “Put yourself out there”
	Independence	<ul style="list-style-type: none"> • “You just have to dive in on your own”
How do these factors contribute to African American undergraduate students’ persistence in the biology major at a predominantly White university in the southeastern United States?	Adaptation	<ul style="list-style-type: none"> • “Build your own community” • “People who look like me”

Research Question One

Research question one was: What are the factors that provide support to African American undergraduate students persisting in the biology major at a predominantly White university in the southeastern United States? Interview responses from study participants revealed three main themes that emerged from the data to address the first research question. The main themes that emerged were: “self-determination,” “peer-support,” and “independence.” The sub-themes that emerged within “self-determination” were: “let your passion push you forward” and “you’ve got to put the work in.” All participants expressed that their determination to succeed in the biology major was a major factor in their ability to persist in biology despite the rigorous coursework, and the lack of academic support they received in the biology major. The theme of “self-determination” was expressed in the statements participants used such as “let your passion push you forward” and “you’ve got to put the work in.”

Let Your Passion Push Your Forward

Marcus spoke about the difficulties he encountered his first semester at UNCC. He expressed feeling extremely confident when he came to UNCC, but admitted his confidence wavered that first semester because he was not prepared for the “life experiences” at a PWI. Marcus shared that the first semester really took a toll on him, but his passion for biology pushed him to continue pursuing his biology degree. Marcus stated:

The first semester was tough, but by the second semester I already knew what it was I wanted to do. I was certain that I wanted to continue pursuing this career. No matter how tough it got, I really just had that idea and that outlook towards the study. It kind of pushed me forward a lot. It propelled me to continue pursuing the career no matter the scenery, social, or academic standards based on the average African American male. It still allowed me to continue pursuing this career no matter any obstacles or difficulties. You really just have to have a passion for it and that passion has to be strong enough to push you to continue it.

Aubree explained that the social and academic challenges that African American students are confronted with at a PWI can be discouraging. She reiterated Marcus’s perspective that you have to use your passion for biology to push you through. Aubree stated:

It hasn't been the easiest thing to do. It's definitely not something that's kind of catered in your favor, but I would definitely just say, it's been a ride. I've gotten through it because I'm passionate about it. I feel like the predicament that a lot of African American students get in can be discouraging, but I would definitely say push forward with it. If it's something that you're passionate and strong about,

don't let the environment change your thoughts about the major or something that you're passionate about.

You've Got to Put the Work In

Rome affirmed that he was interested in biology since high school, and biology is his favorite subject. Rome made it very clear that although he enjoys studying biology, it is a difficult major. Rome said he wants to be successful in biology major and he's willing to put the work in to make it happen. Rome said:

Definitely put the work in cause it's not going to be easy. I'm never going to say that. I personally feel like there's a lot of different degrees that are going to be easier than a biology degree, but if you want to do it then put the work in.

I mean I'm a firm believer in putting in the work to get what you want. So, whenever I had something that was difficult, I just put more work into it. I do more studying. You have to put in the work. Most instructors that I've had mentioned they don't want anyone to not make it, they want us to make it. But they also stress the fact that it's going to be on us. Almost all the instructors that I've had have said we you don't want you to fail but it's on you to do the work.

Aubree's perspective on what it takes to be successful in the biology major was similar to Rome's perspective. She stated, "it's more based off what work the student is willing to put in." Aubree explained that she did not feel her biology professors cared whether she was successful in their classes, therefore it was up to her to put the work in:

Uh, in my honest opinion, I don't think they care. It's more based off what work the student is willing to put in. Cause if you fall short there's not going to be any help. In college you do have to put your own work in. I feel like it's more about,

you know, they're going to get paid regardless. They're going to offer the course content every semester or however often they offer it.

All participants expressed that peer support groups were essential to their academic success in biology. They explained that peer groups provided them with the academic and social support they needed but did not receive within the biology major. All but one participant stated they were not comfortable going to their professors' office and they did not interact with their professors outside of class. Some participants believed their professors could not relate to them because they were not the same race as them, while others felt that even when they sought academic support from their professors, they were not given the level of support they believed their White peers were given. In the absence of authentic relationships with their professors, the participants sought academic support from their peers in biology. The participants explained that it was sometimes difficult to gain access to study groups with their White peers, and even when they asked to join study groups with their white peers, they were not always welcomed into the group. The participants stated that they primarily studied with other African American students in their biology classes, but this was sometimes difficult due to the low number of African Americans in their classes. The theme of "peer support" was expressed in statements the participants used such as "you can't do it alone" and "you've got to put yourself out there."

You Can't Do It Alone

Marcus felt that peer study groups were an important source of encouragement and academic support in some of his more challenging biology courses. Having a peer

study group may sometimes mean that you will have to approach students instead of waiting for them to approach you. Marcus stated:

I actually reached out to a group of students to study, and to, you know, motivate one another to continue to get through the course. You can't do it alone. Some courses require you to step out of your comfort zone and have peer to peer interaction.

Rachel shared that it was helpful for her to have a support group consisting of African American students within the biology major whose goals aligned with hers, stating:

The majority of the time when I, like, go into a biology class, I sit around people that look like me. So normally after like the first week of class, we all kind of connect and we do study groups through that. I feel like having people that are close to your age also pursuing the same goal and dream, it definitely helps.

Put Yourself Out There

Marcus explained that building a peer support group within the biology major can be difficult. He expressed that the competitive nature of students in the biology major prevented some students from participating in study groups. He also shared that some students are just not able to connect with him. Marcus commented that as far as studying together, some students are “okay with it” and others are not:

“I've had times where you can reach out and ask like, hey, would you like to get a study group together? And some would say no, others would say sure, but I'm busy throughout the week so it's hard to really schedule times to meet with that person. Some wouldn't be okay with it.

Marcus described how he sometimes goes to places on campus where students gather to study or socialize in order to find someone he can study with. He also participates in structured peer learning groups. He stated:

I would just put myself in a well populated study areas such as the library or the union. There'll be a lot of students whether they're studying or whether they're just interacting socially. I will also go to peer assisted learning groups. They helped out a lot.

Rome explained that it can be difficult for African American students to ask for academic support from their White peers. The fear of fulfilling racial stereotypes of African Americans as incapable of excelling in STEM majors prevents African American students from asking for help. Rome said:

If you're an African American in a biology course at a predominantly White institution, more than likely it will be less of you in the class. So, this is how it feels sometimes. So, if you're struggling in a class and there's a lot of White people in the class and they're doing well, you know, from a ratio standpoint, you're looking at it like maybe I don't belong because I'm not doing well. I'm not doing well, what's the disconnect? Like people might think because you're African American, you might not be as smart or things of that nature. Don't be afraid to ask for help. Don't let the narrative beat you, you know? Um, like I said, put your success over pride. Put your success over pride and reach out and ask for help.

