2015

Examining The Relationship Between Student Engagement And Stem Persistence At An Hbcu

Saundra Yates Evans
North Carolina Agricultural and Technical State University

Examining the Relationship between Student Engagement and STEM Persistence at an HBCU

Saundra Yates Evans

North Carolina A&T State University

A dissertation submitted to the graduate faculty

in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Department: Leadership Studies

Major Professor: Dr. Ceola Ross Baber

Greensboro, North Carolina

2015

The Graduate School
North Carolina Agricultural and Technical State University

This is to certify that the Doctoral Dissertation of

Saundra Yates Evans

has met the dissertation requirements of
North Carolina Agricultural and Technical State University

Greensboro, North Carolina
2015

Approved by:

Ceola Ross Baber, Ph.D.
Major Professor

G. Scott Jenkins, Ph.D.
Committee Member

Anthony Graham, Ph.D.
Committee Member

Belinda B. McFeeters, Ph.D.
Committee Member

Elon Kulii, Ph.D.
Committee Member

Comfort O. Okpala, Ed.D.
Department Chair

Sanjiv Sarin, Ph.D., P.E.
Dean, The Graduate School

Biographical Sketch

Saundra Yates Evans is a research administration professional at a doctoral research university in the southeastern United States. Charged with increasing the engagement and competitiveness of faculty in sponsored scholarly activities, she leads a team that supports faculty in advancing research, developing proposals for submission to research sponsors, promoting the responsible conduct of research, and managing research awards.

Her professional career includes experiences at public and private, for-profit and not-for-profit entities. She held previous leadership positions as director of a university/industry partnership to stimulate technology-based economic development, an executive manager of a building services contractor, and a marketing development manager for an international manufacturer of tobacco products.

Saundra is a member of the National Council of University Research Administrators, the National Organization of Research Development Professionals, and the Society of Research Administrators, International (SRAI). She is a past Vice President of Development for the North Carolina chapter of SRAI and has facilitated and co-presented conference sessions and workshops for state meetings. Her commitment to public service and civic engagement is satisfied through membership in Delta Sigma Theta Sorority, Inc., a public service organization, where she has chaired key committees and served on executive boards of chapters in two southeastern states.

Saundra is a W. L. Kennedy Scholar and member of Phi Kappa Phi Honor Society. She holds a Ph.D. degree in Leadership Studies from North Carolina A&T State University, an M.B.A. degree from the University of Wisconsin at Madison, and a B.A. degree in Mass Media Arts from Hampton University.

Dedication

This dissertation is dedicated to my mother and father, the late Mrs. Vertella Bullock Yates and the late Mr. Lee Allan Yates. They instilled in me a love of learning and modeled the discipline, persistence, and faith that was necessary to successfully complete this journey. Their loving, guiding spirits are with me always.

Acknowledgments

Achieving this important milestone has required the guidance and support of many people. I extend my heartfelt appreciation to Dr. Ceola Ross Baber, my advisor and committee chairperson, for your dedication, direction, and encouragement in guiding me through the dissertation process. I sincerely thank my advisory committee, Dr. G. Scott Jenkins, Dr. Belinda B. McFeeters, Dr. Anthony Graham, and Dr. Elon Kulii for your time, support and constructive input.

Special acknowledgements go to Dr. Mitzi Bond, my colleague and mentor, whose undying faith and continuous encouragement motivated me in times of triumph and in times of adversity; and to Dr. Osundwa Wanjera, my statistician, whose patience and enthusiasm led me to enjoy working with the research data.

I also thank my colleagues at North Carolina A&T State University who eased my way, Dr. Tonya Hargett for your wisdom and textbooks, Dr. Laura Collins for lending a hand when there were vacancies on my staff, Mr. Christopher Couch for providing technical assistance at all hours of the day and night, and to others in the Division of Research and Economic Development who offered their help and cheered me on.

Likewise, thank you to my enduring friends, Ms. Stephany Dinkins, Ms. Olivia Smashum, and Dr. Deborah Barnes, and to my new friends and colleagues in the Leadership Studies program. Your loyalty, belief, and concern kept me lifted and moving forward.

I thank my loving sister, my role model and idol, Dr. Gail Yates Williams, who was the first person to encourage me to pursue a Ph.D. and who understands what no one else can. Finally, I extend my love and gratitude to my husband Mr. Edward Evans, and to my son, Mr. Leland Evans, for keeping me grounded and for your help and sacrifices during my journey.

Table of Contents

List of Figures x

List of Tables xi

Abstract 1

CHAPTER 1 Introduction 3

1.1 Statement of the Problem 4

1.2 Conceptual Framework 8

1.3 Purpose 14

1.4 Research Question and Hypotheses 15

1.5 Definition of Key Terms 15

1.6 Delimitations and Limitations of the Study 18

1.7 Significance of the Study 19

CHAPTER 2 Literature Review 21

2.1 College Student Engagement 21

2.1.1 Active and collaborative learning. 24

2.1.2 Academic challenge. 27

2.1.3 Interaction with faculty. 29

2.1.4 Enriching educational experiences. 32

2.2 College Student Persistence in STEM 36

2.3 The HBCU Environment and Student STEM Success 40

2.4 Summary 45

CHAPTER 3 Methodology 52

3.1 Assumptions and Rationale for Quantitative Research 52

3.2 Predictive Correlational Design 53

3.3 Role of Researcher 54

3.4 Sample 55

3.5 Data Collection Procedures 57

3.6 Data Analysis Procedures 60

3.7 Reliability, Validity, and Generalizability of the Study 61

CHAPTER 4 Results 64

4.1 Sample Characteristics 64

4.2 Descriptive Analyses of Predictor Variables 71

4.2.1 Level of academic challenge (LAC). 71

4.2.2 Active and collaborative learning (ACL). 72

4.2.3 Student-faculty interaction (SFI). 72

4.2.4 Enriching educational experiences (EEE). 73

4.2.5 Supportive campus environment (SCE). 73

4.3 Inferential Analyses 74

4.3.1 T-test for equality of means. 74

4.3.2 Pearson's r. 75

4.3.3 Logistic regression. 78

CHAPTER 5 Discussion 85

5.1 Alignment of Results with Research Hypotheses associated with Research Question 1 85

5.2 Alignment of Results with Research Question 2 88

5.3 Implications for Practice, Policy and Research 91

5.4 Conclusion 94

References 96

Appendix A Frequency Tables 110

Appendix B NSSE Benchmark Variables.. 113

Appendix C National Survey of Student Engagement (2008 and 2011) 115

List of Figures

Figure 1. Intersections of the conceptual framework... 12

Figure 2. Conceptual framework. 13

List of Tables

Table 1 Students who participated in the NSSE in 2008 and 2011 at the institution 57

Table 2 Age 65

Table 3 Gender 65

Table 4 Race or Ethnicity 66

Table 5 Citizenship 66

Table 6 College Residence 67

Table 7 Mother's Education 67

Table 8 Father's Education 68

Table 9 STEM Major Recodes 69

Table 10 STEM Major 70

Table 11 Stem Persistence 70

Table 12 Level of Academic Challenge 72

Table 13 Active and Collaborative Learning 72

Table 14 Student-Faculty Interaction 73

Table 15 Enriching Education Experiences 73

Table 16 Supportive Campus Environment 74

Table 17 Independent Samples Test 75

Table 18 Pearson's Correlations of Engagement Variables 76

Table 19 Pearson's Correlations of STEM Disciplines 77

Table 20 Pearson's Correlations of Parents' Education Level 78

Table 21 Dependent Variable Encoding 79

Table 22 Categorical Variables Coding 80

Table 23 Omnibus Tests of Model Coefficients 81

Table 24 Classification Table without Predictors 81

Table 25 Classification Table with Predictors 82

Table 26 Logistic Regression Results 83

Abstract

A growing imbalance in the demand for a science and technology workforce and the declining availability of a science and technology talent pool is challenging America's world dominance in research and innovation, economic performance, and quality of life. Contributing to this imbalance is flatness in the trend of students selecting science, technology, engineering and mathematics (STEM) majors coupled with decreasing rates of retention in STEM disciplines.

Many research studies and reports emphasize that incorporating the untapped talents of Americans who are underrepresented in STEM disciplines--African-Americans, Hispanics, and women--is necessary to increase the pipeline of STEM graduates. A synthesis of college persistence literature by Robert Reason (2009) indicates that student engagement is one of the most influential drivers of persistence, and that engagement interventions must address specific student needs within specific institutional contexts to be effective. Past research found that engagement of underrepresented STEM students has been found to positively influence their persistence, and HBCUs have been found to better engage African American students than do other types of institutions.

This predictive correlational study examined the relationship between student engagement and persistence in STEM disciplines at an HBCU located in southeastern United States. The relationship between benchmark variables from the National Survey of Student Engagement (NSSE) (academic challenge, active and collaborative learning, student-faculty interaction, enriching educational experiences, and supportive campus environment) and STEM persistence was examined via a predictive correlational design. A non-random sample of STEM students enrolled full-time in their fourth year during spring 2011 and spring 2014 and who participated in the NSSE as freshmen was studied. While the correlation analysis did not result in significant differences in the relationship of student engagement to STEM persistence among persisters as compared to non-persisters, results of the logistic regression indicate that active and collaborative learning and enriching education experiences, along with majoring in engineering and first year GPA, are predictive of STEM persistence. There are several implications of the study for practice, policy, and future research.

CHAPTER 1

Introduction

The United States enjoys the reputation, economy and quality of life befitting a world leader in scientific and technological innovation. Between 1995 and 2005, the largest share of high-technology manufacturing output in the world was produced by America (Ashby, 2006). A seminal book entitled *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future* reports that U.S. science and engineering leadership has fueled its world dominance in research and innovation, economic performance, and quality of life since World War II (National Research Council, 2007). However, an imbalance in the growing demand for a science and technology workforce and the declining availability of a science and technology talent pool is challenging this position (National Research Council, 2011; Palmer, Maramba & Dancy, 2011).

Employment opportunities in science, technology, engineering and mathematics (STEM) fields are growing faster than STEM degree production. The Bureau of Labor Statistics projects that between 2006 and 2016 science and technology-related occupations will be among the fastest growing occupations, with a growth rate of 27% compared to a 10% average for all other occupations, which is almost three times as fast (Stine & Matthews, 2009). The President's Council of Advisors on Science and Technology announced that the United States will need to produce one million more STEM professionals over the next decade than is currently projected to retain its primacy in science and technology and remain economically competitive (Chen, 2013).

Several factors are contributing to this imbalance between America's demand for STEM workers and its supply. Globalization, innovation, and the infusion of technology across a wide-range of occupations is driving demand for STEM competent workers (National Science Board, 2010). Yet supply is negatively impacted by

- the diversion of STEM workers to nontraditional STEM occupations that also require STEM competencies;
- the retirement of STEM baby boomers from the workforce;
- the growing demand for immigrant STEM workers in their home countries along with tightening immigration restrictions in the U.S.; and
- flatness in the trend of students selecting STEM majors coupled with decreasing rates of retention in STEM disciplines (Carnevale, Smith, & Melton, 2011).

1.1 Statement of the Problem

STEM retention is lowest among America's racial and ethnic minorities who are also underrepresented in STEM fields and are the fastest growing segments of the population. The most recent report of five-year STEM degree completion indicates that only 18.4% of African American, 22.1% of Latino, and 18.8% of Native American undergraduate students persisted to complete college degrees in STEM from 2004 to 2009, compared to almost 33% of White students and 42% of Asian Americans (Higher Education Research Institute, 2010). This gap is wide and poses a serious concern for a nation whose economic viability depends on a scientifically capable workforce.

Research has indicated that harnessing the untapped talents of Americans who are underrepresented in STEM disciplines--African-Americans, Hispanics, and women--is necessary to increase the pipeline of STEM graduates (Museus, Palmer, Davis, & Maramba, 2011; National Research Council, 2011; Southern Education Foundation, 2005; Tsui, 2007). The stated purpose of a 2008 research report commissioned by the National Action Council for

Minorities in Engineering (NACME) was to send the following message: "The solution to America's competitiveness problem is to activate the hidden workforce of young men and women who have traditionally been underrepresented in STEM careers--African Americans, American Indians, and Latinos" (Frehill, Fabio, & Hill, 2008, p. 3). This is echoed in a STEM report by Georgetown University's Center on Education and the Workforce that concludes there is an economic need to incorporate women and racial/ethnic minorities into America's STEM workforce as well as the need for equity (Carnevale, Smith & Melton, 2011).

Minority Serving Institutions (MSIs) are a vital resource to educate Americans who are underrepresented in STEM disciplines (Institute for Higher Education Policy, 2012; Southern Education Foundation, 2005). The vitality of these institutions is especially evident in the contributions of HBCUs to educating African Americans. HBCUs represent only 3% of all postsecondary institutions; however, they conferred 16% of the bachelor's degrees earned by African American students in 2010-2011 (Snyder & Dillow, 2012). In addition, the role of HBCUs is significantly important in graduating African American students in STEM fields and disproportionally so (Perna et al., 2009). HBCUs awarded 19% of the science and engineering bachelor's degrees earned by Black U.S. citizens and permanent residents in 2010 (National Science Board, 2014).

Since 2002, HBCUs have been the primary baccalaureate-origin institutions of African American science and engineering doctorate recipients, accounting for 10 of the top 11 such institutions (Fiegener & Proudfoot, 2013). The National Science Foundation's Survey of Earned Doctorates found that from 2007-2011, 26.3% of African Americans who earned doctorate degrees in science and engineering received their bachelor's degrees from HBCUs (National Science Foundation, 2013a).

Although HBCUs play a vital role in educating African American scientists and engineers, these institutions-like predominantly White institutions (PWIs)--are confronting disturbing trends of decreasing STEM enrollment and increasing rates of attrition; African Americans earning science and engineering degrees at HBCUs declined from 26% in 2001 to 19% in 2010 (National Science Foundation, 2013b). Students intending to major in STEM disciplines are taking longer to complete their degrees and most are changing to non-STEM majors or leaving the institutions where they began as freshman (Higher Education Research Institute, 2010). The most recent report of five-year STEM degree completion indicates that while interest in STEM majors increased among underrepresented students from 1971 to 2009 and is on par with interest among White and Asian American students at about 34% (Higher Education Research Institute, 2010), fewer African Americans actually major in a STEM field and their persistence is much lower (Carnevale, Smith & Melton, 2011).

It is crucial that institutions of higher education increase enrollment, retention, and graduation of students in STEM fields. The solution must include increased enrollment and graduation of Americans who are underrepresented in STEM disciplines. The role of HBCUs is pivotal to helping expand careers in STEM disciplines (Toldson, 2013). Since HBCUs graduate a disproportionate share of African American students in STEM fields, it is critically important that these institutions improve their success in retaining and graduating students who can fuel a national pipeline of STEM workers (Perna et al., 2009).

According to work by the Business Higher Education Forum, interventions to influence students' choices to pursue STEM learning and STEM careers must not only consider mere capability but other factors as well to maintain student interest (Carnevale, Smith & Melton, 2011). Factors that inhibit, and contribute to, the success of underrepresented minority students in STEM fields must be identified and addressed (Strayhorn, Long, Kitchen, Williams, & Stentz, 2013). Efforts must focus attention on the institutional-level goal of retention, as well as the student-level goal of persistence (Reason, 2009).

There is a considerable amount of empirical and prescriptive literature surrounding the issue of student persistence in higher education (Reason, 2009; Strayhorn & DeVita, 2009). The focus of much of the student persistence research has addressed the effects of the college experience on students and whether and how their college experiences were impacted by individual and institutional characteristics (Strayhorn & DeVita, 2009). Studies have been conducted on key factors influencing persistence such as student engagement; models to identify and describe the linkages and impact of these factors on persistence; and the effectiveness of initiatives to reduce, mediate and/or increase their impact.

College persistence research has linked student persistence in STEM disciplines and student engagement (Chen, Lattuca & Hamilton, 2008). The relationship between STEM persistence and student engagement factors (academic challenge, active and collaborative learning, student-faculty interaction, enriching educational experiences, and supportive environment) varies depending on student characteristics such as race and gender (Espinosa, 2011; Griffith, 2010; Ohland, et al., 2008; Perna et al., 2009), academic major (Brint, Cantwell & Hannerman, 2008), instructional methods used by faculty (Kim, Sharma, Land, & Furlong, 2012; Prince, 2004; Stage & Kinzie, 2009), and institution type and campus climate (Brown, Morning, & Watkins, 2005; Jett, 2011; Laird, Bridges, Morelon-Quainoo, Williams, & Holmes, 2007; Perna et al., 2009; & Strayhorn et al., 2013).

Engagement of underrepresented STEM students has been found to positively influence their persistence (Cole, 2008; Ellington & Frederick, 2010; Espinosa, 2011; & Griffith, 2010), and HBCUs have been found to better engage African American students than do other types of institutions (Eagan, Sharkness, Hurtado, Mosqueda, & Chang, 2011; Laird et al., 2007; Perna et al., 2009; Reeder, Schmitt & Neal, 2013). Accordingly, there is a need for further research on the relationship between student engagement and STEM persistence at HBCUs, institutions where African Americans comprise the majority student population. There are many definitions of the term student engagement, a concept that is used to describe the level of involvement and interest of students in their learning and their connectedness with their classes, institutions and each other (Axelson & Flick, 2011). This study relied on the National Survey of Student Engagement's definition of *engagement* as representing constructs such as quality of effort and involvement in productive learning activities (Kuh, 2009).

1.2 Conceptual Framework

The conceptual framework for this study is based on an integration of Alexander Astin's (1984) student involvement theory, George Kuh's (2009) student engagement concept, and Robert Reason's synthesis of persistence research (2009) using the persistence conceptual framework he developed with Terenzini in 2005. Astin's theory posits that "the greater the student's involvement in college, the greater will be the amount of student learning and personal development" (p. 307). Astin suggests that the more students are involved in the academic and social aspects of their college experiences, the more they will learn and develop. Involved students devote substantial energy to studying, spend time on campus, participate actively in student organizations, and interact often with faculty and student peers. Contrarily, uninvolved students neglect their studies, spend little time on campus, refrain from participating in extracurricular activities and interact with faculty and student peers infrequently (Astin, 1984).