Success in the biology major required a level of independence on the part of the study participants. Their willingness to step out on their own in the absence of a true

academic support system for African American students within the biology major, was a key factor in their success. Study participants sought to obtain information that was not readily available to them through academic advising and to better understand course content and learning objectives when they were not clearly defined by their professor. The sub-theme that emerged within independence was “you just have to dive in on your own.”

You Just Have to Dive in On Your Own

Aubree explained that being proactive and figuring some things out on her own helped her to be successful in the biology major:

I do feel like you have to put in a lot of work to figure things out if you're on a different track like PT or optometry or pharmacy. You just have to dive in on your own and do a lot of that work yourself. I feel like what's made me successful in it is really kind of having to do my own leg work to really kind of get in and fit in.

Marcus expressed that there were times when course content was not provided in a way that was comprehensible to him to figure out what his professor was trying to convey.

Sometimes you have a professor that can really articulate and explain what it is you need to do. And there's other courses within the biology major where you have to really sit down with yourself and understand what it is you need to know and how you need to know it in order to continue progressing throughout the biology major.

Katherine shared a similar view as Marcus regarding taking charge of understanding course content and figuring some things out on her own when she feels her instructor is not fully invested in her success. She said:

Just finding the right people that genuinely want to help and want to see me succeed rather than just want me to pass their class. I had to re-strategize how I study, because that has an effect on how well I do in the class as well. In situations where I feel like the professor isn't really there for me a hundred percent, I put it on myself to figure it out.

It was clear that the participants in this study were determined to persist in the biology major despite any obstacles or challenges they encountered. The participants' ability to adapt to an academic environment that was vastly different from their previous academic environments, and their determination to independently seek and secure the resources and support groups they needed to be successful in the biology major, demonstrates the importance of "adaptation" to their persistence in the biology major.

Research Question Two

Research question two was: How do these factors contribute to African American undergraduate students' persistence in the biology major at a predominantly White university in the southeastern United States? One main theme emerged from the data to address research question two. The main theme that emerged was "adaptation." The sub-themes that emerged within adaptation were "build your own community" and "people who look like me."

Adaptation was an emergent theme throughout the study. To be successful in the biology major at UNCC required the study participants to adapt to an environment many

of them described as isolating, disconnected, unsupportive, and unwelcoming. Most of the study participants voiced their disappointment over the lack of community in the biology major which included minimal or no interactions with biology professors outside of class, and a lack of connectedness among biology students. Some participants were noticeably emotional as they recounted stories of feeling unsupported by their biology professors and disconnected from their peers in biology, while others seemed empowered by the challenge of succeeding in biology despite the obstacles they encountered in the biology major. The participants were able to adapt to the environment in the biology major because of their determination to succeed and the academic and social support they received from their African American peers.

Aubree, Rachel, Katherine, and Brittany discussed the lack of care and concern they received from their biology professors. Aubree felt that her biology professors did not express the level of concern regarding her performance in their classes that she expected. Aubree attended an early college high school before coming to UNCC, and expressed that her biology professors did not provide her with the same level of support and concern that she received from the professors in her early college. She referenced her experiences with her professors in early college, stating, "I just know that there's a difference because like I said, I've been to a previous institution." For Aubree, the lack of interaction with her biology professors was contrary to the supportive environment she experienced in early college. Aubree stated:

I often times have felt apprehensive about going to my professors because I just didn't feel a connection like I felt when I went to a previous institution for an early college. There's only one professor that I've taken in the biology

department that I do feel like cares about you and how your performance is affecting you as an individual.

Rachel echoed Aubree's feelings regarding some of her biology professors. She furthered the narrative by discussing the role she feels race plays in her professor's inability to connect with her, stating:

I feel as though some instructors, I'm not saying you gotta be like our mom and dad, but like to me personally, sometimes they don't even reach out at all. I just feel like sometimes people that don't look like us connect better with people who don't look like us. You connect better with people who look like you. And sometimes it was like when you go to talk to a professor that doesn't look like you, it was almost a nonchalant attitude sometimes. It was like, okay, do your best. But I feel as though if I would had looked like them, I would have been given more help.

Katherine continued the discussion on race by stating that her White biology professors could not relate to her as a Black woman. She believes they are incapable of understanding her financial struggles and the affect finances have on her academic performance. Katherine believes her professors view her as lazy. Katherine stated:

I would say, and this may go back to dealing with people that look like me, but they don't understand the different types of challenges and events imposed upon me prior to getting into college. Some kids can focus on their classes completely and not have a worry in the world, but there's some kids that can focus maybe 85% on their classes, but they also have to focus on how they're going to pay to keep a roof over their head because they can't pay for their expenses while they

go to college. Or they're trying to figure out how to get financial aid to not cancel their classes because they just don't have the money. Sometimes that may be translated as, Oh she's lazy. She's not a hard worker, but there are other aspects in their life that's affecting how much energy they can put into their classwork.

Brittany shared that her interactions with professors outside the biology major were drastically different from her interactions with her biology professors. She felt that her professors outside biology were genuinely concerned about her and her success in their classes:

There was one class I can think of in particular, it was in the Spanish department actually. I was struggling a bit in the class and this was like before the professors had to turn in their evaluations if they think you're at risk. But before they had to turn that in, one of the professors, two of them actually in two different classes came to me and asked like, hey are you having trouble with the material? Like what's going on? Is there any way that I can help you or be a resource for you? They noticed that your grades are not what they expected and just basically asked how they could help me better learn the material. I think only one or two of my biology professors that I can remember have mentioned or gone outside of their way to make themselves available.

Aubree felt that her early college high school prepared her for college coursework but did not prepare her for the lack of community among students and professors in the biology major. Aubree described the absence of community as “individuality”:

I went to an early college and took college classes, so I knew the amount of rigor and the importance of studying and time management. I think those skill sets

coming in prepared me, but I don't think as far as the professor interaction that I have at my institution now and the individuality that I have at my institution now, I don't think that I was well prepared for it. I do feel like the biology department could definitely use a lot of work to just be like and feel like more of a community.

Aubree attributes the lack of community among biology majors to the biology department which she described as “disconnected”. Aubree feels the biology department is different from other academic departments at UNCC because of its lack of connectedness among biology students:

It's not like the nursing community where everybody kind of knows each other, or engineering where you can even have housing with other engineering majors. You'll meet someone and be very surprised to find out that they were in your class. And you will be like, “you were in my class? I didn't even know you were a biology major.”

Rachel explained that she has few interactions with her biology peers outside the classroom, and she does not typically interact with them beyond the semester in which they have a class together:

I do interact with them while in class, and sometimes outside the classroom. But if we have one class together in the fall semester and we don't have a class together again in the spring semester, I probably won't interact with them. Normally I only interact with them within the semester that we have classes together.

Katherine echoed Rachel's sentiments regarding her interactions with peers in biology. She stated, “I interact with them mostly inside the classroom. Not so much

outside because I'm picky about who I bring into my energy and into my circle, so I keep you at a classmate distance rather than, 'hey, let's go get a Starbucks.' It's very few that I do that with."

Build Your Own Community

Aubree explained that she conquered the feelings of individuality she experienced in the biology major by building her own community outside biology. Aubree stated the only time she interacted with her peers was for study groups or when meeting for a project, like in chemistry labs. She said:

You kind of have to build your own community. The first semester was quite different from what I expected, but as the semester went along, then I definitely found out about the different African American events and organizations that I could be a part of and feel like a family. Finding my own social outlet outside of an academic setting definitely has been a huge help to me because that was kind of what I leaned on outside of academics. I do kind of wish I had a tight, close knit kind of cohort, but like I said about that community life.

Like Aubree, Brittany found a community outside the biology major. Although Brittany is not an engineering major, she found a community of supporters within an organization for Black engineering students:

Being a part of the National Society of Black Engineers (NSBE) that was very helpful to me because there were a lot of minorities in that group that were not just biology but like mostly engineering majors, still STEM students, and it just helps to have a community that understands what you're going through and that continues to encourage you and support you.

Marcus described his first impression of the biology major at UNCC as mostly White and extremely competitive. He also indicated that some students in biology are so competitive and so focus-driven that they do not want to interact with other students. Marcus indicated that it was a challenge to find students who wanted to interact with him. He explained that attending an early college prepared him for college-level coursework but did not prepare him for the life experiences at a PWI. Marcus shared that although he would have felt more comfortable attending an HBCU, he feels challenged to be successful at a PWI. Marcus replied:

I'd have to say that I'm not necessarily feeling at home with this major, but I'm challenged with it and I'm willing to accept the challenge. It's not really about feeling comfortable within the major for me, but it's about the challenge that I can receive from it. That's why I don't mind the competitive setting at a PWI because I'm not comfortable. I'm not able to settle for just anything. I'm able to continue to strive and to pursue this career within biology. No matter where you go, it's always going to be competitive. But with being an African American at a PWI, it's extremely competitive on a whole other level.

Marcus has a community outside the university. His classmates from his high school biology class provide him with the academic and social support he needs to persist in the biology major:

My high school biology teacher made learning biology really instructive and fun. I haven't really had the chance to experience that anywhere else besides with him. And that really ignited the love for biology. A lot of students that took his class continue to be biology majors, whether they went to a different university than I

did and just connecting with those students as well in my free time, my peers, we really drive each other whether we're at different universities, as long as you are still pursuing biology, we can still motivate you.

People Who Look Like Me

Katherine explained that her relationships outside of her classes are with people who look like her. She doesn't feel as if biology is super welcoming or like a family. She stated, "To be honest, I only get the family vibe from people who look like me. That's kind of the only type of people that I've had relationships with outside of the classroom."

Aubree talked about the need for more African American professors in biology. African American professors are barely represented in the biology major; therefore, African American students do not have the opportunity to have African American professors and mentors. She felt it was important for African American biology students to form support groups with African Americans outside the biology major:

I do feel as if there is a difference in the support systems that we have. I mean because most of the professors are not of African American descent, so it is easier for them to relate to White students. You know, I feel like that support for us is definitely different for sure. We definitely need a lot of African American role models. I would say definitely try to find those outlets that your university offers like support systems and resources that you can go to. And definitely like friends. And just being a part of the African American society of your PWI outside of the classroom.

Rachel also discussed the importance of having a support group within the biology department who looked like her. She felt that gaining a new academic advisor

and a professor who looked like her was a turning point for her as a biology major.

Rachel said:

So definitely getting a new advisor who looks like me helped because she is more into the program, like she knows what's going on within the program. So, she is able to help me to get the resources I needed. And I feel like for my first two years I lacked that. She helped me connect with more people in the biology department that looked like me, that was associated with things that I like to do. And I feel as though that also helped me with being able to reach out and start doing like research and understanding what I need to do in order to be able to maybe go to medical school. I definitely would say to find people that look like you. Definitely. I feel as though even if your advisor is not the same color as you, there are other people who look like you in the department that could still advise you. They could still help you.

Summary

The data for this phenomenological study was collected through the use of in-depth interviews of six African American biology majors at a predominantly White institution. The interview questions were structured to allow study participants to provide thick, rich descriptions of their academic and social experiences as they navigated the biology major at a PWI. The factors that support the persistence of this group of successful African American biology majors is discussed within the emergent themes in this chapter. The participants described the biology major as one in which African Americans were scarcely represented in the professorate, and in which they had few if any interactions outside of class with their majority White professors or their majority

White peers. The lack of connectedness with their professors and peers created feelings of isolation and alienation within the biology major, leading most participants to describe the biology major as disconnected and lacking community. It was clear from the participants' comments that being part of a community was important to them; therefore the participants sought to establish their own communities and support networks with same-race peers within the biology major and same-race peers who were not biology majors but were within the African American community at UNCC. In addition, the participants described positive interactions and support from same-race faculty members and advisors.

Participants relied on same-race peer study groups within the biology major for academic support. Social support was provided through participation in peer groups, clubs, and organizations that were exclusive to members of the African American community on campus. In addition, the participants ventured out on their own to obtain information and resources that were not readily available to them within the biology major such as peer career counseling.

The participants integrated themselves in the campus community while also maintaining a connection to the African American community through peer groups and support networks they established or sought out for themselves. Academic and social integration in the campus community combined with a connection to the African American community is consistent with Tinto's theoretical model regarding persistence in higher education.

Overall findings revealed the factors that support the persistence of the African American biology students in this study were their determination to succeed in the

biology major; the academic and social support they received from same-race peers; their ability to function independently to obtain resources that were not readily available to them, and their ability to adapt to the environment in the biology major. The next chapter provides a discussion of the findings, implications, and recommendations.

CHAPTER 5: DISCUSSION

Overview

The information presented in this final chapter provides a summative discussion of the results of this study. The findings are summarized, connected to the broader literature, and positioned within the theoretical frameworks that guided the research. In the final section, implications and recommendations for educational stakeholders are made as well as recommendations for future research.

Review of the Study

The purpose of this study was to explore the academic and social experiences of African American students who are successfully navigating the biology major at a predominantly White institution. The intention of this study was to better understand the strategies and practices that support the persistence of African American biology majors at a PWI. Focusing exclusively on African American students and using a phenomenological approach to provide thick descriptions of the phenomenon, the guiding research questions for this study were:

- 1) What are the factors that provide support to African American undergraduate students persisting in the biology major at a predominantly White university in the southeastern United States?
- 2) How do these factors contribute to African American undergraduate students' persistence in the biology major at a predominantly White university in the southeastern United States?