Underpinning Astin's (1984) theory are five claims:

> (1) Involvement refers to the investment of physical and psychological energy in various objects; (2) Regardless of its object, involvement occurs along a continuum; (3) Involvement has both quantitative and qualitative features; (4) The amount of student learning and personal development associated with any educational program is directly proportional to the quality and quantity of student involvement in that program; and (5) The effectiveness of any educational policy or practice is directly related to the capacity of that policy or practice to increase student involvement. (p. 298)

The theory was devised to link variables of previous student development theories (categorized by Astin as subject matter, resources, and individualization of approach theories) to desired student and professor learning outcomes. Astin found previous theories inadequate because they depended on human or educational resources that were finite, and/or were difficult to implement and translate into practice. Contrarily, the theory of student involvement focuses on the behavioral aspects that facilitate student development by emphasizing the student's active participation in the learning process (Astin, 1984).

The theory of student involvement has played a major role in evolving the use of the term *student engagement* as a concept that means quality of effort and involvement in learning activities that produce achievement outcomes (Axelson & Flick, 2011). It has served as the basis for considerable research on the direct and indirect influences of student engagement on the college experience. In addition to Astin's theory of involvement, works by other scholars also influenced the concept of student engagement including quality of effort measures (Pace, 1980), social and academic integration (Tinto, 1987, 1993), student effort and college outcomes (Pascarella & Terenzini, 2005), and effective teaching and learning strategies in undergraduate education known as "principles of good practice" (Chickering & Gamson, 1987). Student engagement considers two elements: what the student does and what the institution does (Wolf-Wendel, Ward, & Kinzie, 2009). Evidence of its wide acceptance has been the addition of student engagement as a construct for assessment, accountability and improvement efforts among institutions of higher education (Kuh, 2009).

This acceptance was aided by the ease of use and application of student engagement data to improving the college experience for undergraduate students. George Kuh is credited with facilitating the adoption and use of student engagement in higher education by establishing the widespread use of the National Survey of Student Engagement (NSSE) (Wolf-Wendel, Ward & Kinzie, 2009). NSSE, along with the two-year Community College Survey of Student Engagement (CCSSE), validated the ability to reliably measure student engagement across large numbers of institutions (Kuh, 2009). Also, student engagement was found to be a relevant indicator of student and institutional performance and emphasized the role of institutions to influence students to become involved in activities that are educationally purposeful (Kuh, 2009).

In 2005, Terenzini and Reason proposed a comprehensive conceptual framework to guide student outcomes research (Reason, 2009). Reason (2009) later used this framework to organize and synthesize research on college student persistence. The framework accounts for student, faculty, and institutional forces that influence college success – multiple forces that are interrelated. Reason's comprehensive review included his work, as well as literature reviews conducted by others such as Braxton, 2000–2008; Pascarella and Terenzini, 1991, 2005; and Tinto, 2007 (Reason, 2009). Forces that affect college student persistence are discussed in four areas, with acknowledgement that the areas overlap and interact in how they are experienced by students: (a) student precollege characteristics, (b) organizational factors, (c) student peer environments, and (d) individual student experiences. Reason drew several implications from his review of the literature on persistence research. First, student engagement is one of the most influential drivers of persistence decisions by students. Second, engagement interventions must address specific needs of students within specific institutional contexts in order to be effective. Third, future research should focus on important demographic groups and emerging populations that have been previously excluded from studies.

This study considered Reason's implications and employed an integrated framework to examine student engagement variables that have bases in the works of Astin, Kuh and other scholars reviewed by Reason, and their relationship to STEM persistence. The key thread that connects the frames and facilitates integration is the focus on behaviors as the primary drivers of student achievement outcomes and personal development (Astin, 1984; Kuh, 2009) or persistence (Reason, 2009). Student behaviors are described as effort invested in studying, time spent on campus, participation in student organizations (Astin, 1984); what the student does (Kuh, 2009); and student precollege and college influences (Reason, 2009). Faculty behaviors are described as faculty interaction with students (Astin, 1984), what the faculty does (Kuh, 2009), and faculty influences (Reason, 2009). Institutional behaviors are described as institutional policies or practices to increase student involvement (Astin, 1984), what the institution does (Kuh, 2009), and institutional influences (Reason, 2009). Collectively, these behaviors underpin the measures of student engagement reflected in the NSSE student engagement benchmarks of Level of Academic Challenge (LAC), Active and Collaborative Learning (ACL), Student-Faculty Interaction (SFI), Supportive Campus Environment (SCE), and Enriching Educational Experiences (EEE). The main difference in the premises of Astin, Kuh, and Reason is that Reason's synthesis directly frames student college engagement through the lens of persistence. In addition, the conceptual framework for Reason's synthesis explicitly considers the influence of student precollege characteristics and experiences. Figure 1 shows the intersections of the framework for this study.

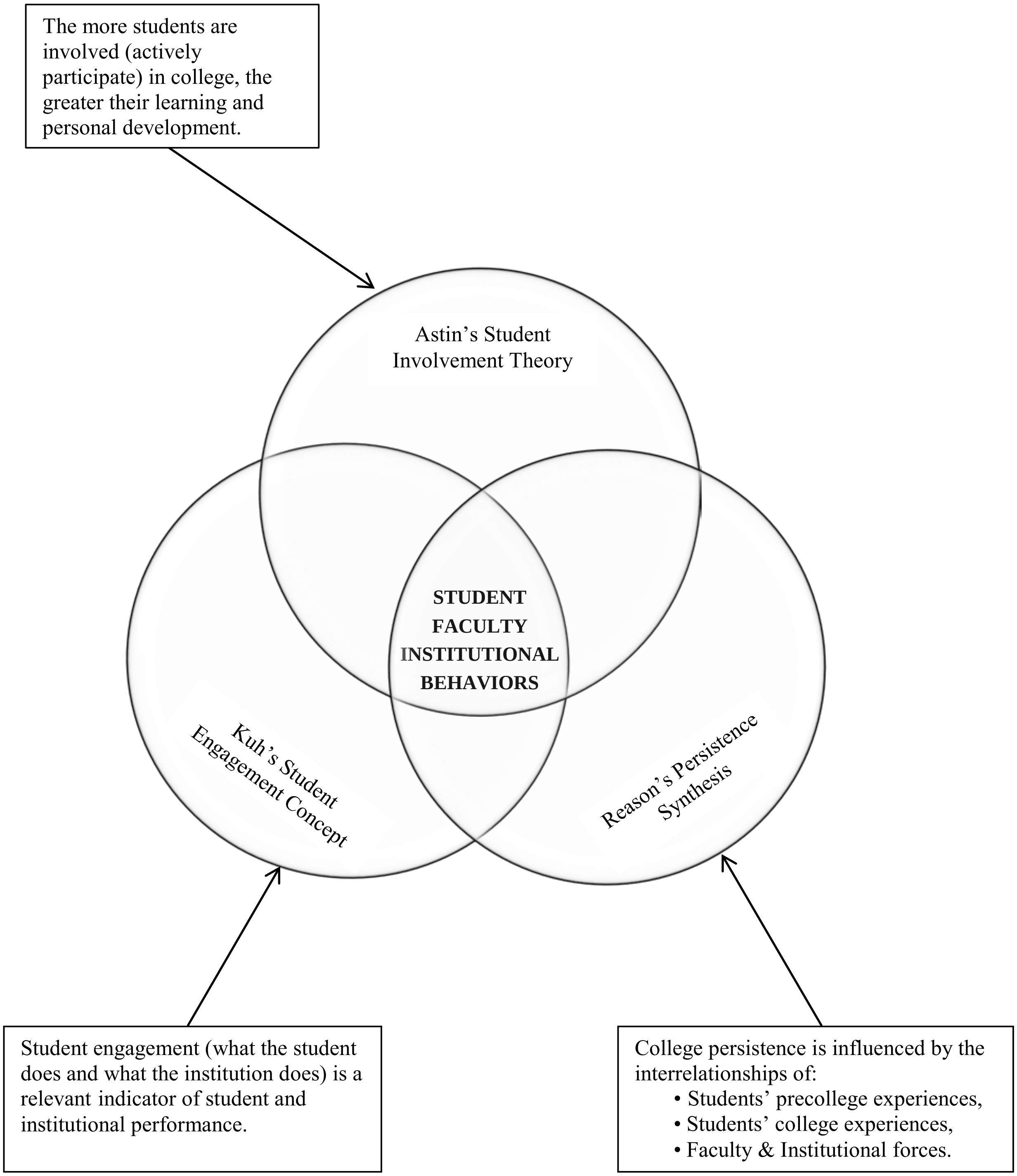

Figure 1. Intersections of the conceptual framework.

The meaning of the student engagement concept has evolved over time with notable influences by research scholars (Kuh, 2009). This evolution is reflected in the conceptual framework for this study. Development of the NSSE benchmark variables, the predictor variables in this study, by George Kuh and colleagues was influenced by Astin's Student Involvement Theory and by works of other scholars who influenced the concept of student engagement. STEM persistence, the criterion variable, is based on the implication from Reason's review and synthesis of persistence research that college student engagement is one of the most influential drivers of persistence decisions. Figure 2 shows the conceptual framework for this study.

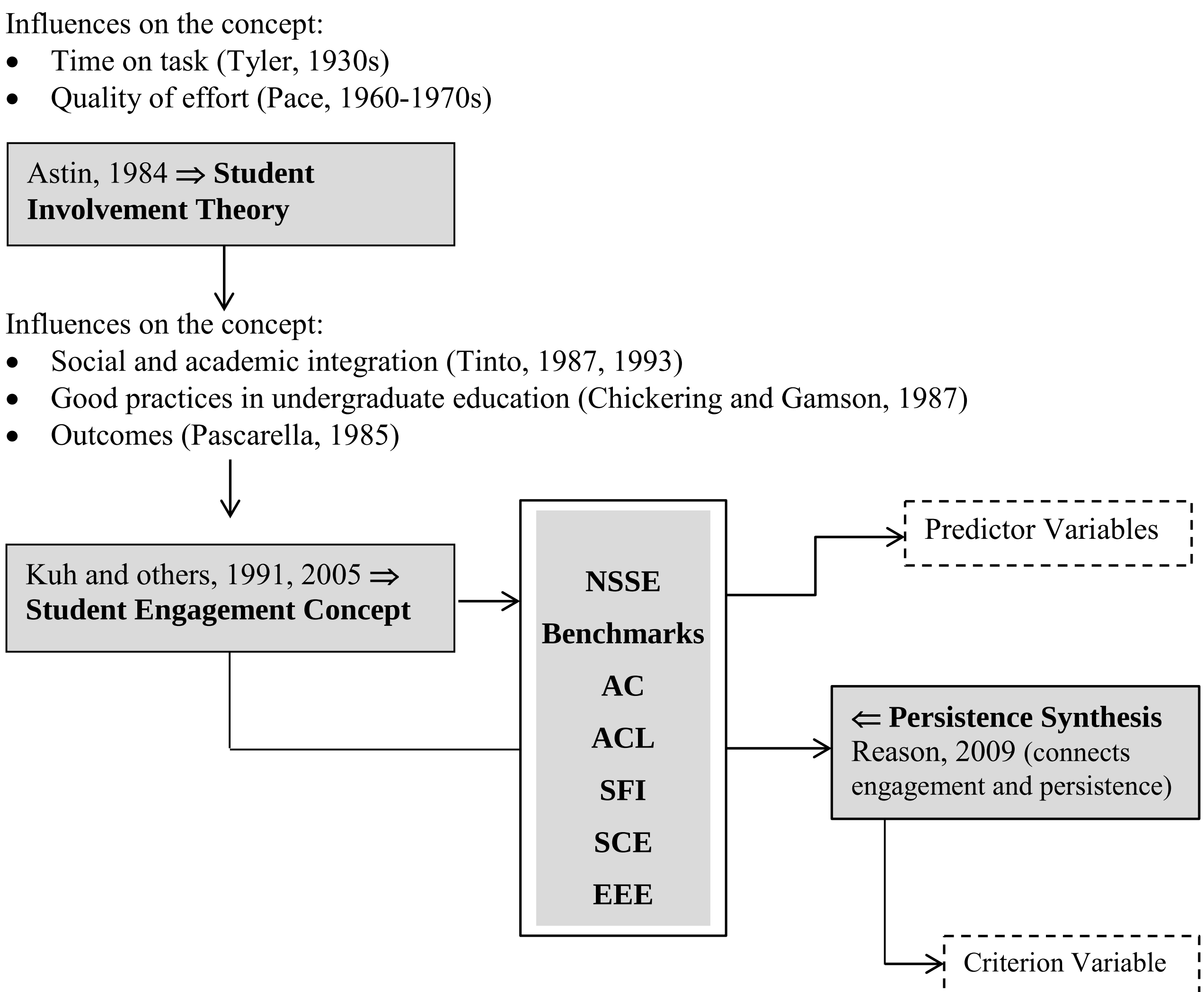

Figure 2. Conceptual framework.

1.3 Purpose

The purpose of this study was to examine the relationship between student engagement and persistence in STEM disciplines at an HBCU located in southeastern United States. The HBCU that was the setting for this research was ranked among the top 10 institutions in the number of bachelor's degrees awarded in engineering to underrepresented minorities in 2011, and the top producer among HBCUs (National Action Council for Minorities in Engineering [NACME], 2013).

The specific aim of this quantitative study was to identify student engagement factors that influence decisions by students to persist in their pursuit of a college degree in a STEM major. The relationship between student engagement and persistence in STEM disciplines at a doctoral research university was examined using a predictive correlational design and secondary data analysis approach. Attributes of student engagement, students' STEM majors, parents' level of education, and GPA were the predictor variables, and STEM persistence was the criterion variable. Data that was analyzed included students' responses to questions on the National Survey of Student Engagement and institutional data on students' majors and GPA. Majors, parents' level of education, and GPA were added as predictor variables during the data analysis phase of the study in an effort to explain the variance of the regression model.

A non-random sample was selected that included students enrolled full-time in their fourth year at an HBCU in southeastern United States during spring 2011 and spring 2014 and who participated in the NSSE administered to entering freshmen in spring 2008 and spring 2011. The sample was divided into two subsamples: persisters and non-persisters. Persisters were defined as first year college students who indicated on the NSSE an intention to major in a STEM discipline as freshmen and who remained in a STEM major through their fourth year of college. Non-persisters were defined as first year college students who indicated on the NSSE an intention to major in a STEM discipline as freshman and who did not remain in a STEM major through their fourth year of college.

1.4 Research Question and Hypotheses

Two research questions guided this study. The first was:

What is the relationship of student engagement factors (predictor variables) and student persistence (criterion variable) in STEM majors? Related hypotheses were:

Hypothesis 1: There will be a difference in Level of Academic Challenge (AC) between persisters and non-persisters.

Hypothesis 2: There will be a difference in Active and Collaborative Learning (ACL) between persisters and non-persisters.

Hypothesis 3: There will be a difference in Student-Faculty Interaction (SFI) between persisters and non-persisters.

Hypothesis 4: There will be a difference in Supportive Campus Environment (SCE) between persisters and non-persisters.

Hypothesis 5: There will be a difference in Enriching Educational Experiences (EEE) between persisters and non-persisters.

The second research question was:

What are the influential student engagement factors that predict STEM persistence?

1.5 Definition of Key Terms

Academic Challenge – This term refers to the amount of time and energy that students expend on academic work in the context of performance expectations set by institutions of higher education (Brint et al., 2008; Kuh, 2009; NSSE, 2014). For this study the term incorporated students' academic effort and institutions' academic rigor.

Active and Collaborative Learning – This term refers to student learning that derives from students' involvement in the learning process through meaningful activities and reflection and application of learning, and through working together with other students in groups to achieve a common goal (Campbell & Cabrera, 2011a; NSSE, 2014; Prince, 2004).

Campus Environment – This term refers to conditions at an institution of higher education that influence students' lives such as institutional support of student success, and the working and social relations among different groups (Campbell & Cabrera, 2011; NSSE, 2014).

Enriching Educational Experiences – These are purposeful learning activities that complement, augment and enhance academic programs. Examples are students' participation in learning communities, research projects and internships or field experiences (Campbell & Cabrera, 2011; NSSE, 2014).

Historically Black Colleges and Universities (HBCUs) - "The amended Higher Education Act of 1965 defines HBCUs as any historically black college or university established before 1964, whose principal mission was, and is, the education of black Americans" (Merisotis & McCarthy 2005, p. 46). The majority of these institutions of higher education principally serve African American students while being open to all students.

Interaction with Faculty – This describes contacts and actions between students and faculty that occur in and out of the classroom (Campbell & Cabrera, 2011; NSSE, 2014).

Persistence - This term refers to the action of a student who remains in college through degree completion (Pascarella & Terenzini, 1991). For this study it also referred to the action of a first year college student who intended to major in a STEM discipline and who remained in a

STEM major through their fourth year of college. Persistence is differentiated from retention in its focus on "individual-level student goal attainment" (Reason, 2009, p. 660). In contrast, retention is an organizational occurrence that focuses on institutional goal attainment (Reason, 2009).

Predominantly White Institutions (PWI) – This term describes institutions of higher education in which 50% or more of the enrolled students are White. Prior to 1964, PWIs principally served White Americans as reflective of the United States' history of racially segregated education (Brown & Dancy, 2010). For this study, PWI was used interchangeably with TWI – Traditionally White Institutions.

STEM - This is an acronym for science, technology, engineering and mathematics. While STEM fields may be broadly defined to include social and behavioral sciences (Chen, 2009), STEM fields in this study align with the US Department of Education's definition and include mathematics; natural sciences (physical, biological and agricultural sciences); engineering/engineering technologies; and computer/information sciences (Chen, 2009).

STEM Non-Persisters – These students are a subgroup of students who enter college in STEM fields but who leave STEM fields by switching to a non-STEM major or by leaving the institution without completing degree requirements (Chen, 2013). For this study it also referred to the action of a first year college student who intended to major in a STEM discipline and who did not remain in a STEM major through their fourth year of college.

STEM Persisters – These students are a subgroup of students who enter college in STEM fields and who remain in STEM fields throughout their college career (Chen, 2013). For this study it also referred to the action of a first year college student who intended to major in a STEM discipline and who remained in a STEM major through their fourth year of college.

Student Engagement - This term is used to describe the level of involvement and interest of students in their learning and their connectedness with their classes, institutions and each other (Axelson & Flick, 2011). This study relied on the NSSE definition of *engagement* as representing constructs such as quality of effort and involvement in productive learning activities (Kuh, 2009).

1.6 Delimitations and Limitations of the Study

Several delimitations and limitations existed with this study. The first involved the limitation of the scope of the study to one institution of higher education which prohibited generalization of results (Creswell, 2009). Second, although the university is a doctoral research HBCU that is a top producer of African American undergraduates in engineering, it is possible that expansion of the study to include other HBCUs with similar characteristics could strengthen identification of factors that impact persistence of African American students in STEM fields.