This study began with an analysis of the burgeoning STEM crisis in the United States, and the need to increase the number of African Americans graduating with STEM

degrees and entering the STEM workforce. Chapter One explored the factors that have contributed to the disparity in the number of African Americans pursuing STEM majors and graduating with STEM degrees. The inequitable distribution of resources, combined with the lack of qualified math and science teachers in K-12 schools with large numbers of racial and ethnic minorities, was shown to adversely affect African American students' performance on standardized assessments (Carter & Welner, 2013; Wiggan & Walton, 2014). Moreover, existing research revealed that the inadequate math and science preparation received by African American students was a contributing factor to the high attrition rates and low graduation rates of African American STEM majors in higher education (Anderson & Kim, 2016; Graham et al., 2013; Landsman & Lewis, 2011). Chapter Two provided a summary of the theoretical frameworks guiding this study, a review of relevant literature examining factors shown to support the persistence of African American STEM majors at HBCUs, and initiatives aimed at supporting the persistence of African American STEM majors at PWIs. Critical Race Theory added the voices of African American biology majors telling their own story, and Tinto's persistence theory emphasized a correlation between academic and social integration and persistence in higher education. Chapter Three outlined the research design and the methodology used to address the research questions in this study. This qualitative study utilized a phenomenological approach to explore the experiences of African American biology majors, to identify the strategies and practices that support the persistence of African American biology majors at a PWI, and to determine how these factors support African American students' persistence in the biology major at a PWI. Chapter Four provided a detailed account of the findings of the study. As it relates to Tinto's theoretical

framework, it was found that students' need for academic and social integration were primarily achieved through interactions with same-race peer groups inside and outside of the biology major. Chapter Five provides a conclusion to the study. Key themes that emerged are discussed, and implications of the findings and recommendations for stakeholders are presented.

The reasons that African American students persist in STEM majors at PWIs are complex and cannot be explained by simply focusing on factors such as pre-college preparation or academic performance in STEM classes (Green et al., 2019). The academic and social experiences of African American STEM majors at PWIs play a significant role in their decision to persist (Johnson et al., 2013). African American STEM students encounter stressful academic settings at PWIs and report feelings of alienation, isolation, and "culture-shock" (Winkle-Wagner & McCoy, 2016). Winkle-Wagner and McCoy (2016) declared that more qualitative research is needed to better understand the experiences of African American students' in STEM programs at PWIs, and to determine the best practices to support their persistence. Further, Winkle-Wagner & McCoy (2016) suggested that PWIs should refer to HBCUs for lessons on how to make African American students feel more supported in their programs, as academic support has been shown to increase African American students' persistence in STEM majors.

As shown in Chapter Two, HBCUs represent just 4% of all four-year colleges and universities in the United States, but award 15% of the STEM degrees earned by African American undergraduate students (Rice et al., 2016; Wilson-Kennedy et al., 2018). PWIs have sought to duplicate many of the programs utilized at HBCUs in order to increase the

number of African Americans graduating with STEM degrees (Domingo et al., 2019; Harper, 2019; Salazar, et al., 2018; Santisteban et al., 2016). Despite the presence of STEM-based programs at PWIs, the graduation rate for African Americans with STEM degrees remains significantly lower than their White and Hispanic counterparts.

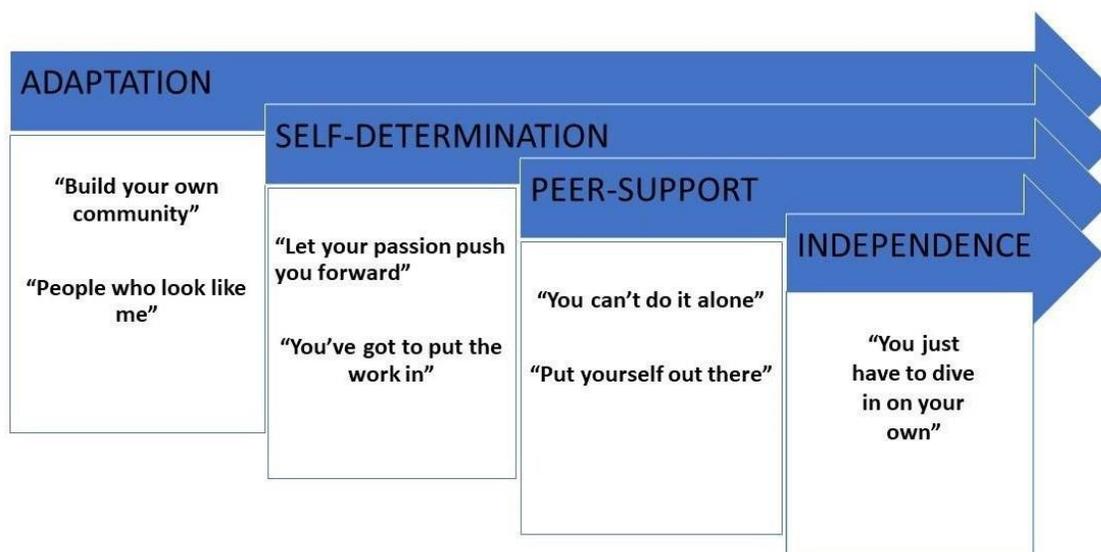
Additional research is needed to determine why PWIs remain largely unsuccessful in increasing African American STEM graduates (Winkle-Wagner & McCoy, 2018). This study contributes to the growing body of anti-deficit literature by focusing on African American students attending a predominantly White institution who are successfully navigating a STEM major and persisting toward graduation with a STEM degree.

The findings of this study are situated within Tinto's (1993) persistence theory and Tinto's (2006) revised persistence theory with limitations. Tinto (1993) posited that academic and social integration within the campus community are essential for students to persist and graduate from college. Tinto characterized academic integration as academic achievement and interaction with faculty, and social integration is characterized as extracurricular activities and interaction with peers. Tinto (2006) posits that to persist in college, students must maintain some level of social connection with on-campus peers, faculty, advisors, and service staff. In addition, Tinto affirmed that the unique needs of students of color, students from underrepresented backgrounds, and students from low-income families requires them to also maintain relationships with family, culture, and community in order to persist in college. According to Tinto (2006), academic integration requires students to interact with faculty; however, the participants did not have interactions with their instructors outside of class. Interaction with biology faculty was replaced with interaction with peer-study groups. Social integration requires students to

participant in extracurricular activities and to interact with peers. The participants interacted with same-race peers and participated in clubs and organizations with same-race memberships.

Figure 2.

Themes That Emerged From the Analysis of Interview Data.



Research Question One

Analysis of the data revealed the factors that support the persistence of African American students at a predominantly White institution. Three themes emerged: "Self-determination," "Peer-support," and "Independence." The findings align with existing literature on the persistence of African American students in STEM disciplines at predominantly White institutions. The themes and corresponding subthemes are represented in Figure 2. Each theme is discussed and its relationship to existing literature is made below .

Theme One: Self-Determination: “Let Your Passion Push You Forward” and “You’ve Got to Put the Work In”.

Self-determination was expressed often by the study participants as the motivating force behind their persistence and success in the biology major. Attributes such as persistence and resilience have been shown to be better predictors of African American students’ success in biology than their high school GPA and SAT scores (Matsui, 2018). Cokley et al. (2013) affirmed that African American students persistence has been shown to increase when African American students experience kindness, dignity, and belonging within the STEM major. However, in the absence of reaffirming experiences within the biology major, the participants’ persistence was fueled by their belief that they could be as successful in the biology major as their White counterparts (Cokley, 2000).

All study participants described the biology major as rigorous, requiring hard-work and dedication to be successful. Undoubtedly, their White counterparts would voice a similar assessment of the biology major. The participants expressed being aware of the academic demands that would be placed upon them as biology majors; however, they did not expect the isolating and unsupportive climate they encountered in the biology major. The lack of academic support and social support for African American students in the biology major combined with feelings of isolation from faculty and peers, created an environment in which the participants were supported by their personal attributes to be successful in the biology major. The participants’ efforts were not thwarted by the lack of resources and support they receive. Interestingly, they expressed confidence in their ability to succeed in the biology major despite the lack of access and support.

Theme Two: Peer Support: “You Can’t Do It Alone” and “You’ve Got to Put Yourself Out There”

Peer support has been shown to significantly impact the persistence of African American STEM majors at PWIs (Palmer et al., 2018). In addition, peer support groups provide a sense of belonging in African American students by building academic and social networks on predominantly White campuses (Wilton et al., 2019). Academic and social networks in turn provide a sense of belonging for African American students who are struggling to integrate in predominantly White spaces (Palmer et al., 2018). Moreover, peer-to-peer interactions are particularly important in the absence of instructor-student interactions in creating a sense of belonging. All study participants discussed their involvement with peer groups that were academic, social, or a combination of both.

Brittany shared that in the absence of academic support from her biology professors, her peer support group helped her to better understand the biology course material and encouraged her to stay in the biology major when expressed feelings of not belonging in the major. Being a part of a peer support group exposed to alternate ways of studying which made the course material easier to understand. Participants described a variety of peer support groups. The participants’ peer support groups took the form of family, friends, peers within the biology major and peers pursuing a different major, clubs, and organizations. Marcus’s peer support group was established in high school and continued even as members of his peer support group pursued biology majors at different colleges and universities. Peer support groups provide African American students with a sense of belonging and a sense of community (Brooms, 2017).

Theme Three: Independence:

“You just have to dive in on your own”. In the absence of student-professor interactions and academic support within the biology major, participants relied on their ability to dive in on their own and obtain the resources and support they needed. The findings are consistent with research showing a relationship between students’ self-confidence and their ability to seek and gain access to the resources, programs, and people they need to navigate the academic and social realms of college (Hurtado et al., (2007). Marcus and Katherine explained that when course material was not provided to them in a way they could understand, they resorted to teaching themselves what they needed to know and how they needed to know it. Aubree demonstrated independence in securing the information she needed regarding professional health programs she would pursue after completing her biology degree in lieu of relying on her academic advisor to provide her with the necessary information. Independence was also demonstrated by participants’ seeking academic and social support groups outside the biology major.

Research Question Two

Analysis of the data revealed a single factor that describes how self-determination, peer-support, and independence are used to support the persistence of African American students at a predominantly White institution. The theme that emerged was “Adaptation.” The theme and corresponding subthemes are represented in Figure 2. The findings align with existing literature on the persistence of African American students in STEM disciplines at predominantly White institutions. The theme is discussed and its relationship to existing literature is made below.

Adaptation means to adjust to one's new surroundings or situation in order to survive in that environment (National Geographic, 2020). According to *Darwin's Theory of Evolution by Natural Selection*, there is variability in the traits of organisms within a population, and this variability means that some organisms possess traits that make them better able to adapt and survive than others (National Geographic,). Green et al. (2019) affirmed a positive relationship between adaptation and success in STEM for African American students. Green et al. (2019) stated that "the successes of African Americans in STEM majors depends on their abilities to conform to the behaviors and norms of the majority culture." The participants' commitment to the biology major was apparent in their narratives describing the practices and strategies they utilize to obtain the academic and social support they need to persist in the biology major. None of the participants expressed a desire to abandon the biology major despite the additional stress of having to conform to the climate in the biology major. Stress related to campus climate and academic environments has been shown to significantly affect the persistence of African American students at PWIs (Johnson et al., 2013).

A key factor in the study participants' persistence in the biology major was their ability to adapt to an environment they described as disconnected, uncaring, and un-nurturing. Interviews with study participants revealed that the lack of racial diversity within the biology major created an environment in which their need for connectedness to family, culture, and community was not met. As a means of adapting to an environment in which they were only minimally represented in the faculty and in their peers, the participants sought opportunities to engage with other Black students through peer groups, student organizations, and campus events that were exclusive to the Black

campus community. Interacting with other Black students contributed to the participants' social integration into college while also providing participants with a connection to family, culture, and community. As indicated by Tinto (1993), social integration is essential to the persistence of all college students, but persistence for African American students hinges on their ability to maintain connections with their culture and community.

Aubree talked about when she first came to UNCC and how it was very different from what she expected. She expressed feelings of abandonment and isolation in the biology major which she referred to as *individuality*. She described individuality as a lack of concern from her biology professors and feeling disconnected from her biology professors and her peers. Faculty should be instrumental in helping Black students navigate STEM majors at PWIs, however it is well documented that Black students attending PWIs do not receive adequate mentoring from faculty (Merriweather & Morgan, 2013; Winkle-Wagner & McCoy, 2016). Winkle-Wagner and McCoy (2016) indicated that the lack of involvement from faculty causes feelings of alienation, isolation, and “culture shock” in Black students on predominantly White campuses..

Aubree shared that her initial perceptions of her biology professors and the climate of the biology major had not changed since her first semester at UNCC. She further stated that “things” improved for her when she discovered that there were African American events and organizations on campus in which she could participate. Jordt et al. (2017) explained that a negative classroom climate supersedes proven pedagogical practices in the classroom. Consequently, a supportive and encouraging classroom environment is essential to the academic success of African American students at PWIs.

A positive social climate is a key factor in the retention of African American students in STEM majors (Harper, 2019; Salazar, et al., 2018). The participation of the study participants in peer groups outside the biology major was found to be a consistent coping mechanism for the lack of community and the unwelcoming environment within the biology major. Persistence in STEM disciplines by students of color has been shown to be influenced by how welcoming they perceive the campus to be (Winkle-Wagner & McCoy, 2016).