Another limitation of the study was the use of secondary data. Analysis of secondary data occurs when data collected by others is reanalyzed (Vogt, 1999). Since data for this study was collected using the NSSE and was not collected specifically for the purpose of this study the analysis may have been limited (Boslaugh, 2007). In addition, the study was restricted to selected variables drawn from a national survey of freshman that cover a wide variety of student characteristics. It is possible that selection of additional variables could better explain factors related to persistence (Boslaugh, 2007) or that disaggregating scaled variables could be more meaningful (Kiecolt & Nathan, 1985). It is also possible that the manner in which the data were collected for the study may have skewed the findings. Participants responded to items as written on the NSSE (2008, 2011) and may have misinterpreted intended meanings, or may have perceived engagement differently due to differences in their backgrounds and points of reference. In addition, they may not have been candid in their self-reported responses which might have influenced results. Finally, a limitation of correlation analysis is that its efficacy is dependent on the quality of the data being analyzed. Data should be based on precise quantification (Thomas, 2003).

Even with these limitations, this study was important because there is a need to explore the impact of student engagement on persistence among diverse and important populations (Flowers, 2004; Reason, 2009). In addition, there is a need to examine this relationship within students' college environments since research has shown that student engagement differs in different environments (Museus, Nichols & Lambert, 2008; Reason, 2009). Finally, there is a need to examine the role and impact of HBCUs on African American students who persist in STEM (Jett, 2011). The research provided an opportunity to expand the body of knowledge on STEM persistence among students who are pursuing degrees in STEM fields at HBCUs, which have predominantly African American student populations. More research should be conducted to inform educators and policymakers concerned with increasing the number of underrepresented STEM graduates.

1.7 Significance of the Study

This study is significant for future practice, policy, and scholarship in leadership studies. Regarding practice, results of this study can be of value for STEM educators and administrators in higher education, particularly at HBCUs. Findings can be used to inform the design of initiatives, support services and changes in pedagogy aimed at increasing engagement and persistence of underrepresented STEM students. The study may also provide a model for tracking and monitoring student persistence as affected by engagement benchmarks.

In addition, educators can use results to guide college and university partnerships with elementary and secondary schools to affect STEM engagement earlier in students' educational experiences.

This study is significant for policymakers who allocate resources to increase the percentages of underrepresented workers in the STEM pipeline. Understanding factors that influence persistence of STEM students at HBCUs could be valuable in helping governments target funding appropriations such as research expenditures.

Finally, this study will contribute significantly to scholarship in leadership studies. Leadership at all levels is essential to addressing the national problem of an imbalance in the need and supply of America's STEM workforce. President Obama has made STEM education a national priority. He has expanded the national dialogue regarding STEM interventions targeting underrepresented groups, federal allocations through competitive grant programs, engagement of the business community in STEM education and innovation, and initiatives for K12 through higher education to fuel the STEM pipeline (Toldson & Esters, 2012). This study adds to that conversation with implications that are relevant for administrators, faculty and student leaders in STEM disciplines at HBCUs.

CHAPTER 2

Literature Review

The purpose of this study was to examine the relationship of student engagement to persistence in STEM disciplines at an HBCU located in southeastern United States. Literature relevant to this study was organized around three primary strands: (a) college student engagement, including active and collaborative learning, academic challenge, student interaction with faculty, and enriching educational experiences; (b) college student persistence in STEM disciplines; and (c) impact of the HBCU environment on student STEM success.

2.1 College Student Engagement

Student engagement is used to describe student participation in meaningful activities and experiences such as faculty-student collaborations, interactions with peers, class discourse and active learning (Strayhorn & DeVita, 2009). In the National Survey of Student Engagement the term represents the amount of time and effort students expend on educationally purposeful activities, together with how an institution applies and organizes its resources to motivate students to participate in activities that are linked to student learning (NSSE, 2013). Descriptions and studies of student engagement have focused on students' levels of active involvement in their undergraduate programs and on fundamental program components such as learning inside the classroom, in student organizations, and in research experiences (Chen et al., 2008).

In modern education research, engagement is often used interchangebly with involvement. This traces to development of the concept of engagement based on educational research by C. Robert Pace and Alexander Astin (Chen et al., 2008). Pace contributed the idea of quality of effort - that a student will learn more, the more he or she meaningfully engages in an academic task. He developed the College Student Experiences Questionnaire (CSEQ) to measure quality of effort. Astin developed the concept of student involvement - that the more a student actively participates in the college environment, the more he or she will learn and develop. George Kuh used the CSEQ as the basis for the National Survey of Student Engagement noting that "whether [students] persevere, and how much they get out of their studies are largely the result of the individual effort and involvement" (as cited in Chen et al., 2008). Hence, quality of effort and student involvement were foundational to development of the NSSE (Chen et al., 2008).

The meaning of the term student engagement is discussed in an article entitled "Defining Student Engagement" by Rick D. Axelson and Arend Flick (2011). The authors describe the evolution of the term and how it is defined in critical theories about student engagement. The major point of the article is that the definition of student engagement lacks specificity and as a result, takes on a variety of meanings.

While a causal relationship between engagement and learning is often assumed, Axelson and Flick purport that this relationship is not clear. They point out that behavioral engagement may minimize the importance of forms of engagement that are less easy to observe such as psychological investment by the student. Another criticism is that student engagement may be better understood as a multidimensional construct and that disaggregating the forms of engagement negates the interrelationship among behavioral, emotional and cognitive types. Axelson and Flick (2011) conclude that there is a need to test current assumptions regarding student engagement and be more precise in defining it to improve evaluation of engagement in higher education.

The nomenclature used by students, educators and researchers regarding student involvement, engagement and integration was the subject of a study by Wolf-Wendel, Ward and

Kinzie (2009) that investigated the terms' definitions, evolution, use in research and practice, and uniqueness and similarities. They found that student involvement and engagement are both distinct and overlapping and can be contextually nuanced. Results suggest that the concepts be visualized separately with involvement being viewed as the student's responsibility and its unit of analysis the student's energy. Integration should be seen as a reciprocal relationship between the student and the campus, where the student learns and adopts the campus culture and where the institution is changed by the relationship. Lastly, engagement is focused on the creation of campus environments that readily offer opportunities for students to engage (Wolf-Wendel, Ward & Kinzie, 2009).

The merging of student engagement with other factors to influence college success and persistence was found in a study of African American high achieving mathematics students (Ellington & Frederick, 2010). Results led the researchers to conclude that the students' success and persistence in college trace not only to rigorous pre-college mathematics preparation and support by family, peers and teachers, but also to their participation in college scholarship programs. Participation in these programs engages students in a variety of support services that are instrumental in their retention in mathematics. In addition to financial support, students are advantaged by peer and faculty mentoring, study groups, summer bridge programs, support from scholarship program staff, internships, participation in professional programs and conferences, and student-based mentoring. Ellington and Frederick (2010) determined that a range of factors, including family experiences, school experiences, role of participants and role of the larger community, converge to contribute to the students' success.

Academic engagement may differ depending on undergraduate students' majors. In a study conducted in a research university setting, the culture of academic engagement in the natural sciences and engineering, which emphasized improvement of quantitative skills through collaborative study, was found to be different from the culture of engagement in the arts, humanities and social sciences which emphasized interaction, participation, and interest in ideas (Brint et al., 2008).

2.1.1 Active and collaborative learning. Active and collaborative learning refers to practices that guide students to increased involvement in their educations (Brint et al., 2008) and to increased engagement in the learning process (Prince, 2004). The universally accepted definition of collaborative learning is "any instructional methods in which students work together in small groups toward a common goal" (Prince, 2004, p. 223). The core element of collaboration is emphasis on student interactions, as contrasted to individual work or learning as a solitary activity.

Relevant literature includes studies on the impact of active and collaborative learning on student achievement, engagement, persistence and other valued outcomes, and studies on the efficacy of various active and collaborative learning models and how to use them in the classroom. Other literature on active and collaborative learning focuses on reforming teaching pedagogies and structuring physical collaborative learning environments or STEM spaces (Singer, 2011). Primary instructional methods used in active learning include collaborative learning, cooperative learning and problem-based learning (Prince, 2004).

A study by Michael Prince (2004) of the literature on active learning supports the importance of collaborative learning behaviors to student engagement. Evidence regarding the effectiveness of active learning was examined to provide clarity to engineering faculty about which active learning elements they may want to incorporate into their teaching methods to achieve valued learning outcomes.

Findings indicate that active learning promotes student engagement. Prince cites Wiggins and McTighe's *Understanding by Design* (1998) which posits that instructional activities should be designed around important learning outcomes that thoughtfully engage students in the learning process. Accordingly, collaborative learning is an active learning method. Meta-analyses on the impact of collaborative learning on learning outcomes indicate that collaboration yields several positive outcomes including improvement in academic achievement, student attitudes and retention. Prince notes studies by E. Frederickson (1998) that collaboration reduces attrition in technical programs by 22%, and by L. Berry (1991) that collaboration is an effective instructional method for improving retention of minority students (Prince, 2004).

Use of active learning strategies can promote critical thinking in undergraduate general science courses (Kim, Sharma, Land, & Furlong, 2012). A study on the effect of active learning on students' critical thinking was conducted among undergraduate students from an introductory geoscience course at a large public university. The research used active learning mechanisms that were based in activities that engaged students in argumentation and reflective learning. Specifically, researchers incorporated group-based learning with authentic tasks, scaffolding, and preparation of written individual reports to implement active learning. Results indicate that appropriately designed active learning instruction mechanisms can advance critical thinking in undergraduate science education (Kim et al., 2012).

The reformation of STEM educators' roles from wielders of absolute power to facilitators of students' activities is discussed in James Ejiwale's article, (2012) "Facilitating Teaching and Learning across STEM Fields." Ejiwale identifies several factors to assist educators' in facilitating active and collaborative student activities in STEM. He cites literature that supports the practical use of creative programs, including hands-on activities, to excite STEM students and enhance their educations. Factors that promote educators' facilitation include: having a deep understanding of their STEM subject matter from multiple perspectives in order to make teachable moments of students' questions; using activities that are connected to real-world problems; using a repertoire of teaching strategies such as stimulating group interaction skills, fostering cooperation and diminishing competition; and, knowing their students in order to create curricular activities that students can personally identify with and thereby self-direct their engagements (Ejiwale, 2012).

Consistent with Ejiwale's findings are results of a study by Frances Stage and Jillian Kinzie (2009). Stage and Kinzie researched undergraduate science education programs engaged in institution-wide reform of STEM courses. Their goal was to better meet the learning needs of undergraduate STEM students, including students with diverse learning styles and diverse academic backgrounds. Active learning and a view of learning as collaborative were among six approaches to teaching that Stage and Kinzie identified as facilitating the transformation from traditional teaching approaches to learner-centered ones. Several methods can be used to enact active and collaborative learning approaches within the classroom including "team teaching and combining two courses from two differing disciplines, the development of community-based activities, heavy reliance on group projects, and a focus on active approaches for the tasks of those groups" (Stage & Kinzie, 2009, p. 101).

Although research has shown that active and collaborative learning practices increase student engagement and positively impact academic performance, the wide use of such pedagogies across STEM fields has not taken hold (Laird, Sullivan, Zimmerman, & McCormick, 2011). A study by Laird, Sullivan, Zimmerman and McCormick (2011) that examined differences by disciplines in the degree of student exposure to active and collaborative educational environments found that STEM faculty tend to use such pedagogies significantly less frequently than do faculty in non-STEM fields. While the differences were small for higher-order learning, which includes analysis, synthesis, and judgment regarding evidence, the differences were large for integrative and reflective learning (Laird et al., 2011).

2.1.2 Academic challenge. Academic challenge is defined as the time and energy (effort) that students expend on academic course work and the institution's/faculty's expectations (Brint et al., 2008; Kuh, 2009). Elements of academic challenge are institutional requirements and the challenging nature of coursework.

A study by Amy Strage (2007) was conducted to improve the understanding of the "determinants and consequences of college students' willingness to work hard" (p.1225). Strage's quantitative study was designed to capture students' study activities and attitudes about school work. Included were four scales to assess students' motivations – (a) learning goals, (b) perseverance, (c) task involvement, and (d) teacher rapport. Strage found that students' efforts differ from one academic course to another based on the degree to which they care about the course. Students work harder (study more) in their major courses than in electives, in courses that are central to their interests, and in courses where they feel connected with the instructor (Strage, 2007).

Student effort was one of several variables examined in a study by Wyatt, Saunders, and Zelmer (2005). The purpose of this study was to determine differences in attitudes toward academic preparation, effort, performance and performance standards between undergraduate students and faculty within the framework of how much effort should be required for academic success. Survey questions in this quantitative study addressed perceptions regarding academic challenge and academic effort.

Results indicated two key inferences about expected and required perceptions of academic effort. While the estimates of hours spent studying were consistent between faculty and students, faculty perceived significantly higher hours were required to obtain grades of A or B than were perceived by students. This indicated that expectations of effort by faculty may be too high since student perceptions of effort were impacted by the grades they received. The researchers noted that this could have resulted because students with higher GPA's comprised the student respondent sample (Wyatt et al., 2005). Secondly, results indicated that the discrepancy between expected effort and grade assignments was acknowledged by the faculty but faculty did not perceive themselves as contributing to the problem. Researchers concluded that faculty and students differ in their perceptions of academic rigor (expectations) and engagement in academic efforts (Wyatt et al., 2005).

The direct impact of student effort (amount of time spent on studying) on academic performance was found in a study that investigated the relationship between multiple predictors and academic performance among undergraduate first semester psychology students in Norway (Diseth, Pallesen, Brunborg & Larsen, 2009). Other predictors in the study model included the learning context as experienced by the student, and prior performance and approaches to learning. Findings, as related to student effort (versus other predictors), indicated that students with increased effort also used more strategic approaches to learning which had a positive impact on their academic performance. Researchers concluded that students should be made aware of their abilities to control academic performance since it is partially governed by their effort and motives/learning strategies (Diseth et al., 2009).

Differences in engagement should be considered in approaches to increase good educational practices that are foundational to academic engagement according to Brint, Cantwell, and Hanneman (2008). They investigated whether academic engagement, normatively conceptualized as "good educational practices", is equally relevant across all major disciplines and all types of institutions. Findings from their quantitative analysis of results from the University of California's Undergraduate Experience Survey indicated that there are two distinct cultures of academic engagement – (a) engagement in the arts, humanities and social sciences and (b) engagement in the natural sciences and engineering. The arts, humanities and social sciences engagement culture is interactive and participatory in focus while the natural sciences and engineering engagement culture focuses on improvement of quantitative skills to compete for employment (Brint et al., 2008).

2.1.3 Interaction with faculty. Research indicates that constructive student-faculty interaction positively affects students' learning, engagement and persistence (Braxton, Hirschy, McClendon, 2004; Hurtado, Eagan, Tran, Newman, Chang, & Velasco, 2011; Soldner, Rowan-Kenyon, Inkelas, Garvey, & Robbins, 2012). The quality and frequency of these interactions are particularly important to understanding academic performance of minority students; more faculty contact does not necessarily result in academic gains by these populations (Cole, 2008).

Faculty interaction (with students) was identified as one of three college environments that may significantly improve STEM persistence in a study that explored the role of living-learning programs as an intervention to support student persistence in STEM (Soldner et al., 2012). Faculty interaction with students (course-related and non-course related) was found to enhance students' interest in pursuing STEM degrees and in their academic performance (grades).

Institutional cultures regarding science education can sometimes impede rather than advance students' persistence in science disciplines (Hurtado et al., 2011). In view of this, a study was conducted to examine the effects of institutional contexts in higher education on faculty interactions with underrepresented students in STEM disciplines (Hurtado et al., 2011).

Hurtado and colleagues employed a mixed-methods design to analyze data of first-year college students from a quantitative longitudinal study across 117 higher education institutions, and a qualitative case study of five campuses. HBCUs represented 13% of the quantitative sample and Hispanic Serving Institutions (HSIs) were 9%. A purposeful sample of two PWIs, two HSIs, and one HBCU was used in the qualitative study.

The study found that "specific campuses and patterns of faculty engagement with students can make a significant difference in establishing a culture of support [in science] while still maintaining the rigor in science training" (Hurtado et al., 2011, p.14). There were several other notable findings, based on the quantitative analysis. Student-faculty interaction is lower at institutions with larger undergraduate enrollments, more selective environments, and impersonal environments. Student-faculty interaction can be increased through structured opportunities such as academic clubs, minority support programs and participation in faculty research projects. These student support opportunities also help socialize students into the science culture. In addition, a finding with particular relevance for my study is that the level of contact with faculty is strongest for Black students who attend HBCUs than for other students attending other types of institutions.

Analysis of the case study qualitative data indicates that students determine whether an instructor is approachable by interpreting certain cues that are usually demonstrated in the classrooms. Examples are whether professors motivate students to ask questions and whether their instruction methods are interactive versus didactic.

Differences in student-faculty engagement by type of institution were also found in a summary of HBCU relevant data from the Minority Male STEM Initiative Survey. Better faculty relationships are significantly more likely among minority students attending HBCUs than among minority students attending PWIs. Students at HBCUs are also more likely to have a higher sense of belonging (Toldson, 2013).

Student-faculty interactions, in the context of constructive criticism from faculty, significantly influence GPA and educational satisfaction of African American and Hispanic college students (Cole, 2008). Using data from the Cooperative Institutional Research Program, Cole conducted a quantitative study to examine the “effects of faculty constructive criticism, as constructed through student-faculty interactions, on minority students’ average college grades (GPA) and educational satisfaction” (Cole, 2008, p.591). His findings suggest that the academic success of underrepresented students is positively impacted by faculty support and encouragement.

An exploratory study by Schreiner, Noel, Anderson & Cantwell (2011) to identify the attitudes and behaviors of faculty and staff that impact the success and persistence of high-risk students revealed seven themes on the positive influence of college personnel. Included are:

> (a) a desire to connect with students, (b) being unaware of their influence on students at critical junctures, (c) wanting to make a difference in students’ lives, (d) possessing a wide variety of personality styles and strengths but being perceived by students as genuine and authentic, (e) being intentional about connecting personally with students, (f) different approaches utilized by faculty compared to staff, and (g) differences in the types of behaviors that community college students reported as fostering their success (p.5).

Results indicate the need for a change in faculty hiring practices to include assessment of candidates' experiences in interacting with students, and the need for faculty and staff to recognize the impact of meaningful student connections to their (students') ability to succeed and persist (Schreiner, Noel, Anderson & Cantwell, 2011).