Brittany, Katherine, and Rachel expressed their disappointment over the lack of concern they have received from their biology professors. Katherine explained that she plans to continue in the biology major and to complete her biology degree, but she no longer likes biology and does not feel as if she belongs in the biology major. Katherine's negative feelings towards the biology major are consistent with the literature of Wilton et al. regarding how instructor-student interactions are essential to promoting a sense of belonging in African American biology majors (Wilton et al., 2019). While positive interactions with faculty outside of class are associated with retention in STEM disciplines, African American students are more likely than their White counterparts to experience unfavorable, discriminatory, or racist interactions with faculty (Carlone & Johnson, 2007; Hurtado et al., 2007, Park et al., 2019).

Recommendations

The findings of this study necessitate the inclusion of recommendations for higher education administrators and faculty at predominantly White institutions. The findings of this study revealed that for this group of African American students, persistence in the biology major was directly related to their personal attributes and ability to adapt to an

environment in which they felt alienated, isolated, unsupported, and unwelcomed. The participants' descriptions of the environment within the biology major was consistent with the broader literature regarding the negative experiences and stresses that African American STEM majors encounter at PWIs (Brooms & Davis, 2017; Guiffrida, 2006; Guiffrida & Douthit, 2010; Hurtado et al, 2007; Johnson et al., 2013; Oseguera et al., 2020; Park et al., 2019; Palmer et al., 2011; Solorzano et al., 2000; Winkle-Wagner and McCoy (2016). It is therefore understandable that the attrition rate for African American students in STEM majors remains higher than any other racial/ethnic group as African American students in STEM majors are faced with the tremendous pressures of succeeding in an academically challenging major while also managing feelings of isolation and alienation (Guiffrida & Douthit, 2010).

If predominantly White institutions are to increase the number of African Americans graduating with STEM degrees, then it is imperative that they create environments that are inclusive and supportive of African American students. The following recommendations are given to (a) education policy makers at the state and federal level, (b) education administrators at predominantly White institutions, and (c) biology faculty at predominantly White institutions.

Recommendations for Education Policy Makers

It is recommended that education policy makers consider the role they can play in making K-12 and higher education curricula more inclusive to African Americans. This study highlighted the burgeoning stem crisis in the United States and the nations' efforts to make U.S. students globally competitive in math and science. Although the focus on math and science competency has increased, there has been little attention given to

students' cultural competency. Japan, one of the seven countries that scored higher than the United States in the 4th and 8th grade TIMSS report (TIMSS, 2015) emphasizes a culturally inclusive curriculum. The Japanese curriculum emphasizes traditions, culture, and respect for ancestors in its course of study (Stromquist & Monkman, 2014). Public schools in the United States are an amalgam of cultures, most notably African American and Hispanic, however the curriculum in U.S. schools is taught from a Eurocentric perspective and is reflective of a White, male world view (Cohen, et. al., 2018). The STEM curriculum taught in U.S. public schools and higher education institutions marginalizes African American students through the omission of the contributions of African Americans in science, technology, engineering and math fields (Hancock & Pass, 2020). It is essential that all students are afforded a comprehensive curriculum that includes the contributions of non-Europeans in STEM research and discovery. A significant finding in this study was that African American students felt alienated, isolated, and unwelcomed in the biology major. Incorporating the contributions of African Americans in the biology curriculum would be transformative for all students and would create a more inclusive environment for African American students. In addition, it would serve to dismantle the stereotypical and accepted view of scientists as White, middle-class men.

Funding for public schools in the United States primarily comes from state and local taxes, as a result, neighborhoods with higher taxes have better schools. Schools in more affluent areas are provided a greater share of the resources including well-qualified teachers and a stronger curriculum than students in low-income areas (Darling-Hammond, 2010). In many countries that are considered poor in comparison to the

United States, students are provided an equal education regardless of their socioeconomic status (Darling-Hammond, 2010). While all students in this study received some type of advance academic preparation before coming to UNCC, most African American students do not have access to AP, IB, or Early College Programs (Darling-Hammond, 2010; Ladson-Billings, 2016). The United States has fallen short on its promise to provide all its students with an equal education. There is a critical need for education reform in the United States. Education reform must include the allocation of federal funds to low-income schools to compensate for the disparity in funding available to them through state and local taxes. Increased funding to low-income schools is needed to lessen the opportunity gap between African American students and White students, and to ensure all students have equal access to qualified teachers and 21st-century education resources. African American students from low-income high schools would enter college with the academic experiences necessary to be successful in STEM majors.

Recommendations for Administrators at PWIs

While this study identified factors that were utilized by the students to support their persistence in the biology major, persistence in a STEM major is not the students' responsibility alone. Predominantly White institutions are also accountable for African American students' persistence (Tinto, 1993). STEM majors are academically challenging for all students, but the added strain of feeling disconnected from your professors, and academically and socially isolated from your peers, creates a nearly unbearable environment for African American students to thrive and persist to degree attainment.

Administrators at predominantly White institutions must be intentional in hiring African American faculty who can serve as role models and mentors for African American students. The shared cultural experiences and understanding of race and oppression by African American students and African American faculty, has been shown to support African American students' success in STEM majors at HBCUs (Toldson, 2018). However, as Park et al. (2019) explained, African American STEM majors at PWIs are less likely to have African American faculty members and are more likely than their White peers to experience negative interactions with White faculty. Efforts must be made to ensure African American STEM students are not further disenfranchised by the lack of access to the social capital relationships with STEM faculty provide.

It is recommended that STEM departments have a diversity, equity, and inclusion (DEI) committee dedicated to ensuring that African Americans are recruited and hired for tenure-track positions within the department. The DEI committee should develop strategies for recruiting African American faculty members including identifying how and where to advertise available positions. Resources such as Nemnet, a minority recruitment firm, could be instrumental in the search for African American candidates. Databases of minority applicants such as IMDiversity.com, the Directory of Minority Candidates, Ford Foundation Fellows, The Faculty for the Future Project, and NSF's ADVANCE Programs could also be utilized to identify potential candidates.

Broader research has shown that African American children have fewer opportunities to engage in STEM activities than their White counterparts (Ladson-Billings, 2016). Partnerships between university STEM departments and area K-12 schools would provide opportunities for students in low-socioeconomic schools which

are largely populated with African American and Hispanic students, to receive supplemental instruction in science courses and to perform hands-on lab activities. This partnership would provide graduate students in STEM disciplines with teaching and mentoring opportunities, while also increasing interest and engagement in science among K-12 URM students. Implementing Pre-college STEM programs for middle school and high school students, and summer bridge programs for incoming college freshmen who plan to major in a STEM discipline would provide opportunities African American students to acclimate to a predominantly White campus to reduce the “culture-shock” and feelings of isolation. Programs targeting students in K-12 education would increase the number of African American students in the STEM pipeline and could create a potential pool of African American students for enrollment in STEM majors.