Gasiewski, Egan, Garcia, Hurtado, and Change (2012) also found significant associations between instructor characteristics and student engagement in their study to address low student persistence in science majors. A sequential, explanatory mixed methods approach was used to explore the relationship between student academic engagement and performance in introductory college math and science courses. Introductory college math and science are considered "gatekeeper" courses because they prevent a large portion of students from progressing to later courses in the sciences.

Gasiewski et al. (2012) concluded that student engagement is higher in introductory math and science courses where instructors exhibit an understanding of their roles to help students succeed by transforming from "gatekeepers" to "engaged faculty." Engaged faculty are open to student questions and to using active learning techniques to change their classrooms into engaging spaces.

2.1.4 Enriching educational experiences. Enriching educational experiences are purposeful learning activities that complement, augment and enhance academic programs. Examples are students' participation in learning communities, research projects, and internships or field experiences (Campbell & Cabrera, 2011; NSSE, 2014).

A quantitative study, conducted as part of the 2007 National Study of Living-Learning Programs Baseline Study, found that STEM-focused living-learning interventions appear to positively benefit students intending to major in a STEM discipline (Soldner et al., 2012).

Living-learning programs are structured so that students live together on campus, share academic curriculum and have access to special resources that support their interests. Programs are designed to promote a sense of community among students and faculty through a blending of in-class and out-of-class experiences, in this case experiences that were related to STEM (Soldner et al., 2012).

Researchers examined possible relationships between living-learning programs (STEM focused and non-STEM focused) on the students' major goals, and whether students' participation in living-learning programs related to socio-cognitive factors that affect their choice of majors. Three of six living-learning environments studied were found to significantly enhance students' interest in pursuing STEM degrees and in their academic performance (grades). These included faculty interactions (course-related and non-course related), academic conversations with peers which relates to greater interest in STEM pursuits and to better grades, and socially-supportive residences because of their relationship to positive outcome expectations (Soldner et al., 2012).

STEM learning communities have a positive effect on African American students' motivation and learning in STEM classes at HBCUs (Freeman, Alston, & Wilborne, 2008). A mixed method study of African American students at two HBCUs found that students' motivation and attitudes about science and mathematics were enhanced in classes that used a learning community approach. As participants in the Learning Communities for Science, Technology, Engineering, and Mathematics Academic Achievement (LCSAA) project, students took part in linked or clustered STEM classes. "At the heart of learning communities is collaboration among students and faculty toward shared construction of knowledge and attainment of academic goals" (Freeman et al., 2008, p.1). Study results suggest that the experience fostered a level of comfort, confidence and motivation among the STEM students (Freeman et al., 2008).

The benefits of student engagement in research activities as an enriching educational experience are well documented in a monograph entitled “Reinventing Undergraduate Education” (Hu, Scheuch, Schwartz, Gayles, & Li, 2008). Positive outcomes include improved cognitive and personal skills, increased confidence in students’ research abilities, substantive interaction between students and faculty, and improved critical thinking and reflective judgment.

Consistent with the monograph by Hu et al. (2008), are findings from a study that explored the benefits (and costs) of undergraduate engagement in faculty-mentored research for students in STEM disciplines. Thiry, Laursen, and Hunter (2011) found that STEM undergraduates benefit greatly from research experiences that supplement their coursework.

Using a longitudinal and comparative qualitative study design, they conducted in-depth, open-ended semi-structured interviews with students and their faculty advisors at four selective liberal arts colleges with strong experience in faculty-led undergraduate research. Students participated in a variety of experiential STEM research opportunities including summer research on campus; research in government laboratories; research at research universities, engineering and technology firms, health care institutions, and non-profit organizations such as community agencies or environmental organizations; and apprentice-style research internships.

Results indicated that STEM undergraduates benefit greatly from research experiences that supplement their coursework. Students’ positive comments regarding their education were a consequence of their engagement in research activities more than their coursework, regardless of the type of research experience they participated in. Benefits include development of teamwork skills, clarity in career goals, and development of a scientific identity. Compared to their STEM peers who did not participate in research outside of class work, participants in experiential research had an increased appreciation for the scientific process and experimental design. Students who had poor research experiences lost interest in their STEM major or abandoned their educational or career goals which indicated the importance of the quality of the research experience. Thiry, Lauren, and Hunter (2011) concluded that participation in research is a more effective way [than inquiry-based lab courses alone] to socialize students into the scientific research community.

A quantitative study by Eagan, Sharkness, Hurtado, Mosqueda, and Chang (2011), using data from the Higher Education Research Institute's 2007-2008 Faculty Survey, examined factors that influence faculty members' decisions to involve STEM undergraduates in their research. Some of the factors were (a) faculty members' tenure status, rank, discipline and time at their current institution; (b) teaching activities; (c) volunteer activities such as advising student groups; and (d) research productivity. Other factors included faculty members' goals for undergraduate education, and institutional climates.

An important and highly relevant finding was that the likelihood to involve undergraduate students in research is significantly higher among faculty at HBCUs than among their peers at other kinds of institutions (Eagan et al., 2011). This was also the case for faculty at liberal arts colleges. Results further indicated that faculty in life sciences and those whose research is sponsored by state or federal governments, and faculty at selective institutions (where students are better prepared academically) are more likely to involve undergraduates in their research projects.

The federal government funds several intervention programs designed to support underrepresented students in the health sciences and STEM disciplines (Schultz et al., 2011).

Program approaches and service offerings vary widely, yet there are few credible empirical evaluations of how well these programs work in meeting the goal to increase the quality and quantity of minority students completing degrees in STEM (Schultz et al., 2011). Given this, a rigorous examination of the effectiveness of a prototypical intervention program was conducted by Schultz et al. (2011).

The study focused on the NIH-funded Research Initiative for Science Excellence (RISE) program that provides research support for faculty and students at minority serving institutions. Typical services offered by RISE programs include faculty mentoring of students, on-campus research opportunities and summer research internships, graduate school preparation, substantial stipends and funds to attend and present at professional conferences (Shultz et al., 2011).

Results showed that the RISE program can sustain student interests in the sciences over time, both in terms of sustaining students' intentions to pursue a research career and in terms of moderating declines in such intentions. In addition, participation in undergraduate research increases the likelihood that interest in the sciences is sustained. This occurred among students participating in RISE programs and also among students who engaged in research but who were not RISE participants. Finally, an unexpected finding was that having a faculty mentor does not significantly affect student intentions (Shultz et al., 2011).

2.2 College Student Persistence in STEM

A study by A. L. Griffith (2010) addresses the issue of students switching from planned STEM majors to other majors with particular attention on women and racial/ethnic minorities for whom STEM persistence is much lower. The study employed a quantitative research methodology using longitudinal data from the National Longitudinal Survey of Freshman in fall of 1999 and the National Education Longitudinal Study of 1988. Findings indicate that differences in STEM persistence for women and minorities, compared to males and non-minorities, trace to preparation and educational experiences. Further, institutional characteristics like research spending (relative to other educational spending), gender and racial role models in STEM departments, and the undergraduate teaching focus also impact STEM persistence (Griffith, 2010).

The impact of the college experience and the college environment were also found to be important factors in the persistence of women of color in STEM in a quantitative study by Lorelle Espinosa (2011). In addition, her research found that these are more impactful than high school performance and family background characteristics. Using longitudinal data from the Cooperative Institutional Research Program (CIRP) survey, Espinosa conducted a quantitative study on the effect of precollege characteristics, college experiences and institutional setting on the persistence of undergraduate women of color compared to the persistence of White women.

Results indicate that STEM persistence for women of color is positively affected by science identity development (importance of science to their personal goals), intrapersonal processes (satisfaction with the institution's science and math curriculum), and academic integration (peer group interaction, membership in major-related clubs, participation in research programs). Regarding institution type, women of color are more likely to persist in STEM at private institutions than at highly selective colleges and universities. Institution type is not a significant predictor for persistence of White women (Espinosa, 2011).

Another variable that has been examined in the persistence literature, though to a lesser degree than those discussed so far, is student learning. The influence of student learning on persistence from the first year of college into the second year was the subject of a study by Walniak, Mayhew, and Engberg (2012). This was a quantitative study that employed descriptive and multivariate techniques to analyze longitudinal data from the Wabash National Study of Liberal Arts Education (WNSLAE) collected in 2006-2007.

Controlling for background characteristics, experiential measures, institutional environment and academic and social integration, Walniak, Mayhew, and Engberg (2012) drew three major conclusions. First, students' decisions to persist are influenced by their mastery of course content and by teaching practices. Secondly, teaching practices within the classroom more positively influence persistence than do frequency of student interactions with faculty. Lastly student persistence is also facilitated by their involvement in cocurricular activities (Walniak et al., 2012).

Do persistence, engagement and migration of engineering majors differ from that of students in other academic majors? This question was explored in a study that focused specifically on undergraduate engineering majors in the context of other majors (Ohland et al., 2008). The purpose of the study was to gain new information about (a) persistence and engagement regarding engineering students; (b) the extent to which these outcomes held true for engineering students only, compared to students in other majors; and (c) how desirable outcomes could be improved and undesirable outcomes could be mediated. Outcomes included such variables as grades and gains in general education, course related interactions with faculty, and time-on-task.

Results indicated that undergraduate engineering students are more persistent than other college students and are equally engaged. However, the rate of migration into engineering by students switching from other majors was very low. Ohland et al. concluded that factors other than persistence, higher rates of attrition, and lower rates of satisfaction are impacting the decline in the production of engineering graduates. These include factors that influence the appeal or attraction of engineering disciplines to students. In addition, while this study looked at similarities in persistence, outcomes and engagement of engineering students and students in other majors, further study was recommended to explore whether engagement and persistence are related similarly across students in engineering and non-engineering majors (Ohland et al., 2008).

Such a study was conducted by Lichtenstein, McCormick, Sheppard, and Puma (2010) that compared experiences of undergraduate engineering students to experiences of students in other majors in terms of engagement, time on task, and enriching educational experiences. Engineering students were found to be comparable to other students on most engagement variables. They differed significantly on ‘gains in practical competence and higher order thinking’ where they were higher than non-engineering students, and ‘reflective learning and general education gains’ where they were lower.

The study also compared engineering persisters, non-persisters, and migrators and found them to be similar except on ‘participating in independent study/self-designed major and foreign language coursework’ which was significantly lower for persisters. Researchers concluded that engineering majors must make trade-offs between meeting the demands of earning an engineering degree (more time preparing for class due to the engineering curriculum) and participating in enriching educational experiences (Lichtenstein et al., 2010).

“Trajectories of persistence [in engineering] are non-linear, gendered, and racialized…various populations respond differently to the same institutional conditions” (Ohland, Brawner, Camacho, Layton, Long, Lord, & Washburn, 2011, p.1). Ohland et al. (2011) compared eight-semester persistence and six-year graduation rates among various race and gender populations of engineering students for a ten year period. They found that differences in the type of institution matter more than gender differences in the persistence of engineering students across all races. However, racial differences in persistence surpass institutional differences. In addition, variation of the persistence of Black students was higher than for any other racial group (Ohland et al., 2011).

A qualitative study to identify and explore academic and social experiences of African American and Latino American male students in STEM revealed four major themes that present barriers to persistence at PWIs. Strayhorn, Long, Kitchen, Williams & Stentz (2013) identified these as:

> (a) alienation and invisibility, (b) lack of same race peers and faculty upon whom students could depend for support, (c) difficulty applying theory and curriculum to practice, as well as few opportunities to do so in introductory engineering courses and (d) lack of pre-college preparation for STEM coursework in college" (p. 10).

Several recommendations were offered to overcome these barriers to STEM success. Among those that address alienation and faculty support are to increase outreach efforts targeting African American and Latino males, incentivize the tenure and promotion process for faculty outreach and mentoring, and pair students with same race faculty. Among recommendations to address students' difficulty applying theory and curriculum to practice are to provide more opportunities for students to engage in hands-on tasks in curriculum, have students work on projects for local community agencies, and engage industry partners to inform faculty on skills and competencies needed in the real-world and to help create student design projects. Lastly, increase student exposure to STEM-related content earlier in their educational experiences by partnering with local K-12 schools (Strayhorn et al., 2013, p. 10).

2.3 The HBCU Environment and Student STEM Success

HBCUs better engage African American students than do PWIs according to a study that explored African American and Hispanic student engagement at minority serving and predominantly White institutions (Laird, 2007). The study also investigated whether Hispanic students are served by Hispanic serving institutions in similar ways that African American students are served by HBCUs.

Laird et al. (2007) employed a quantitative methodology using data from the National Survey of Student Engagement (NSSE). Six measures from the NSSE were analyzed including students' engagement in effective educational practice. Findings indicate similarity in terms of engagement, satisfaction with college, and gains in overall development among Hispanic seniors at PWIs and HSIs. However, results differed for African American seniors who were found to be more engaged at HBCUs than at PWIs (Laird et al., 2007).

Support to help address social and academic problem situations for African American students is usually more available and accessible at HBCUs than at PWIs based on a study by Reeder, Schmitt & Neal (2013). They compared African American college students at HBCUs and PWIs on the relationship of perseverance, continuous learning and academic judgment to academic performance, and whether institution type is a moderating factor. Results suggest that HBCUs moderate the relationship between judgment (regarding social and academic problems) and academic performance (Reeder, Schmitt & Neal, 2013).

The supportive role of the HBCU in promoting STEM success was found in a study that addressed the gender gap among African Americans in science, technology, engineering and mathematics (STEM) fields by focusing on how Spelman College, a historically Black women's college, promotes STEM degree attainment for its students (Perna et al., 2009). Black women are substantially less represented in STEM fields than Black men, which is consistent with other racial/ethnic groups. In this qualitative inquiry, focus group interviews were conducted among students, faculty and administrators to understand institutional culture; faculty and student interactions; and available supports.

A key finding of the study was that certain characteristics and practices at Spelman mitigate the academic, psychological and financial barriers that limit Black women's persistence in STEM fields (Perna et al., 2009). Characteristics that appear to relate to sociological and psychological factors include structural characteristics that facilitate student-faculty interaction, e.g. small class sizes and easily accessible faculty offices, a supportive rather than competitive peer environment that facilitates student interaction and a supportive STEM peer culture, and faculty encouragement and involvement that promote self-efficacy in students. The relationship between self-efficacy and educational attainment in STEM fields, particularly for women and students of color has been demonstrated in research (Perna et al., 2009).

Among their conclusions the researchers noted that their findings build on prior research showing that African Americans who attend HBCUs experience less social isolation, alienation, personal dissatisfaction and overt racism than African American students at predominantly White colleges and universities. They also concluded that the social, cultural, and racial environment at HBCUs promotes academic success because it is more supportive, caring and nurturing (Perna et al., 2009).

The importance of campus climate to the success of African American engineering students was evidenced in a study aimed at understanding how students' perceptions of climate influenced their academic performance and graduation rates. The quantitative study examined the perceptions of a national cross-section of African American students in engineering programs at various types of colleges and universities accredited by the Accreditation Board for

Engineering and Technology (ABET). Nearly 25% of the sample was comprised of students from HBCUs (Brown et al., 2005).

A key result was that engineering students enrolled at HBCUs have the most favorable campus climate perceptions compared to students enrolled at other institutions. Higher graduation rates are associated with lower perceptions of racism and discrimination and with higher institutional commitment. Relationships between graduation rate and perceptions of classroom experiences, faculty and staff interactions, student support services, peer interaction, student effort, or goal commitment were not found to be statistically significant in this study (Brown et al., 2005).

Examining the importance of HBCUs in producing successful African American male mathematics majors was the purpose of Jett's (2011) study of four African American men pursuing graduate degrees in mathematics or mathematics education, and who majored in mathematics as undergraduate students. All participants attended HBCUs as undergraduates in this multiple case study.

Results indicated that for undergraduate African American males majoring in mathematics, HBCUs provide positive racial environments, play a key role in facilitating peer academic support, and prepare students for graduate studies in mathematics. Several factors relating to the HBCU environment, enriching student engagement and student-faculty interaction emerged in the study's findings (Jett, 2011).

One factor that influenced positive experiences was participation in activities that engaged students in the predominantly African American communities surrounding their campuses. These activities included tutoring community college students in mathematics, teaching SAT preparatory classes and participating in an educational service initiative as a member of a fraternal organization (Jett, 2011).

Another factor that seemed to relate to positive racial support for these male students was being in environments that had large numbers of African American students. Jett (2011) noted a consistency, in this respect, with literature that indicates increased comfort levels and decreased fear of condescension and disrespect when African American students are in such environments. Finally, Jett concludes that respondents' persistence in mathematics was influenced by African American male mathematics professors who were sources of academic and social support and thereby served as role models.

A qualitative study to explore the impact of STEM initiatives on student success at an HBCU found that STEM initiatives that use student affairs approaches along with academic affairs approaches positively impact retention and graduation (Palmer, Davis, & Thompson, 2010). This promotes the idea that engagement activities addressing the sociological and psychological needs of students, along with their academic needs, improve persistence and retention.

In the study, interviews about STEM initiatives were conducted with STEM program coordinators at an HBCU in a mid-Atlantic state. Initiatives included the Pre-Accelerated Curriculum in Engineering (PACE), Foundations of Mathematics (FOM), WebWork and Fast Track programs. Other support services were also discussed and included departmental tutorial support and the use of STEM retention counselors as primary academic advisors until students reached their junior year (Palmer et al., 2010).

The researchers concluded that the initiatives are successful because they foster students' academic and social integration. They not only introduce the rigors of STEM curricula and provide academic support systems, but they also help students become involved in campus life, facilitate development of student relationships with role models (successful upper classmen and faculty), and enhance students' commitment to the university (Palmer et al., 2010).

2.4 Summary

There were several relevant findings and implications of the literature review for my study. It is critically important to specify the engagement definition used in research and thereby provide context for information presented (Axelson & Flick, 2011). The terms and concepts of involvement, engagement and integration are both distinct and overlapping and can be contextually nuanced (Wolf-Wendel, Ward & Kinzie, 2009). In my study, the terms overlapped and student engagement encompassed the student's involvement and experiences in meaningful academic pursuit; the student's interaction with faculty and peers; and the student's integration with the campus environment.

The literature indicates that student engagement is important to students' interest in science and to their persistence in STEM disciplines. Student effort and involvement impact their persistence (Chen et al., 2008). Persistence of underrepresented STEM students is influenced by their engagement (Ellington Frederick, 2010; Griffith, 2010; Espinosa, 2011; Cole, 2008). Engagement takes several forms that can be broadly characterized as active and collaborative learning, academic challenge, faculty-student interaction and campus environments that support the cognitive and psycho-social needs of students.