African American STEM majors have expressed feeling isolated and alienated on predominantly White campuses (Hurtado et al, 2007). STEM departments should establish guidelines for promoting a climate of inclusivity. Opportunities should be provided for African American students to engage with non-African American students and non-African American faculty members outside the classroom to build community for all students and to promote a sense of belonging for African American students within predominantly White spaces (Palmer et al., 2018). One recommendation is for clubs and organizations within the STEM major to be advertised as diverse and inclusive spaces. The constitution/bylaws of the organizations should contain a diversity statement and a goal of the organization should be to increase diversity in STEM fields. Faculty members should engage with students outside the classroom whose race is different from their own race by serving as advisors for STEM clubs and organizations with diverse memberships.

The students expressed the importance of same-race peer support but explained that it was sometimes difficult because of the low number of African American faculty and African American students in their classes. Students on predominantly White campuses experience difficulties establishing relationships with African American peers and faculty (Park et al., 2019). It is therefore recommended that clubs and organizations exclusive to African American/Black students be established within STEM disciplines to allow African American STEM majors to engage with African students and with African American faculty. These organizations could also provide opportunities for African American students to build social capital by establishing networks with African American faculty and African American professionals working in STEM fields. Organizations such as the Minority Association of Pre-medical Students, the National Society of Black Engineers, and the Black Students in Science Club are examples of academic clubs and organizations with African American/Black memberships and African American faculty advisors.

Recommendations for Biology Faculty at PWIs

The students talked about the lack of support they received from the faculty in the biology major. It is recommended that STEM faculty at PWIs model the practices of HBCUs in creating environments in which students feel supported and nurtured by their professors (Lewis et al., 2011). Faculty in STEM disciplines at PWIs have regular but largely detached interactions with African American students in their classrooms. STEM faculty have the opportunity to build bridges between themselves and their African American students by creating environments in which all students feel valued regardless of their race or ethnicity. STEM faculty can ensure that African American students have

positive education experiences by providing curricula that is culturally responsive and culturally sustaining (Ash & Wiggan, 2018; Ladson-Billings, 2013; Wiggan et al., 2020). Curricula that respects and acknowledges African American students' diversity and culture has been shown to positively affect the academic performance of African American students' in STEM.

It is recommended that White faculty work to establish a rapport with their African American students as these students are less likely to interact with White faculty they do not feel connected with (Park et al., 2019). In the absence of African American faculty in the biology major, White biology faculty must encourage and support African American students and must adopt the role of mentor to African American students. Palmer et al. (2011) conveyed that undergraduate research and faculty mentoring have been shown to positively impact African American students' self-confidence and self-efficacy in STEM. Moreover, African American students who participate in research and mentorships with faculty have been shown to have higher grade point averages, graduate from science and engineering majors at higher rates, and have higher rates of admittance to graduate school (Cavnar & Stanny, 2018).

Faculty should be instrumental in forming diverse peer support groups within their classes. Diverse peer support groups provide opportunities for African American biology students who may be the only African American student, or one of a few African American students in their classes to form peer groups with students in the same major but are not African American. Creating opportunities for diverse groups of biology students to collaborate and interact through peer groups can encourage a feeling of community and sense of belonging for African American students on predominantly

White campuses (Palmer et al., 2018). This is particularly important for students who are already feeling isolated and disconnected within their majors and the university at large (Hurtado et al., 2007).

It is recommended that STEM departments require faculty members to actively engage in workshops/training sessions related to diversity and inclusion. Training would be provided through invited speakers, book discussions, films, and documentaries. Opportunities for deeper discussions and self-reflection would be provided following each workshop/training session. Recommended readings for the book discussions are: *The Nature of Race: How Scientists Think and Teach about Human Difference* (Morning, 2011) and *Race Decoded: The Genomic Fight for Social Justice* (Bliss & Bliss, 2013).

Implications for Future Research

The current study focused on the factors that support the persistence of African American students in the Biology major at a PWI. The study revealed that students who persisted in the biology major did so because they adapted to the environment in the biology major. Adaptation was achieved as a result of their fervent determination to succeed in the biology major, the support of their African American peers, and their ability to function independently when necessary. It is important to understand if African American students who did not persist in the biology major, who either transferred to a different major or left the university, did so because they did not *adapt* to the environment in the biology major. The question that should be asked is if African American students who chose to leave the biology major (not academically suspended) have the same concerns regarding the lack of community among students in the biology major and the lack of interaction and support from biology faculty? Academic

preparedness as it relates to K-12 education is the primary focus of attrition studies in STEM disciplines; however, students' satisfaction with the climate in the biology major may be a more significant factor in their decision to depart from the STEM major at a PWI. This study will give researchers a more in depth look at the factors that support African American students' persistence in a STEM major.

Summary and Conclusion

This phenomenological study was designed to examine the experiences of African American biology majors who “stay the course,” successfully navigating the biology major at a predominantly White institution. Tinto's Persistence Theory and Critical Race Theory shaped the inquiry as the academic and social experiences of this group of African American students was explored. As participants recounted their experiences in the biology major, it became apparent that although the participants were successfully persisting in the biology major, the factors that supported their persistence in biology were implemented in response to an environment in which they felt unwelcomed and unsupported.

In conclusion, this study included the voices of successful African American biology majors to provide counter-narratives to the deficit-based discourse that is prevalent in the broader literature on African Americans in STEM majors. This study contributes to the asset-based literature on African Americans in STEM. The participants in this study were successful biology majors who were persisting towards degree attainment, which is unquestionably the goal of any STEM program; however, the study revealed that the participants' success was primarily due to their ability to adapt to a less than favorable environment in the biology major. The narratives shared by the

participants revealed feelings of isolation and disconnection from biology faculty and peers. The participants sought opportunities outside the biology major to build a community and to receive the academic and social support they were deprived of within their major. A key factor in the success of the participants was their willingness to go above and beyond what was required of their counterparts in order to be successful in the biology major. Therefore, university administrators and biology faculty members should implement programs and practices to provide academic and social support to African American students in the biology major. African American biology students should not be expected to figure out how to fit in within the biology program or the university.

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Appendix A: Recruitment Email

Dear {insert name},

My name is Michelle Pass and I am a doctoral student in the Department of Middle, Secondary, and K-12 Education at UNC Charlotte. You are being invited to participate in a research study, the focus of which is to explore the academic and social experiences of African American undergraduate students majoring in Biological Sciences at a predominantly White institution. This study aims to understand the experiences of this group of students as they navigate the social and academic settings of a predominantly White university, and to identify the factors that contribute to their ability to persist in the Biological Sciences major.

Students who volunteer to participate in the study will be interviewed for no more than 80 minutes about their experiences in the Biological Sciences major at a predominantly White university. The format of the interview will be one-on-one with me, the principal researcher of the study, and will be held either in-person in the Department of Biological Sciences at UNC Charlotte, by phone or virtually using an online format. Your confidentiality will be maintained in this study and as such your name will not be included in any writings or reports from this study.

If you agree to an interview, please respond by _____ with three good days and times over the next week for the interview. I will send you a follow-up email to confirm the day and time of the interview. A consent form will be sent with the follow-up email. You must read and sign the consent form and return it to me.

If you have any questions about the study, please email me at mbpass@uncc.edu

Sincerely,

Principal Investigator: Michelle Pass, PhD Candidate, 704-687-8519, mbpass@uncc.edu

Responsible Faculty: Chance Lewis, PhD, 704-659-6842; email: chance.lewis@uncc.edu

Appendix B: Consent to Participate in a Research Study



Department of Middle, Secondary and K-12 Education

9201 University City Boulevard, Charlotte, NC 28223-0001

Consent to Participate in a Research Study

Title of the Project: Staying the Course: The Persistence of African American Biology Majors at a Predominantly White Institution

Principal Investigator: Michelle B. Pass, Doctoral Candidate

Responsible Faculty Member: Dr. Chance Lewis, Department of Middle, Secondary and K-12 Education at the University of North Carolina at Charlotte.

You are invited to participate in a research study. Participation in this research study is voluntary. The information provided is to help you decide whether or not to participate. If you have any questions, please ask.

Important Information You Need to Know

- The purpose of this study is to explore the academic and social experiences of African American undergraduate students enrolled in the Biological Sciences major at a predominantly White institution (PWI), and to determine how their experiences contribute to their persistence in the Biological Sciences major.
- I am asking African American students who are majoring in Biological Sciences to participate in an interview which will be conducted either in-person, by phone, or by video calling. The interview will last a maximum of 60 minutes. The interview will follow a semi-structured interview protocol. The interview will not be video recorded. The interview will be audio recorded and then transcribed. To make sure that your information will be protected, your name will not be included on the transcribed data or any written reports. Your name will appear on the Consent form however Consent forms will not be matched with the interview data and will be stored separately from interview

data on the UNC Charlotte Google drive and is only accessible by the principle investigator. Audio Data will be disposed of after one year.

- Some of the questions I'll ask you are personal and sensitive, and you might experience some mild emotional discomfort. You may choose to skip a question you do not want to answer. You will not personally benefit from taking part in this research, but our study results may help us better understand the factors that support the persistence of African American students in the Biological Sciences major.
- Please read this form and ask any questions you may have before you decide whether to participate in this research study.

Why are we doing this study?

The purpose of this study is to better understand the experiences of African American students who are enrolled in the Biological Sciences major at a predominantly White university. The voices of African American students in Biological Sciences will provide greater insight into the everyday experiences of this group of students and the factors that support and contribute to their persistence and retention in the Biological Sciences major.

Why are you being asked to be in this research study.

You are being asked to be in this study because you self-identify as Black/African American and are an undergraduate student majoring in Biological Sciences at a predominantly White university.

What will happen if I take part in this study?

If you choose to participate you will be interviewed once by the primary investigator of this study. The interview will be in-person, by phone or by video calling. In-person interviews will take place in a conference room in the Department of Biological Sciences at UNC Charlotte. There will be no video recording. Only audio will be recorded. After audio data is transcribed, you'll receive an email asking you to check and verify the validity of the transcript from your interview. After your transcript is validated, your name will be replaced with Your total time commitment if you participate in this study will be 10 minutes to respond to the recruitment email, 45 to 60 minutes for the interview, and 10 min to check and validate the transcript of your audio data.

What benefits might I experience?

You will not benefit directly from being in this study. Others might benefit because findings from this study can be used to develop programs and practices to support the persistence of African American undergraduate students in the Biological Sciences major.

What risks might I experience?

The questions we'll ask you are personal and may be sensitive. You might experience some mild emotional discomfort when answering these questions. We do not expect this risk to be common and you may choose to skip questions you do not want to answer.

How will my information be protected?

Your name will not be listed on the transcript or any written reports. Your name will be listed on your Consent form; however, your Consent form will not be matched with your interview question responses and your Consent form will be stored separately from your interview responses on the UNCC Google Drive. While the study is active, all data will be stored on the UNCC Google Drive that can be accessed only by the primary researcher. Only the research team will have routine access to the study data.

How will my information be used after the study is over?

After this study is complete, study data may be shared with other researchers for use in other studies or as may be needed as part of publishing our results. The data we share will NOT include information that could identify you.

Will I be paid for taking part in this study?

No, you will not be paid to take part in this study.

What other choices do I have if I don't take part in this study?

You are a volunteer. The decision to participate in this study is completely up to you. If you decide to be in the study, you may stop at any time. You will not be treated any differently if you decide not to participate in the study.

What are my rights if I take part in this study?

It is up to you to decide to be in this research study. Participating in this study is voluntary. Even if you decide to be part of the study now, you may change your mind and stop at any time. You do not have to answer any questions you do not want to answer.

Who can answer my questions about this study and my rights as a participant?

For questions about this research, you may contact Principal Investigator: Michelle Pass, 704-687-8519, mbpass@uncc.edu. Responsible Faculty: Chance Lewis, PhD, 704-659-6842; email: chance.lewis@uncc.edu.

If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the Office of Research Compliance at 704-687-1871 or uncc-irb@uncc.edu.

Consent to Participate

By signing this document, you are agreeing to be in this study. Make sure you understand what the study is about before you sign. You will receive a copy of this document for your records. If you have any questions about the study after you sign this document, you can contact the study team using the information provided above.

I understand what the study is about and my questions so far have been answered. I agree to take part in this study.

Name (PRINT)

Signature

Date

Name & Signature of person obtaining consent

Date

Appendix C: Interview Protocol

Warm-Up

1. Thank you for agreeing to be interviewed for my study.
 2. Introduce myself (my name is..., say something about myself as a faculty member, say something about myself as a student).
 3. Ask student to tell you a little about themselves.
 4. Confirm consent.
-
1. What is your overall impression of the biological sciences major? Do you feel you belong in this major? Have you ever felt you don't belong on this major?
 2. What are your feelings regarding the classes you have taken in the biological sciences major? Do you interact with your peers inside/outside the classroom?
 3. What are your feelings regarding the instructors whose classes you have taken in the biological sciences major?
 4. Do you think your biology instructors care about you and whether you were successful in their classes?
 5. Do you feel your pre-college education prepared you for your classes in the biological sciences major?
 6. What are the major challenges/obstacles you've faced as a student in the biological sciences major?
 7. How did you overcome these challenges/obstacles? Describe any resources, support systems, or strategies you used to overcome these challenges/obstacles.
 8. Do you feel you would have experienced the same obstacles/challenges if you were not an African American student?
 9. What factors have contributed to your persistence/success in the biological sciences major? Describe any personal, social, or academic factors that have helped you as an African American student at a predominantly white institution.
 10. What advice do you have for other African American students who are new to the biological sciences major or are considering the biological sciences major at a PWI?
 11. Is there anything else you want to share about your experiences as an African American student in the biological sciences major?