Active learning promotes student engagement by involving students in the learning process (Prince, 2004). Active learning strategies can promote critical thinking in undergraduate science education (Kim, Sharma, Land, & Furlong, 2012). STEM educators can enact active learning activities into the classroom to enhance student learning by using approaches that connect class activities to real-world problems, stimulate group interaction, and foster cooperation and diminish competition (Ejiwale, 2010); and by using such approaches as team teaching, developing community-based activities, and assigning group projects with active tasks (Stage & Kinzi, 2009).

Collaborative learning is an active learning method that emphasizes student interactions, as contrasted to individual work or learning as a solitary activity. Meta-analyses on the impact of collaborative learning on learning outcomes indicate that collaboration yields several positive outcomes including improvement in academic achievement, student attitudes and retention, particularly retention of minority students (Prince, 2004).

Academic challenge, or the time and energy that students expend on academic course work and the institution's/faculty's expectations, directly impacts students' academic performance in STEM and non-STEM disciplines (Strage, 2007; Diseth, Pallesen, Brunborg & Larsen, 2009). Students' efforts differ from one academic course to another based on the degree to which they care about the course (Strage, 2007). Students who exert increased effort also use more strategic approaches to learning and should be made aware that they are controlling their academic performance (Diseth, Pallesen, Brunborg & Larsen, 2009).

Students and faculty differ in their perceptions of academic rigor (expectations) and engagement in academic efforts (Wyatt, Saunders, & Zelmer, 2005). The perceived level of student effort, in terms of hours spent studying to achieve expected academic outcomes, is higher among faculty than among students. While faculty acknowledge this discrepancy, they do not perceive themselves as personally contributing to the problem of academic rigor (Wyatt, Saunders, & Zelmer, 2005).

Students work harder (study more) in their major courses than in electives, in courses in their interest areas, and in courses where they feel connected with the instructor (Strage, 2007). Also, there are cultural distinctions in academic engagement in the arts, humanities and social sciences compared to academic engagement in the natural sciences and engineering (Brint et al., 2008). These differences should be considered in approaches to increase good educational practices that are foundational to academic engagement (Brint et al., 2008).

Faculty members are significantly important to fostering student engagement (Gasiewski et al., 2012; Soldner et al., 2012; Hurtado et al., 2011; Toldson, 2013) and to the success and persistence of high-risk students (Schreiner et al., 2011) and underrepresented students (Cole, 2008). Engaged faculty understand their roles to help students succeed and are open to student questions and to using active learning techniques to change their classrooms into engaging spaces (Gasiewski et al., 2012).

Faculty engagement with students differs depending on the type of campus environment. The level of contact with faculty and better student-faculty relationships are more likely for Black students who attend HBCUs than for other students attending other types of institutions (Hurtado et al., 2011; Toldson, 2013). Students at HBCUs are also more likely to have a higher sense of belonging (Toldson, 2013), and comfort, particularly African American males (Strayhorn et al., 2013). Student-faculty interaction can be increased through structured opportunities such as academic clubs, minority support programs and participation in faculty research projects (Hurtado et al., 2011).

STEM learning communities foster student engagement. Living-learning environments that significantly enhance students' interest in pursuing STEM degrees and in their academic performance (grades) include STEM-focused interventions that incorporate student-faculty interactions (course-related and non-course related), academic conversations with peers which relates to greater interest in STEM pursuits and to better grades, and socially-supportive residences because of their relationship to positive outcome expectations (Soldner et al., 2012). STEM learning communities have a positive effect on African American students' motivation and learning in STEM classes at HBCUs because they facilitate student-faculty collaborations that promote shared knowledge building and goal attainment (Freeman et al., 2008).

Participation in undergraduate research is an enriching educational experience of particular benefit to students in STEM disciplines. Positive outcomes include improved cognitive and personal skills, increased confidence in their research abilities, substantive interaction between students and faculty, and improved critical thinking and reflective judgment (Hu et al., 2008). Participation in research promotes development of teamwork skills, clarity in career goals, and development of a scientific identity; and is a more effective way, than inquiry-based lab courses alone, to socialize students into the scientific research community and (Thiry et al., 2011).

Faculty members at HBCUs and at liberal arts colleges are significantly more likely to involve undergraduate students in research than are faculty at other kinds of institutions. This particularly holds for life sciences faculty and those whose research is sponsored by state or federal governments (Eagan et al., 2011). A prototypical example is the NIH-funded Research Initiative for Science Excellence (RISE) program that provides research support for faculty and students at minority serving institutions. This program was found to sustain students' interests in the sciences over time, both in terms of sustaining students' intentions to pursue a research career and in terms of moderating declines in such intentions (Shultz et al., 2011).

College student persistence in STEM is lower for women and racial/ethnic minorities, compared to males and non-minorities. Differences are impacted by preparation and educational experiences, institutional characteristics like research spending (relative to other educational spending), gender and racial role models in STEM departments, and the undergraduate teaching focus (Griffith, 2010). Low persistence in "gatekeeper" introductory math and science courses can be positively impacted when faculty motivate student engagement through active learning techniques and by being open to student questions (Gasiewski et al., 2010).

STEM persistence for women of color is positively affected by science identity development, intrapersonal processes, and academic integration (Espinosa, 2011). Women of color are more likely to persist in STEM at private institutions than at highly selective colleges and universities (Espinosa, 2011).

Undergraduate engineering students are more persistent than other college students and are equally engaged (Ohland et al., 2008). Even so, student persistence in engineering varies and is impacted by race, institutional type, and gender (Ohland et al., 2011). Engineering students are less likely than other students to engage in enriching activities that distract from time required to earn an engineering degree (Lichtenstien et al., 2010). The rate of migration into engineering by students switching from other majors is low and indicates that the decline in the production of engineering graduates may trace to factors that influence the attraction of students to engineering majors (Ohland et al., 2008).

Students' success and persistence in STEM is positively influenced by their participation in college scholarship programs that provide a variety of engagement support services (Ellington & Frederick, 2010). In addition to college scholarship programs, initiatives that facilitate development of student peer relationships (Soldner et al., 2012) and that socially integrate students into campus life (Hurtado et al., 2011) have a positive impact on STEM persistence. Students' decisions to persist from the first year of college into the second year are also influenced by student learning (mastery of course content) and by their involvement in cocurricular activities (Walniak et al., 2012).

Institution type matters in the persistence in STEM by underrepresented students (Brown et al., 2005; Jett, 2011; Laird et al., 2007; Perna et al., and 2009 Strayhorn et al., 2013).
Among the barriers to persistence for African American and Latino male students in STEM at PWIs are alienation, lack of same race peers and faculty, difficulty applying theory and curriculum to practice, and lack of pre-college preparation for STEM coursework (Strayhorn et al., 2013). Possible initiatives to address these barriers include targeted outreach programs, curriculum modification to include hands-on tasks, engaging industry to inform faculty on real-world competency requirements and as co-creators in student design projects, and partnering with local K-12 schools to expose students early to STEM-related content (Strayhorn et al., 2013).

Students enrolled at HBCUs have the most favorable campus climate perceptions compared to students enrolled at other institutions (Brown et al., 2005). African American students are more engaged at HBCUs than at PWIs, and are more engaged than Hispanic students are at HSIs (Nelson Laird et al., 2007). Compared to PWIs, social and academic support for African American students is more available and accessible at HBCUs (Reeder, Schmitt & Neal, 2013).

The HBCU environment is particularly important in producing successful African American male mathematics majors. HBCUs provide them with positive racial support, enriching engagement opportunities with the institution and with the African American community, and African American male mathematics professors who serve as role models (Jett, 2011).

STEM initiatives at HBCUs that use student affairs approaches along with academic affairs approaches positively impact retention and graduation because they foster students' academic and social integration (Palmer et al., 2010). The social, cultural, and racial environment at HBCUs promotes academic success because it is more supportive, caring and nurturing (Perna et al., 2009).

CHAPTER 3

Methodology

This chapter provides details of the research methodology used in the study. The sampling procedure, instrumentation, and procedures to collect and analyze the data are discussed. The purpose of this study was to identify student engagement factors that influence persistence in STEM disciplines at an HBCU located in southeastern United States. The relationship between student engagement factors (academic challenge, active and collaborative learning, student-faculty interaction, enriching educational experiences, and supportive environment) and persistence in STEM disciplines was examined via a prediction correlational design.

3.1 Assumptions and Rationale for Quantitative Research

This research employed a quantitative approach using a secondary analysis of NSSE datasets. Quantitative research assumes a postpositivist worldview (Creswell, 2009). The underlying principles of postpositivism are determination, reductionism, empirical observation and measurement and theory verification (Creswell, 2009). This worldview was appropriate for this study because the emphasis was on determining whether student engagement factors are related to and predictive of persistence among STEM majors at an HBCU. The relationship of a discrete set of predictor student engagement variables, to the criterion variable of STEM persistence, was tested. Results were analyzed and interpreted from a conceptual framework based on an integration of Alexander Astin's (1984) student involvement theory, George Kuh's (2009) student engagement concept, and Reason's (2009) persistence conceptual framework.

3.2 Predictive Correlational Design

This study employed a predictive correlational design and secondary data analysis approach. Correlation analysis describes the relationships between variables (Thomas, 2003). A predictive correlational research design enables the identification of variables that will forecast an outcome (Creswell, 2012). This study sought to identify highly related student engagement variables that predict student persistence in STEM majors.

Secondary analysis of survey data provides access to data from a national sample that would be difficult to collect as a sole researcher due to constraints in time and resources (Kiecolt & Nathan, 1985). Secondary analysis can be used for a variety of research designs including correlation analyses (Kiecolt & Nathan, 1985). An abundance of secondary data is being generated from a variety of sources, both public and private, at unprecedented scales and velocity (OECD, 2013). One of the largest generators of data is the Federal government which collects data from many sources including the Census Bureau, the Bureau of Labor Statistics, and agencies such as the Department of Education and the National Institute of Health, and makes it available for use by researchers and the public through such outlets as the National Center for Education Statistics and such websites as Data.gov. Data generated from so many sources can be difficult to find, or to access in a format that is not limited due to proprietary restrictions. As a result, there is a wealth of data that remains untapped and efforts such as Data.gov, a resource for the US government's open datasets, are being developed to facilitate ease of access to federal data sets (http://www.ed.gov/open/plan/data-gov). Accordingly, there is a need to use this secondary data and secondary data from other public and private repositories to conduct data-driven, evidence-based research to advance knowledge. Secondary data for this study included datasets of student responses from the National Survey of Student Engagement (NSSE) that was administered in 2008 and 2011 to first year students at the HBCU where the research was conducted. NSSE data is collected and analyzed for member institutions by the Center for Postsecondary Research at Indiana University's School of Education, the administrator of the NSSE.

3.3 Role of Researcher

Since I was the principal investigator in this study, it is important to disclose personal experiences that influenced my passion for the study and my perceptions and interpretation of findings (Creswell, 2009). I am an African American graduate of a private HBCU and a public PWI. These experiences informed my understanding of differences in engagement climates and cultures at these types of institutions. I attended the HBCU as an undergraduate student. The HBCU was a small (4500 students) private institution where most students shared similarities with each other and with their professors in terms of race and ethnicity (African American), culture, values and academic expectations. Engagement with the college experience was promoted, nurtured and facilitated. I attended the PWI as a graduate student. The PWI was a large (40,000 students) public institution where the majority of students were white and where a variety of cultural and socio-economic backgrounds were represented. Student engagement and institutional efforts to foster engagement differed from one academic school or college to another, and may have also differed for graduate students versus undergraduates. More opportunities to engage were available at the PWI; however, the responsibility to engage was largely the student's, particularly at the graduate level. Since August 2004 I have been affiliated with research at the university where this study was conducted. As a consequence, I have been exposed to faculty in STEM disciplines and to their efforts to research, support and enhance student engagement in STEM related activities. Likewise, I have been exposed to students pursuing degrees in STEM majors at this institution. These experiences have informed my knowledge of the higher education environment, of various initiatives to attract, retain, and graduate students in STEM disciplines (particularly underrepresented students), and of student perceptions regarding their educational experiences.

Cultural and personal biases resulting from my experiences were controlled in several ways to ensure the study was conducted in a responsible manner that promotes integrity of the research (O'Leary, 2004). Data in the secondary dataset did not include identifiers in order to maintain anonymity from me of students who participated in the NSSE surveys. Analyzed data will be discarded after a reasonable time to ensure it is not used inappropriately (Creswell, 2009). Subjectivities were acknowledged and balanced by using appropriate rigor (systematic, well-documented methods) in analyzing data, and findings were accurately reported to guard against misrepresentation and over generalization (O'Leary, 2004). Finally, research plans were reviewed by the university's Institutional Review Board and approved before this study began to ensure the protection of the human subjects whose survey responses comprised the secondary dataset (Creswell, 2009).

3.4 Sample

A non-random sample of students enrolled full-time in their fourth year at an HBCU in southeastern United States during spring 2011 and spring 2014 and who participated in the NSSE administered to entering freshmen in spring 2008 and spring 2011 were selected for this study. The sample was divided into two subsamples. One subsample included students who indicated on the NSSE an intention to major in STEM disciplines as freshmen and who persisted in majoring in STEM disciplines through their fourth year of college. The second subsample included students who indicated on the NSSE an intention to major in STEM disciplines as freshmen and who switched to non-STEM majors by their fourth year of college. STEM majors (and related classification codes) offered at the institution include animal science (01.0901); applied engineering technology (15.0613); biology (26.0101); chemistry (40.0501); computer science (14.0901); computer electronics and information technology (11.0101); engineering – chemical (14.0701), civil (14.0801), electrical (14.1001), industrial and systems (14.3501), mechanical (14.1901), nano (14.9999); environmental science (03.0104); mathematics (27.0101); and physics (40.0801).

The NSSE is a continuing longitudinal study of higher education that is administered in the United States and Canada to randomly-selected first year and senior year full-time students seeking bachelor's degrees at participating institutions. However, according to the former director of institutional research at the university where this study was conducted, the survey is administered to all eligible first year and senior year full-time students at the institution. The NSSE survey was suitable for this study that examined statistical relationships between students' engagement characteristics and their persistence in STEM disciplines because it (the NSSE) surveys and reports "the extent to which students engage in educational practices associated with high levels of learning and development" (NSSE, 2014a). Participating institutions receive a report of survey results for students at their institutions. This study used results of the web-based version of the NSSE administered in 2008 and 2011 to first year, full-time, students at the HBCU where the research was conducted. In 2008, almost 380,000 students participated nationally (NSSE, 2008) and 214 participated at the institution from which the sample for this study was drawn (NSSE, 2008b). In 2011, 428,073 students participated nationally (NSSE, 2011) and 283 participated at the institution from which the sample for this study was drawn (NSSE, 2011b). Combining survey participants for the two years yielded a total of 497 students from which the sample for this study was drawn. Table 1 shows survey participants from which the sample was drawn.

Table 1

Students who participated in the NSSE in 2008 and 2011 at the institution

Majors	Total NSSE Participants at the Institution (2008 and 2011)
Engineering	67
Biology	44
Physical Sciences	14
Computer Sciences	12
Agriculture	22
Non STEM	232
Undeclared	106
Total NSSE Participants	497

3.5 Data Collection Procedures

The NSSE collects information about the participation of undergraduates in programs and activities that colleges provide for student learning and personal development. The survey is widely accepted by institutional researchers in higher education (Kuh, 2009). Over 720 and 750 institutions participated in 2008 and 2011, respectively (NSSE, 2008 & 2011). The NSSE built on such national surveys as the College Student Experiences Questionnaire (CSEQ), which was retired after the spring 2014 administration, and the Cooperative Institutional Research Program's Entering Student Survey and College Senior Survey. The NSSE uses a well-developed, validated set of items designed to capture a variety of student behaviors and experiences that are related to student engagement (Gordon, Ludlum & Hoey, 2008; Kuh, 2009). Unlike previous surveys, the NSSE was designed to be easier to administer and to assist accountability and improvement efforts in response to a national need expressed by the U.S.

Department of Education (Kuh, 2009). Survey questions represent student behaviors that are highly correlated with desired learning and personal development outcomes of college (Wolf-Wendel, Ward & Kinzie, 2009). It should be noted, however, that research on the NSSE instrument indicates a difference in responses by traditional students compared to non-traditional students such as those who attend college part-time, transfer students, older students and commuters (Lerer and Talley, 2010).

Quantitative data on participants' engagement with the college environment and participants' demographic data was drawn from results of the NSSE that was administered to first year students enrolled full-time in spring 2008 and in spring 2011 at the HBCU where the study was conducted. Permission to use the NSSE data for this study was granted by the Director of Institutional Research at the HBCU where the research was conducted. Students were invited by e-mail to complete the survey online. Each of the 2008 and 2011 NSSE instruments consisted of 100 items with Likert-type response options. In both surveys, information was collected in five categories including "students' participation in educationally purposeful activities, institutional requirements and the challenging nature of coursework, students' perceptions of the college environment, estimates of educational and personal growth [anticipated or experienced] since starting college, and background and demographic information" (NSSE, 2014a).

Survey results indicate how students spend their time and what they gain from attending college. Institutional results are reported on five benchmarks of effective educational practice. The benchmarks are broad measures resulting from student responses to 42 key survey questions that capture behaviors and institutional features that contribute significantly to student learning and personal development (NSSE, 2014). The five benchmarks are: *Level of Academic*

Challenge (LAC), *Active and Collaborative Learning (ACL)*, *Student-Faculty Interaction (SFI)*, *Supportive Campus Environment (SCE)*, and *Enriching Educational Experiences (EEE).* The LAC benchmark addresses students' academic effort and institutional expectations for performance via measures of 11 related activities and conditions. The ACL benchmark addresses students' involvement in learning tasks and in collaboration via measures of seven related activities. The SFI benchmark addresses students' interaction with faculty members inside and outside the classroom via measures of six related activities. The SCC benchmark addresses students' working and social relations with different groups on campus via measures of six related conditions. The EEE benchmark addresses students' engagement in complementary learning opportunities inside and outside the classroom that augment the academic program via measures of five related activities and conditions (NSSE, 2014).

NSSE constructed the benchmarks using principal components analyses (oblique rotation) to identify benchmark item groupings. Subsequently, knowledge from theory and practice was used in the final determination of item groupings. Construction of the benchmarks employed four steps. The first step was the conversion of benchmark items to a 0 – 100 point scale. Second, scores for part-time students were adjusted on four of the Level of Academic Challenge items (READASGN, WRITEMID, WRITESML, and ACADPR01) so as not to exceed 100. Third, the mean of each student's scores was calculated to create student-level benchmark scores. Finally, the weighted averages of the student-level scores for first-year students and seniors were calculated to create the institutional benchmarks (NSSE, 2014). NSSE variables included in the benchmark constructs are presented in Appendix A.

Data on STEM persistence was drawn from institutional data. Academic majors and cumulative grade point averages were collected for students in the sample who were enrolled full time in their fourth year of college. Grades are assigned using the following four-point quality scale: excellent performance equals 4 points; good performance equals 3 points; average performance equals 2 points; below average (but passing) performance equals 1 point. Quality points are computed by multiplying the number of semester hours for which a completed course is offered times the quality value of the student's performance. The grade point average is obtained by dividing the total number of quality points earned by the total number of semester hours attempted.

3.6 Data Analysis Procedures

Several descriptive and associational statistics were used to analyze student engagement data from the NSSE among STEM persisters and STEM non-persisters. The relationship of a discrete set of predictor student engagement variables, to the criterion variable of STEM persistence, was tested. Predictor variables included the NSSE benchmarks: level of academic challenge, active and collaborative learning, student-faculty interaction, supportive campus environment, and enriching educational experiences. Also, other predictor variables from the NSSE and from institutional data were analyzed to render results that enabled answers to the research question that guided this study. These variables included students' majors -engineering, biology, physical sciences, computer sciences, and agriculture; and students' cumulative grade point averages. Descriptive statistics were used to determine the frequency of occurrence, means, standard deviations and range of scores for individual student characteristics. These characteristics were based on self-reported student demographics collected on the NSSE. They included gender, nationality, race or ethnicity, college classification, education since high school graduation, fraternity or sorority membership, student-athlete status, current grades, types of residency while in college, and parents' highest levels of education.

Descriptive statistics summarize data for the sample being studied and are not generalizable to a larger population (Morgan, Leech, Gloeckner & Barrett, 2013). Analysis of the descriptive statistics was used to determine whether individual characteristics should be controlled to isolate the effect of student engagement on persistence. Control variables enable determination of the true influence of predictor variables on criterion variables (Creswell, 2009). To elucidate results, independent samples T-tests were performed to determine whether the mean ratings on engagement variables were statistically different between persisters and non-persisters.

Correlation statistics were employed to measure and analyze the strength and direction of the relationships of student engagement characteristics and STEM persistence to determine student engagement factors that influence student persistence in STEM disciplines. Correlation statistics measure the degree of association between two or more predictor variables and an outcome (Creswell, 2012).

Binary logistic regression analysis was used to evaluate whether engagement variables predict the outcome of STEM persistence. Binary logistic regression analysis applies when there is a single dichotomous outcome and more than one independent variable. It enables prediction of the odds of an outcome occurring (or not) (Leech, Barrett & Morgan, 2011).

3.7 Reliability, Validity, and Generalizability of the Study

Quantitative reliability is an estimate of how well the research instrument yields consistent results when a study is repeated using the same methodology and sample population (Golafshani, 2003). Reliability of this quantitative study derived from the use of a survey instrument that has been tested for reliability by the Indiana University Center for Postsecondary Research, the developers and administrators of the NSSE. Since variables on the NSSE instrument are combined into scales to develop institutional benchmarks, internal consistency of benchmark results is necessary. Internal consistency of the 2008 and 2011 NSSE benchmark results was calculated using Cronbach's alphas and intercorrelations for NSSE scales (NSSE, 2008a & 2011a). An alpha coefficient of .70 or higher indicates reliability (Morgan, Leech, Gloeckner & Barret, 2013; Vogt, 1999). Survey results were found to be highly reliable for the academic challenge, student-faculty interaction, and supportive campus environment benchmarks with Cronbach's alphas ranging from .71 to .79. Reliabilities for active and collaborative learning and enriching educational experiences were lower, with alphas ranging from .60 to .68 (NSSE, 2008a & 2011a). Statistical analyses using these benchmarks were analyzed with caution.

This study was designed to minimize potential threats to internal and external validity of quantitative outcomes. A primary threat to internal validity is the self-selection bias of respondents. Students who chose to participate in the NSSE may be different from students who chose not to participate. As the researcher, I was cognizant that multiple truths exist and have accurately reported findings based solely on the sample that was studied (Creswell, 2009). Another internal threat is maturation of participants. Maturation was controlled by selecting a sample of students from the same classification cohorts. Potential threats to external validity include violating statistical assumptions and drawing incorrect inferences from the sample to other populations (Creswell, 2009). A sufficiently large sample was drawn to support statistical assumptions and to provide adequate statistical power thereby enabling inferences to be drawn from the data.

The ability to extend research findings and conclusions resulting from this study to the population at large is limited by the self-selection of respondents who completed the NSSE and by the narrow scope of the sample population to one HBCU in the southeast. This limitation on generalizability of findings to populations other than students at the institution where the study was conducted is acknowledged.

CHAPTER 4

Results

This study sought to identify student engagement factors that influence persistence in STEM disciplines at an HBCU located in the southeastern United States. The sample was drawn from a non-random sample of students enrolled full-time in their fourth year at an HBCU in southeastern United States during spring 2011 and spring 2014 and who participated in the NSSE administered to entering freshmen in spring 2008 and spring 2011. Subsamples of student persisters and non-persisters in STEM disciplines were studied. Quantitative data on student engagement was collected from results of the NSSE and quantitative data on STEM persistence was collected from institutional data. Results of the data analyses are presented in this chapter. Frequencies of sample characteristics are presented first, followed by descriptive analyses of predictor and criterion variables, and results of inferential analyses.

4.1 Sample Characteristics

This section includes frequencies of key characteristics of the sample (N=117). Information is reported for persister and non-persister subsamples in valid percentages, the percentages that are calculated from only responders to the survey questions. At the time the survey was administered, the majority of students in both subsamples, over 91%, were 19 years old or younger. There were no responses in the age categories of 40 – 55 and over 55 so these categories are not displayed (see Table 2).

Table 2

Age

Age	Persisters Valid Percent	Non Persisters Valid Percent
19 or younger	91.8	94.7
20 – 23	4.1	5.3
24 – 29	2.7	-
30 or older	1.4	-

STEM persisters were equally male as female (48.3% male and 51.7% female), while STEM non persisters skewed more female (67.9% female compared to 32.1% male). The NSSE survey asks students to report their sex, which has a biological and physical anatomy context. However, this profile was based on institutional data that records students' gender, which has a behavioral, cultural or psychological context like masculine and feminine (Merriam-Webster, 2014). Institutional gender data was used in this study because, unlike the NSSE results on sex, there were no missing cases (see Table 3).

Table 3

Gender

Gender	Persisters Valid Percent	Non Persisters Valid Percent
Male	48.3	32.1
Female	51.7	67.9

Students identifying their race or ethnicity as Black or African American comprised the majority of the sample. Almost 85% of persisters and almost 79% of non-persisters indicated Black or African American as their race or ethnicity. Multiracial identity and Other race categories were equally selected by 4.2 of persisters and 5.3% of non-persisters. There were no responses in the race/ethnicity categories of Asian, Asian American, or Pacific Islander; Mexican or Mexican American; and Puerto Rican so these categories are not displayed (see Table 4).

Table 4

Race or Ethnicity

Race or Ethnicity	Persisters Valid Percent	Non Persisters Valid Percent
Black or African American	84.7	78.9
White	1.4	-
Other Hispanic or Latino	1.4	-
Multiracial	4.2	5.3
Other race	4.2	5.3
Preferred not to respond	4.2	10.5

Students were primarily citizens of the United States (see Table 5).

Table 5

Citizenship

Citizenship	Persisters Valid Percent	Non Persisters Valid Percent
U.S.	93.2	100
International or Foreign	7.0	-

A dormitory or campus housing was the predominant residence for most students at the time they participated in the survey (see Table 6).

Table 6

College Residence

College residence	Persisters Valid Percent	Non Persisters Valid Percent
Dormitory or campus housing	80.9	89.5
Residence w/in walking distance	5.9	-
Residence w/in driving distance	13.2	10.5

Almost half of students' mothers achieved a bachelor's degree or higher. While 39.1% of persisters' mothers completed a bachelor's degree as compared to only 21.1% of non-persisters' mothers, a higher percentage of non-persisters' mothers had advanced degrees (31.6%) than did mothers of persisters (11.5%) as shown in Table 7.

Table 7

Mother's Education

Mother's education	Persisters Valid Percent	Non Persisters Valid Percent
Did not finish high school	7.2	5.3
Graduated from high school	11.6	15.8
Attended college but did not complete degree	18.8	15.8
Completed an associate's degree (A.A., A.S., etc.)	11.6	10.5
Completed a bachelor's degree (B.A., B.S., etc.)	39.1	21.1
Completed a master's degree (M.A., M.S., etc.)	10.1	26.3

Completed a doctoral degree (Ph.D., J.D., M.D., etc.)	1.4	5.3

The level of education of students' fathers was higher among persisters than among non-persisters. Thirty-seven percent (37.3%) of persisters' fathers had bachelor's and advanced degrees compared to 26.3% of non-persisters' fathers. The highest level of education for 47.4% of non-persisters' fathers was high school graduation or less (see Table 8).

Table 8

Father's Education

Father's education	Persisters Valid Percent	Non Persisters Valid Percent
Did not finish high school	9.0	5.3
Graduated from high school	26.9	42.1
Attended college but did not complete degree	19.4	15.8
Completed an associate's degree (A.A., A.S., etc.)	7.5	10.5
Completed a bachelor's degree (B.A., B.S., etc.)	19.4	5.3
Completed a master's degree (M.A., M.S., etc.)	16.4	10.5
Completed a doctoral degree (Ph.D., J.D., M.D., etc.)	1.5	10.5

With the exception of biology, STEM academic majors were recoded as shown in Table 9 to group related majors into categories of STEM disciplines (see Table 9).

Table 9

STEM Major Recodes

Academic Majors	STEM Major Recodes
Architectural engineering	Engineering
Electrical engineering	
Mechanical engineering	
Industrial engineering	
Chemical engineering	
Civil engineering	
Biological engineering	
Computer engineering	
General engineering (interdisciplinary)	
Chemistry	Physical Sciences
Mathematics	
Physics	
Applied mathematics	
Geomatics	
Computer science	Computer Sciences
Electronic technology	
Electrical technology/computer technology	
Electrical technology/information technology	
Laboratory animal science	Agriculture
Animal science (animal industry)	
Animal science	

Almost 71% (70.8%) of persisters and 82.1% of non-persisters majored in engineering or biology. At 46.1%, more persisters majored in engineering than majored in other STEM disciplines. At 50%, more non-persisters majored in biology than majored in other STEM disciplines (see Table 10).

Table 10

STEM Major

STEM major	Persisters Valid Percent	Non Persisters Valid Percent
Engineering	46.1	32.1
Biology	24.7	50.0
Physical sciences	9.0	3.6
Computer sciences	9.0	7.1
Agriculture	11.2	7.1

Approximately 76% of students who intended to major in a STEM discipline persisted in STEM through their fourth year of college, and approximately 24% did not persist in STEM (see Table 11).

Table 11

Stem Persistence

STEM students	N	Percent
Persisters	89	76.07
Non-persisters	28	23.93

In summary, the sample was comprised primarily of traditional college students; they were nineteen years old or younger and resided in campus housing. Most were U.S. citizens who identified their race or ethnicity as Black or African American. Several differences emerged in the profiles of persisters compared to non-persisters. Persisters were equally male and female while non-persisters skewed more female. More persisters majored in engineering than in any other STEM discipline while more non-persisters majored in biology. There were also differences in the levels of education achieved by students' parents. While over half of students' mothers completed a bachelor's degree or higher, more non-persisters' mothers completed master's and doctoral degrees than did persisters' mothers. The level of education of students' fathers was higher among persisters; however, less than 38% of all students' fathers completed a bachelor's or advanced degree.

4.2 Descriptive Analyses of Predictor Variables

Minimums, maximums, means and standard deviations were computed for students' scores on the NSSE engagement benchmark predictor variables. These measures of central tendency were computed for scores by persisters and non-persisters. NSSE benchmark scores are indices of scaled scores, not percentages, and are reported on a range from zero to 100. Therefore, every student would have to choose the lowest response option for every item to result in a benchmark score of zero, and every student would have to choose the highest response option for every item to result in a benchmark score of 100. The mean ratings are the weighted arithmetic averages of student level benchmark scores (NSSE, 2011b).

Persister samples less than 89 students (N<89) and non-persister samples less than 28 students (N<28) indicate instances of missing cases. Missing cases occur when students do not respond on a survey item.

4.2.1 Level of academic challenge (LAC). On a scale of 0 to 100, persisters and non-persisters had similar mean ratings on their levels of academic challenge at 54.35 and 53.11, respectively (see Table 12).

Table 12

Level of Academic Challenge

Level of academic challenge (LAC)	N	Minimum	Maximum	Mean	Std. Deviation
Persisters	79	19.48	88.64	54.3588	14.3135
Non Persisters	21	30.21	81.82	53.1084	14.3301

4.2.2 Active and collaborative learning (ACL). On a scale of 0 to 100, persisters and non-persisters had similar mean ratings on the active and collaborative learning benchmark at 53.73 and 52.85, respectively (see Table 13).

Table 13

Active and Collaborative Learning

Active and collaborative learning (ACL)	N	Minimum	Maximum	Mean	Std. Deviation
Persisters	88	16.67	100.00	53.7320	16.8868
Non Persisters	28	14.29	85.71	52.8486	18.2553

4.2.3 Student-faculty interaction (SFI). On a scale of 0 to 100, persisters and non-persisters had similar mean ratings on student-faculty interaction at 41.18 and 42.17, respectively (see Table 14).

Table 14

Student-Faculty Interaction

Student-faculty interaction (SFI)	N	Minimum	Maximum	Mean	Std. Deviation
Persisters	81	5.56	100.00	41.1797	19.8095
Non Persisters	22	.00	100.00	42.1717	25.6611

4.2.4 Enriching educational experiences (EEE). On a scale of 0 to 100, persisters and non-persisters had similar mean ratings on enriching educational experiences at 25.57 and 30.82, respectively (see Table 15).

Table 15

Enriching Education Experiences

Enriching educational experiences (EEE)	N	Minimum	Maximum	Mean	Std. Deviation
Persisters	78	3.33	95.24	25.5664	13.1485
Non Persisters	18	2.78	92.86	30.8157	20.5139

4.2.5 Supportive campus environment (SCE). On a scale of 0 to 100, persisters and non-persisters had similar mean ratings on the supportive campus environment benchmark at 62.52 and 67.75, respectively (see Table 16).

Table 16

Supportive Campus Environment

Supportive campus environment (SCE)	N	Minimum	Maximum	Mean	Std. Deviation
Persisters	76	5.56	100.00	62.5219	18.4541
Non Persisters	18	36.11	100.00	67.7469	16.6432

Mean ratings from the descriptive analysis of students' responses on the engagement variables appeared to be similar for persisters and non-persisters. This indicates that persisters and non-persisters may not differ in their levels of engagement and that other factors are influencing STEM persistence.

4.3 Inferential Analyses

Inferential statistics were computed to investigate statistical differences in the data that may enable inferences about the relationship between the predictor and criterion variables. This section reports results of t-tests for equality of means, Pearson's correlations, and logistic regression analyses of student engagement variables and STEM persistence.

Sample sizes less than 117 students (N<117) indicate instances of missing cases. Missing cases occur when students do not respond on a survey item.

4.3.1 T-test for equality of means. Mean ratings on student engagement benchmark variables as described in section 4.2 were analyzed to determine whether they were significantly different for persisters compared to non-persisters. None of the Levene's F coefficients were significant so the sample was homogenous. No significant differences in t-values were found at a 95% confidence level indicating that persisters and non-persisters rated student engagement variables the same. All p-values exceeded .05 as shown in Table 17 (see Table 17).This is consistent with findings from the descriptive analysis.

Table 17

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Academic Challenge (unadjusted) – raw, student-level score	Equal variances assumed	.004	.953	-.356	98	.723	-1.25041	3.51500	-8.22581	5.72498
Active AND Collaborative Learning – raw, student-level score	Equal variances assumed	.468	.495	-.236	114	.814	-.88332	3.73646	-8.28522	6.51857
Student-Faculty Interaction - raw, student-level score	Equal variances assumed	3.103	.081	.195	101	.846	.99202	5.08719	-9.09960	11.08363
Enriching Educational Experiences – raw, student-level score	Equal variances assumed	3.585	.061	1.361	94	.177	5.24932	3.85836	-2.41155	12.91019
Supportive Campus Environment – raw, student-level score	Equal variances assumed	.131	.718	1.099	92	.275	5.22498	4.75328	-4.21545	14.66541

4.3.2 Pearson's r. Pearson's correlations were computed to investigate whether there was a statistically significant association between the student engagement benchmarks (predictors) and student persistence (criterion). There was no relationship between the engagement benchmarks and STEM persistence. Significance levels of Pearson's r coefficients were higher than .05 for all correlations ($p>.05$). The correlation matrix is below (see Table 18).

Table 18

Pearson's Correlations of Engagement Variables

		Persisters	Non Persisters
Academic Challenge	Pearson Correlation	.036	-.036
	Sig. (2-tailed)	.723	.723
	N	100	100
Active and Collaborative Learning	Pearson Correlation	.022	-.022
	Sig. (2-tailed)	.814	.814
	N	116	116
Student-Faculty Interaction	Pearson Correlation	-.019	.019
	Sig. (2-tailed)	.846	.846
	N	103	103
Enriching Educational Experiences	Pearson Correlation	-.139	.139
	Sig. (2-tailed)	.177	.177
	N	96	96
Supportive Campus Environment	Pearson Correlation	-.114	.114
	Sig. (2-tailed)	.275	.275
	N	94	94

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

Given differences in the profiles of persisters and non-persisters on academic majors and parents' levels of education, Pearson's correlations were also computed for these variables to determine whether they were significantly associated with student persistence in STEM disciplines. There was a weak negative relationship of majoring in biology and STEM persistence. Correlation coefficients were significant at the 95% confidence level with $r = -.220$ for persisters and $r = .237$ for non-persisters (see Table 19).

Table 19

Pearson's Correlations of STEM Disciplines

		Persisters	Non Persisters
Engineering	Pearson Correlation	.101	-.125
	Sig. (2-tailed)	.278	.178
	N	117	117
Biology	Pearson Correlation	-.220*	.236*
	Sig. (2-tailed)	.017	.010
	N	117	117
Physical Sciences	Pearson Correlation	.090	-.085
	Sig. (2-tailed)	.333	.359
	N	117	117
Computer Sciences	Pearson Correlation	.032	-.027
	Sig. (2-tailed)	.728	.774
	N	117	117
Agriculture	Pearson Correlation	.062	-.056
	Sig. (2-tailed)	.506	.548
	N	117	117

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

There was no relationship between parent's level of education and STEM persistence. Significance levels of Pearson's r coefficients were higher than .05 for all correlations ($p>.05$) (see Table 20).

Table 20

Pearson's Correlations of Parents' Education Level

		Persisters	Non Persisters
Mother's Education Level	Pearson Correlation	.051	-.025
	Sig. (2-tailed)	.580	.787
	N	117	117
Father's Education Level	Pearson Correlation	.108	-.087
	Sig. (2-tailed)	.243	.351
	N	117	117

In summary, the Pearson's correlation analysis resulted in no relationships between the student engagement benchmarks and STEM persistence. Neither were significant relationships found between parents' level of education and STEM persistence, nor between most of the STEM academic disciplines and STEM persistence. The exception was biology where there is a weak negative association of majoring in biology and persisting in STEM.

4.3.3 Logistic regression. Binary logistic regression was conducted to estimate the factors that influence STEM persistence. Binary logistic regression was appropriate because persistence, the dependent variable, is discrete (0, 1). The dependent persistence variable which measures the likelihood that STEM students will remain in STEM disciplines through their fourth year of college is Yes. Yes is equal to 1 if the respondent persists in STEM and 0 otherwise (see Table 21).

Table 21

Dependent Variable Encoding

Original Value	Internal Value
All others	0
Persisters	1

The theory behind the analysis can be summarized by the following conceptual model:

STEM Persistence = f(student engagement; STEM academic majors; parents' education; and students' first year GPA). Academic majors were included in the model because the Pearson's correlations indicated a significant, though weak, association between biology and STEM persistence. Parents' education variables were included in the model because of differences in levels of educational attainment between parents of persisters compared to those of non-persisters. Students' GPA after their first year at the institution was included to see whether academic performance early in a student's college career contributes to predicting STEM persistence. The likelihood of persisting in STEM is expected to be positively related to (1) students' experiences of academic challenge, active and collaborative learning, student-faculty interaction, enriching educational experiences, and supportive campus engagement (student engagement); (2) students' majors in engineering, biology, physical sciences, computer sciences, and agriculture (STEM academic majors); (3) the education levels of students' mothers and fathers (parents' education); and (4) students' academic performance early in their college careers (first year GPA). Coding for categorical variables is presented in Table 22 (see Table 22).

Table 22

Categorical Variables Coding

		Frequency	Parameter coding (1)
Agriculture major	0	94	1.000
	1	17	.000
Biology major	0	79	1.000
	1	32	.000
Physical Sciences major	0	100	1.000
	1	11	.000
Computer Sciences major	0	104	1.000
	1	7	.000
Engineering major	0	67	1.000
	1	44	.000

The logistic regression model was not statistically significant. The model chi-square p-value was .071. This indicates that the model as a whole is not predictive of STEM persistence. There were 12 degrees of freedom for each predictor in the model (see Table 23).

Table 23

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	17.794	12	.071
	Block	17.794	12	.071
	Model	17.794	12	.071

There were 24 cases that were observed to be non-persisters and correctly predicted to be non-persisters; and there were 53 cases observed to be persisters and correctly predicted to be persisters. As a result, the overall percent of cases that were correctly predicted by the logistic regression model was 69.4. This percentage represented an increase from 59.5 for the null model to 69.4 for the full model (see Tables 24 and 25).

Table 24

Classification Table without Predictors

Classification Table[a,b]

			Predicted[d]					
			Selected Cases[c]			Unselected Cases[e]		
			Persisters		Percentage Correct	Persisters		Percentage Correct
	Observed		All Others	Persister		All Others	Persister	
Step 0	Persisters	All Others	0	45	.0	0	0	.
		Persister	0	66	100.0	0	0	.
	Overall Percentage				59.5			.

a. Constant is included in the model.

b. The cut value is .500

c. Selected cases STEM EQ 1

d. There are no unselected cases. Therefore, no unselected cases are classified.

e. Unselected cases STEM NE 1

Table 25

Classification Table with Predictors

Classification Table[a]

			Predicted[c]					
			Selected Cases[b]			Unselected Cases[d]		
			Persisters		Percentage Correct	Persisters		Percentage Correct
	Observed		All Others	Persister		All Others	Persister	
Step 1	Persisters	All Others	24	21	53.3	0	0	.
		Persister	13	53	80.3	0	0	.
	Overall Percentage				69.4			.

a. The cut value is .500

b. Selected cases STEM EQ 1

c. There are no unselected cases. Therefore, no unselected cases are classified.

d. Unselected cases STEM NE 1

Results of the logistic regression model indicate the odds ratio for GPA is 1.8 with a 95% confidence interval suggesting that for each unit increase in GPA a STEM student is 1.8 times more likely to persist, holding all other predictors constant. Odds ratios for active and collaborative learning, enriching educational experiences, and majoring in engineering were 1.036, .968, and .314 respectively with a 90% confidence interval, holding all other predictors constant. However, the direction of the predictive value is positive for active and collaborative learning and negative for enriching educational experiences and engineering. This suggests that for each unit increase in active and collaborative learning, a STEM student is 1.036 times more likely to persist; however, for each unit increase in enriching educational experiences a STEM student is .968 times less likely to persist, and for each unit increase in engineering a STEM student is .314 times less likely to persist. Logistic regression results are presented in Table 26 (see Table 26).

Table 26

Logistic Regression Results

Variables in the Equation		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	AC	-.019	.019	.987	1	.320	.981
	ACL	.035	.021	2.810	1	.094	1.036
	SFI	.007	.017	.177	1	.674	1.007
	EEE	-.032	.019	2.902	1	.088	.968
	SCE	.004	.014	.066	1	.797	1.004
	mothredu	.138	.164	.707	1	.400	1.148
	fathredu	-.084	.149	.319	1	.572	.919
	Engineering(1)	-1.157	.657	3.099	1	.078	.314
	Biology(1)	-.396	.666	.354	1	.552	.673
	PhysSciences(1)	.120	.836	.021	1	.886	1.128
	CompSci(1)	-1.677	1.056	2.520	1	.112	.187
	GPAFirst	.607	.241	6.332	1	.012	1.835
	Constant	.541	2.350	.053	1	.818	1.717

a. Variable(s) entered on step 1: AC, ACL, SFI, EEE, SCE, mothredu, fathredu, Engineering, Biology, PhysSciences, CompSci, GPAFirst.

Logistic regression results indicate that the engagement predictor variables of active and collaborative learning, enriching educational experiences, majoring in engineering and first year GPA are predictive of persistence by STEM students. All variables were predictive at a 90% confidence interval except first year GPA, which was predictive at a 95% confidence interval. For every unit increase in first year GPA and in active and collaborative learning, there is an increase in persistence among STEM students. Conversely, for every unit increase in enriching educational experiences and in majoring in engineering, there is a decrease in persistence among STEM students indicating a negative association. Academic challenge, student-faculty interaction and supportive campus environment were not predictive of persistence in STEM. Neither were the other STEM majors – agriculture, biology, physical sciences, and computer sciences, nor parents’ education.

CHAPTER 5

Discussion

The purpose of this study was to examine the relationship between student engagement and persistence in STEM disciplines at an HBCU located in southeastern United States. The specific aim was to identify student engagement factors that influence decisions by students to persist in their pursuit of a college degree in a STEM major. Although research exists on the topic of student engagement and college persistence in STEM disciplines, there is a void of empirical research that explores the impact of student engagement on persistence among diverse populations of students who are pursuing degrees in STEM fields at HBCUs.

A predictive correlational design and secondary analysis approach was used to examine the relationship between student engagement factors (level of academic challenge, active and collaborative learning, student-faculty interaction, enriching educational experiences, and supportive environment) and persistence in STEM disciplines. Benchmark results for students' responses to questions on the National Survey of Student Engagement and institutional data on students' majors and GPAs were analyzed. The overall research questions that guided this study were: (1) what is the relationship of student engagement factors (predictor variables) and student persistence (criterion variable) in STEM majors, and (2) what are the influential student engagement factors that predict STEM persistence?

5.1 Alignment of Results with Research Hypotheses associated with Research Question 1

H1: There will be a difference in LAC between persisters and non-persisters.

H2: There will be a difference in ACL between persisters and non-persisters.

H3: There will be a difference in SFI between persisters and non-persisters.

H4: There will be a difference in SCE between persisters and non-persisters.

H5: There will be a difference in EEE between persisters and non-persisters.

The hypotheses are rejected because no differences were found in student engagement between persisters and non-persisters in level of academic challenge (LAC), active and collaborative learning (ACL), student-faculty interaction (SFI), supportive campus environment (SCE) and enriching educational experiences (EEE). Several factors may be contributing to the lack of differences between persisters and non-persisters. First, students at HBCUs who select majors in STEM disciplines, whether they persist or not, may be more similar than different in how they engage with the college environment. Work done by the Business Higher Education Forum found that students who pursue STEM majors differ from other students because STEM students have the required academic competencies as well as an interest in a STEM career. This coupling of proficiency and interest is important because competency alone is not enough to motivate pursuit and persistence in STEM (Carnevale et al., 2011).

This homogeneity of persisters and non-persisters was also seen in the profile of the key characteristics of the sample. Persisters and non-persisters were similar in age, race or ethnicity, citizenship, college residence and mothers' education levels. Similarities in age, citizenship, and race or ethnicity were not surprising since they mirror the composition of undergraduate students at the HBCU where the study was conducted. However, persisters and non-persisters differed slightly in fathers' levels of education, and differed markedly in gender, where persisters were equally male as female but where non-persisters skewed more female. They also differed in major choice where more persisters majored in engineering and more non-persisters majored in biology than in any other STEM disciplines. The difference in major choice may reflect the sociological impact of sex on STEM academic and career aspirations. Since publication of the 1975 report entitled "The Double Bind: The Price of Being a Minority

Woman in Science" (Malcom, Hall, & Brown, 1976) students' intentions to major in science and engineering are still impacted by sex differences that favor underrepresented minority (URM) males over females (Malcom & Malcom, 2011). In addition, intention to major in engineering is less likely to be declared by URM women than their intention to declare majors in life sciences [such as biology], and social, or behavioral sciences (Malcom & Malcom, 2011). Although these findings specifically address underrepresented women in STEM, sex differences also impact the persistence of majority women pursuing STEM degrees. The odds of women persisting in STEM majors are less than for men, the proportion of women obtaining graduate STEM degrees is less than for men, and women are less likely to move into STEM occupations (Carnevale et al., 2011). The literature indicates that these trends are underpinned by societal influences regarding the roles of women, that these influences begin early in childhood, and that the effects of this socialization start to manifest in middle school girls (Carnevale et al., 2011). The profile skew of non-persisters as predominantly female may also reflect a lack of female teachers in STEM at the institution where this study was conducted. College student persistence in STEM is lower for women, compared to men, due to a lack of gender and racial role models in STEM departments (Griffith, 2010), and a lack of faculty diversity in such STEM fields as computer science and engineering (Malcom & Malcom, 2011).

Second, differences in major choice may help explain differences in engagement and persistence by academic disciplines. While results of this study showed a weak negative relationship in majoring in biology and STEM persistence, this research did not examine correlations of STEM majors and engagement variables. Related research has indicated differences regarding engineering students. A study on persistence and engagement by undergraduate engineering students found that they were more persistent than other college students but equally engaged (Ohland et al., 2008). However, the study did not test whether persistence and engagement were similarly related across engineering students and non-engineering majors. Therefore, an examination of the relationship of engagement variables by STEM disciplines may illuminate findings.

5.2 Alignment of Results with Research Question 2

Engagement variables of active and collaborative learning, enriching educational experiences, majoring in engineering and first year GPA are predictive of persistence by STEM students. However, the direction of the predictive values is positive for active and collaborative learning and first year GPA, and negative for enriching educational experiences and engineering. Academic challenge, student-faculty interaction and supportive campus environment were not predictive of persistence in STEM. Neither were the other STEM majors – agriculture, biology, physical sciences, and computer sciences, nor parents' education.

The significance of active and collaborative learning may reflect practices at the HBCU where this study was conducted that promote student engagement in collaborative, learner-centered activities. However, the absence of level of academic challenge, student-faculty interaction and supportive campus environment as significant predictors is puzzling. In the case of level of academic challenge, although not significant, results of the logistic regression model indicate a negative association with persistence. This may be related to the NSSE instrument. The level of academic challenge benchmark, which is comprised of survey questions that emphasize book assignments, written papers and reports, and analysis of theories, may capture engagement in coursework that better suits the humanities and arts than the STEM disciplines. This is consistent with the premise by Brint et al. (2008) that there are different cultures of engagement depending on undergraduate students' majors. They found that the culture of academic engagement in the natural sciences and engineering emphasized improvement of quantitative skills through collaborative study and was different from the academic engagement culture in the arts, humanities and social sciences which emphasized interaction, participation and interest in ideas. Rigid cultures and structures that characterize science, engineering, and other math-intensive STEM fields contribute to department and discipline-specific barriers that minority women face in pursuing STEM degrees (Malcom & Malcom, 2011).

The predictive but negative association of enriching educational experiences to STEM persistence was likely driven by the large representation of engineering majors in the study's sample (42.7%). As noted previously, majoring in engineering was predictive but negatively associated with STEM persistence. This may relate to students' having less time to spend on activities that the NSSE uses to gauge enriching educational experiences. Lichtenstein et al. (2010) found engineering persisters, compared to non-persisters and migrators, to be less engaged in enriching educational experiences such as 'participating in independent study/self-designed majors and foreign language coursework' which they concluded was due to the higher class preparation time required by the engineering curriculum.

The significance of first year GPA as a predictor of STEM persistence is consistent with past research that has shown strong relations of academic performance and college persistence. Amanda Griffith (2010) found that the academic performance of students in STEM field majors in their first two years of college significantly impacts their decisions to persist. An increase in the ratio of GPA in STEM courses to GPA in all courses positively impacts the probability of students' persisting in STEM to sophomore year (Griffith, 2010). Other research supports the importance of student academic performance to persistence (St. John, Hu, Simmons Carter &

Weber, 2004) and further, that first year academic performance [as indicated by GPA] predicts whether a student will persist in their entering major (Allen & Robbins, 2008).

The absence of student faculty interaction and supportive campus environment as predictors of STEM persistence was surprising. Based on the literature review, both of these engagement variables were seen as key differentiators of the HBCU environment compared to other types of institutions, particularly compared to PWIs. HBCUs were found to provide environments that are more supportive, caring and nurturing (Perna et al., 2009); that address the sociological and psychological needs of students (Palmer, Davis, & Thompson, 2010); and that have faculty who serve as African American role models which is particularly impactful on the STEM persistence of males (Jett, 2011; Toldson, 2013). The race and ethnicity of STEM faculty at this institution was not considered in this study but may be a factor in understanding why student faculty interaction and supportive campus environment were not predictive. In addition, the NSSE survey does not differentiate engagement in courses taught in a classroom or laboratory setting versus an on-line environment which can potentially impact student faculty interaction.

Finally, this study does not consider the impact of engagement predispositions that students bring with them to their college experiences. An article on the effectiveness of NSSE benchmarks in predicting education outcomes notes that distinguishing the added value of engagement on college outcomes may be difficult without a precollege measure of students' propensities to report learning gains. This suggests that engagement may be affected by the degree to which individual students are receptive to college educational experiences (Pascarella, Seifert & Blaich, 2010).

5.3 Implications for Practice, Policy and Research

HBCUs continue to be a critical pathway to STEM degrees for African American students. Understanding the impact of student engagement on factors that indicate institutional effectiveness of undergraduate education, such as STEM persistence, is an important goal in higher education. Since engagement policies and practices can more easily be changed by the institution than can resources and academic selectivity (Pascarella, Seifert & Blaich, 2010), studies such as this one can be impactful. Accordingly, there are several implications of this study for practice, policy and research.

Regarding practice, active and collaborative learning activities should be infused in STEM teaching practices because they are positively associated with STEM persistence among students where this study was conducted. Active and collaborative learning activities may be especially impactful in transforming college engagement experiences in STEM disciplines where the culture is characterized as more rigid and structured, versus other disciplines, and where the culture presents barriers to student persistence.

STEM engagement interventions must be implemented very early in the STEM education pipeline. Early exposure to STEM education and career pathways is particularly needed for female students to counteract early socialization that leads to the gendered nature of choices in STEM majors and occupations.

Empirical studies can contribute to an institution's return on investment in data driven tools like the NSSE. This study is an example of how empirical examination and parsing of results from national surveys subscribed to by the institution can be used to advance knowledge that can impact institutional effectiveness and issues of critical importance to the institution and to the nation.

There are also implications of this study for policy. Given the continuing and disproportional importance of HBCUs in producing underrepresented STEM graduates to support a pipeline of STEM workers, policy makers should advocate for support of STEM related research and initiatives at these institutions. Outcomes of research studies that guide the development of strategic practices related to national priorities should be leveraged to attract public and private sector resources for research and academic programs to advance those priorities.

This study is important to the design of future empirical research that informs educational leaders, policy makers, and businesses concerned with addressing the national challenge of growing the supply of America's STEM workforce. There are several recommendations for further research that examines the impact of student engagement on STEM persistence at HBCUs. Among them are changes in sample selection, expansion of the study to include other HBCUs, and changes in the survey items that are selected for examination.

Since this study examined institutional benchmark results of the NSSE administered to first year full-time students seeking bachelor's degrees, results are primarily based on students' engagement intentions rather than on students' actual behaviors. It is recommended that the study be replicated based on results of the NSSE administered to senior year full-time students. This would enable analysis of students' responses based on their actual experiences and behaviors during their college years which may prove to be stronger indicators than intentions.

Predicting persistence may require inclusion of factors other than engagement as examined using the NSSE benchmark variables, or from the interaction of engagement and other influential factors that were not included in the regression model. Results support this implication in that an expansion of predictor variables in the logistic regression to include academic majors, parents' education and first year GPA slightly increased the model's predictive value although these variables did not independently correlate with STEM persistence. Given the gendered nature of STEM disciplines at HBCUs and elsewhere, it is recommended that sex be added as a variable in examining the relationship of student engagement and STEM persistence.

It is also recommended that additional HBCUs with similar characteristics to those of the institution where this study was located, e.g. size of enrollment, public vs. private, STEM focused, etc., be added to the study. This would provide a larger sample of students from which to draw persister and non-persister subsamples and would expand the study's scope and generalizability.

Each of the 2008 and 2011 NSSE instruments used in this study consisted of 100 items with Likert-type response options. Since the NSSE benchmarks are broad measures constructed from survey results of student responses to 42 key survey questions, disaggregation of variables to select particular items within the benchmarks, and/or inclusion of responses on additional survey items may result in more robust and differentiating findings. An example would be inclusion of different survey items to assess level of academic challenge since differences in academic cultures, science and engineering versus arts and humanities, may have impacted results of this study.

Results from this quantitative study may also be used to help inform development of questions for a qualitative study. Semi-structured interviews with persisters and non-persisters may provide a richer understanding of the relationship between student engagement and STEM persistence. In summary, this study which analyzed NSSE benchmark results to inform strategic decisions to grow STEM persistence, can serve as a platform for the development of more robust models of scientific inquiry regarding the impact of student engagement.

5.4 Conclusion

This look at the relationship of student engagement and persistence in STEM disciplines at an HBCU indicates that certain elements of student engagement are predictive of persistence, and has led to several implications for practice, policy, and research. Active and collaborative learning activities should be infused in STEM teaching practices, and STEM engagement interventions should be implemented very early in the K-12 pipeline. Resources to support STEM-related research and initiatives at HBCUs are justified, and advocacy for these resources is warranted. Future empirical research that builds on this study has the potential to improve our understanding of how student engagement impacts STEM persistence.

This study also impacted me as a leader in research administration, and can be impactful to faculty and administrative leaders at the HBCU where I am employed. It has raised my awareness of the importance of student engagement to STEM persistence and the need for all leaders in higher education to “own” this issue and to be mindful of how we can impact persistence in our different roles at the institution. To that end, I can be more conscientious in helping faculty prepare grant proposals to secure funding that supports the development and improvement of STEM initiatives. In addition, I can disseminate knowledge from this study by exploiting opportunities to share information with my campus community and in relevant external forums.

President Barack Obama has articulated a vision and mission for America to strengthen the STEM education and workforce pipeline. In launching the “Educate to Innovate” campaign in 2009, he said:

> Reaffirming and strengthening America's role as the world's engine of scientific discovery and technological innovation is essential to meeting the challenges of this century. That's why I am committed to making the improvement of STEM education over the next decade a national priority (The White House, Office of the Press Secretary, 2009, p. 1).

Arguably, HBCUs have an important role in the fulfillment of this mission. The challenge to effect change by improving and increasing the engagement of STEM students at these institutions offers significant opportunities to research, educate, develop, improve, and implement successful engagement programs.

References

Allen, J., Robbins, S. B. (2008). Prediction of college major persistence based on vocational interests, academic preparation, and first-year academic performance. *Research in Higher Education, 49*, 62-67. doi:10.1007/s11162-007-9064-5

Ashby, C. M. (2006). Higher-education: science, technology, engineering, and mathematics trends and the role of federal programs. United States Government Accountability Office Retrieved from http://www.gao.gov/new.items/d06702t.pdf

Astin, A. W. (1984). Student involvement: A developmental theory for higher education. *Journal of College Student Personnel, 25*(4), 897-307.

Axelson, R. D., Flick, A. (2011). Defining student engagement. *Change, 43*(1), 38.doi: 10.1080/00091383.2011.533096

Beasley, R. L. (Ed.). (2013, May 14). HBCUs--the best producers of Black graduates in STEM [Web notes post]. Retrieved from http://hbcu-levers.blogspot.com/2013/05/hbcus-best-producers-of-black-graduates.html

Berry, L. (1991). *Collaborative learning: A program for improving the retention of minority students*. Retrieved from ERIC database. (ED384323)

Boslaugh, S. (2007). *Secondary data sources for public health: A practical guide.* United Kingdom: Cambridge University Press.

Brint, S., Cantwell, A. M., & Hanneman, R. A. (2008). The two cultures of undergraduate academic engagement. *Research in Higher Education, 49*, 383-402. doi:10.1007/s11162-008-9090-y

Brown, C. M., & Dancy, E. T. (2010). Predominantly White institutions. *Encyclopedia of African American Education*. Thousand Oaks, CA: SAGE Publications, Inc. doi: 10.4135/9781412971966

Brown, R., Morning, C., & Watkins, C. (2005). Influence of African American engineering student perceptions of campus climate on graduate rates. *Journal of Engineering Education, 94*(2), 263-271.

Brownell, J. E., & Swaner, L. E. (2009). High-impact practices: Applying the learning outcomes literature to the development of successful campus programs. *Association of American Colleges &Universities Peer Review, 11*(2), 26-30.

Campbell, C. M., & Cabrera, A. F. (2011). How sound is NSSE?: Investigating the psychometric properties of NSSE at a public, research-extensive institution. *The Review of Higher Education. 35*(1), 77-103.

Carnevale, A. P., Smith, N., & Melton, M. (2011). *STEM: Science, technology, engineering, mathematics*. Washington, DC: Georgetown University Center on Education and the Workforce.

Chen, H., Lattuca, L. R., & Hamilton, E. R. (2008). Conceptualizing engagement: Contributions of faculty to student engagement in engineering. *Journal of Engineering Education, 97*(3), 339-353. Retrieved from http://search.proquest.com/docview/217952249?accountid=12711

Chen, S. (2009). Students who study science, technology, engineering and mathematics (STEM) in postsecondary education. *Stats in Brief, NCES 2009-161*. Retrieved from http://nces.ed.gov/pubs2009/2009161.pdf

Chen, X. (2013). STEM attrition: College students' paths into and out of STEM fields. *NCES 2014-001.* National Center for Education Statistics, Institute of Education Sciences U.S. Department of Education. Washington, DC.

Chickering, A. W., & Gamson, Z. F. (1987). Seven principles for good practice in undergraduate education. *AAHE Bulletin, 39*(7), 3-7.

Cole, D. (2008). Constructive criticism: The role of student-faculty interactions on African American and Hispanic students' educational gains. *Journal of College Development, 49*(6), 587-605. Doi: 10.1353/csd.0.0040

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches* (3rd ed.). Thousand Oaks, CA: SAGE Publications.

Creswell, J. W. (2012). *Educational research: Planning, conducting, evaluating quantitative and qualitative research*. Boston, MA: Pearson.

Diseth, A., Pallensen, S., Brunborg, G. S., & Larsen, S. (2010). Academic achievement among first semester undergraduate psychology students: The role of course experience, effort, motives and learning strategies. *Higher Education, 59*(3), 335-352. Doi 10.1007/s10734-009-9251-8

Eagan, M. K., Sharkness, J., Hurtado, S., Mosqueda, C. M., & Chang, M. J. (2011). Engaging undergraduates in science research: Not just about faculty willingness. *Research in Higher Education, 52*, 151-177. doi:10.1007/s11162-010-9189-9.

Ejiwale, J. A. (2012). Facilitating teaching and learning across STEM fields. *Journal of STEM Education: Innovations and Research, 13*(3), 87-94. Retrieved from http://search.proquest.com/docview/1015211575?accountid=12711

Ellington, R. M., & Frederick, R. (2010). Black high achieving undergraduate mathematics majors discuss success and persistence in mathematics. *Negro Educational Review, 61*(1-4), 61-84.

Espinosa, L. (2011). Pipelines and pathways: Women of color in undergraduate STEM majors and the college experiences that contribute to persistence. *Harvard Educational Review, 81*(2), 209-240,388. Retrieved from http://search.proquest.com/docview/874155315?accountid=12711

Fiegener, M.K., & Proudfoot, S. L. (2013). Baccalaureate origins of U.S.-trained S&E doctorate recipients. *InfoBrief, NSF 13-323.*

Fredericksen, E., (1998). Minority students and the learning community experience: A cluster experiment. Retrieved from ERIC database. (ED423533)

Freeman, K. E., Alston, S. T., & Winborne, D. G. (2008). Do learning communities enhance the quality of students' learning and motivation in STEM? *The Journal of Negro Education*, *77*(3), 227-240. Retrieved from http://search.proquest.com/docview/222068511?accountid=12711

Flowers, L. A. (2004). Examining the effects of student involvement on African American college student development. *Journal of College Student Development, 45*(6), 633-654. doi:10.1353/csd.2004.0067

Frehill, L. M., Fabio, N. M. D., & Hill, S. T. (2008). Confronting the "new" American dilemma. NACME. Retrieved from http://www.nacme.org/user/docs/NACME%2008%20ResearchReport.pdf

Gasiewski, J., Eagan, M., Garcia, G., Hurtado, S., & Chang, M. (2012) From gatekeeping to engagement: A multicontextual, mixed method study of student academic engagement in introductory STEM courses. *Research in Higher Education, 53*(2), 229-261. doi:10.1007/s11162-011-9247-y

Golafshani, N. (2003). Understanding reliability and validity in qualitative research. *The Qualitative Report, 8*(4), 10.

Griffith, A. L. (2010). Persistence of women and minorities in STEM field majors: Is it the school that matters. *Economics of Education Review, 29*, 911-922. doi: 10.1016/j.econedurev.2010.06.010

Higher Education Research Institute. (2010). Degrees of success: Bachelor's degree completion rates among initial STEM majors. *Research Brief* (January 2010). Los Angeles, CA: UCLA. Retrieved from http://www.heri.ucla.edu/nih/downloads/2010%20-%20Hurtado,%20Eagan,%20Chang%20-%20Degrees%20of%20Success.pdf

Hu, S., Scheuch, K., Schwartz, R., Gayles, J. G., & Li, S. (Eds.) (2008). Impact of student engagement in research and creative activities. *ASHE Higher Education Report*, *33*(4), 33-43. doi:10.1002/aehe.3304

Hurtado, S., Eagan, M. K., Tran, M. C., Newman, C. B., Chang, M. J., & Velasco, P. (2011). “We do science here”: Underrepresented students’ interactions with faculty in different college contexts. *Journal of Social Issues, 67*(3), 553-579. doi:10.1111/j.1540-4560. 2011.01714.x

Institute for Higher Education Policy. (2012, January). *The role of minority-serving institutions in national college completion* (Issue Brief). Washington, DC: Harmon.

Jett, C. C. (2011). HBCUs propel African American male mathematics majors. *Journal of African American Studies, 17*, 189-205.

Kiecolt, K. J., & Nathan, L. E. (1985). *Secondary analysis of survey data.* Newberry Park, CA: SAGE Publications.

Kim, K., Sharma, P., Land S. M., & Furlong, K. P. (2013). Effects of active learning on enhancing student critical thinking in an undergraduate general science course. *Innovative Higher Education,* 38(3), 223-235. doi:http://dx.doi.org/10.1007/s10755-012-9236-x

Kuh, G. D. (2009). The national survey of student engagement: Conceptual and empirical foundations. *New Directions for Institutional Research 141*(Spring 2009). doi: 10.1002/ir.283

Laird, T. F. N., Bridges, B. K., Morelon-Quainoo, C. L., Williams, J. M., & Holmes, M. S. (2007). African American and Hispanic student engagement at minority serving and predominantly White institutions. *Journal of College Student Development, 48*(1), 39-56. doi: 10.1353/csd.2007.0005

Laird, T. F. N., Sullivan, D. F., Zimmerman, C., & McCormick, A. C. (2011). STEM/non-STEM differences in engagement at US institutions. *Peer Review*, *13*(3), 23-26.

Leech, N.L., Barrett, K.C., & Morgan, G.A. (2011). *IBM SPSS for intermediate statistics use and interpretation* (4th ed.). New York, NY: Routledge Taylor & Francis Group.

Lichtenstein, G., McCormick, A. C., Sheppard, S. D., & Puma, J. (2010). Comparing the undergraduate experience of engineers to all other majors: Significant differences are programmatic. *Journal of Engineering Education, 99*(4), 305–317. doi:10.1002/j.2168-9830.2010.tb01065.x

Lundy-Wagner, V. (2013). Is it really a man’s world? Black men in science, technology, engineering, and mathematics at historically Black colleges and universities. *The Journal* *of Negro Education*, *82*(2), 157-168.

Malcom, S. M., Hall, P. Q., & Brown, J. W. (1976). The double bind: The price of being a minority woman in science. Washington, DC: American Association for the Advancement of Science.

Malcom, L., & Malcom, S. (2011). The double bind: The next generation. *Harvard Educational Review*, *81*(2), 162-171.

Mendez, G., Burdick, T. D. B., Lohr, S., & Haag, S. (2008). Factors associated with persistence In science and engineering majors: An exploratory study using classification trees and random forests. *Journal of Engineering Education, 97*(1), 57-70. Retrieved from http://search.proquest.com/docview/217963118?accountid=12711

Merisotis, J. P., & McCarthy, K. (2005). Retention and student success at minority-serving institutions. *New Directions for Institutional Research, 2005*(125), 45-58. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=aph&AN= 16620869&site=ehost-live

Merriam-Webster. (2014). *Dictionary.* Retrieved from http://www.merriam-webster.com/dictionary

Museus, S. D., Nichols, A. H., & Lambert, A. D. (2008). Racial differences in the effects of campus racial climate on degree completion: A structural equation model. *The Review of Higher Education 32*(1), 107-134.

Museus, S. D., Palmer, R. T., Davis, R. J., & Maramba, D. C. (2011). *Special issue: Racial and and ethnic minority students' success in STEM education* (36). Association for the Study of Higher Education. Retrieved from http://0-onlinelibrary.wiley.com.sheba.ncat.edu /doi/10.1002/aehe.v36.6/issuetoc

National Action Council for Minorities in Engineering. (2013). Engineering degrees in the United States. *Research & Policy 3*(2). Retrieved from http://www.nacme.org/user/docs/EngineeringDegreesUS.pdf

National Research Council. (2007). *Rising above the gathering storm: Energizing and employing America for a brighter economic future*. Washington, DC: The National Academies Press.

National Research Council. (2011). *Expanding underrepresented minority participation: America's science and technology talent at the crossroads*. Washington, DC: The National Academies Press.

National Science Board. (2010). Preparing the next generation of STEM innovators: Identifying and developing our nation's human capital. *NSB-10-33*. Washington, D.C.: National Science Foundation.

National Science Board. (2014). *Science and Engineering Indicators 2014*. Arlington VA: National Science Foundation (NSB 14-01). Retrieved from http://www.nsf.gov/statistics/seind14/content/chapter-2/chapter-2.pdf

National Science Foundation, National Center for Science and Engineering Statistics. (2013a). S*pecial tabulations of the Survey of Earned Doctorates, 2007–11*. Retrieved from http://www.nsf.gov/statistics/seind14/index.cfm/chapter-2/tt02-03.htm

National Science Foundation, National Center for Science and Engineering Statistics. (2013b). *Women, Minorities, and Persons with Disabilities in Science and Engineering: 2013,* Special Report NSF 13-304. NSF, 2013. Retrieved from http://www.nsf.gov/statistics/wmpd/2013/pdf/nsf13304_full.pdf

National Survey of Student Engagement. (2008). *Promoting engagement for all students: The* *imperative to look within—2008 Results.* Bloomington, IN: Indiana University Center for Postsecondary Research.

National Survey of Student Engagement. (2008a). *Reliability 2008 internal consistency*. Retrieved from http://nsse.iub.edu/pdf/psychometric_portfolio/Reliability_ Intercorrelation_2008.pdf

National Survey of Student Engagement. (2008b). *Institutional report for North Carolina A&T State University 2008.* Bloomington, IN: Indiana University Center for Postsecondary Research.

National Survey of Student Engagement. (2011). *Fostering student engagement campuswide—annual results 2011*. Bloomington, IN: Indiana University Center for Postsecondary Research.

National Survey of Student Engagement. (2011a). *Reliability 2011 internal consistency*. Retrieved from http://nsse.iub.edu/pdf/psychometric_portfolio/Reliability_Internal Consistency_2011_Intercorrelations.pdf

National Survey of Student Engagement. (2011b). *Institutional report for North Carolina A&T State University 2011.* Bloomington, IN: Indiana University Center for Postsecondary Research.

National Survey of Student Engagement. (2013). *About NSSE.* Retrieved from http://nsse.iub.edu/html/about.cfm

National Survey of Student Engagement. (2014). *Benchmarks of effective educational practice*. Retrieved from http://nsse.iub.edu/pdf/nsse_benchmarks.pdf

National Survey of Student Engagement. (2014a). *Survey instruments*. Retrieved from http://nsse.iub.edu/html/survey_instruments.cfm

OECD Global Science Forum. (2013). New data for understanding the human condition: international perspectives. Retrieved from http://www.oecd.org/sti/sci-tech/new-data-for-understanding-the-human-condition.htm

Ohland, M. W., Brawner, C. E., Camacho, M., Layton, R. A., Long, R., Lord, S. M., & Wasburn, M. H. (2011). Race, gender, and measures of success in engineering education. *Journal of Engineering Education, 100*(2), 225-252. Retrieved from http://search.proquest.com/docview/873571305?accountid=12711

Ohland, M. W., Sheppard, S. D., Lichtenstein, G., Eris, O., Chachra, D., & Layton, R. A. (2008). Persistence, engagement, and migration in engineering programs. *Journal of Engineering Education, 97*(3), 259-278.

O'Leary, Z. (2004). *The essential guide to doing research.* Thousand Oaks, CA: SAGE Publications.

Pace, C. R. (1980). Measuring the quality of student effort. *Current Issues in Higher Education, 2*, 10-16.

Palmer, R. T., Davis, R. J., & Thompson, T. (2010). Theory meets practice: HBCU initiatives that promote academic success among African Americans in STEM. *Journal of College Student Development, 51*(4), 440-443.

Palmer, R.T., Maramba, D.C., & Dancy, T.E. (2011). A qualitative investigation of factors promoting the retention and persistence of students of color in STEM. *The Journal of Negro Education, 80*(4), 491-505.

Pascarella, E. T., Seifert, T. A., & Blaich, C. (2010). How effective are the NSSE benchmarks in predicting important educational outcomes? Retrieved from http://www.changemag.org/Archives/Back%20Issues/January-February%202010/full-how-effective.html

Pascarella, E. T., & Terenzini, P. T. (1991). *How college affects students: Findings and insights from twenty years of research*. San Francisco, CA: Jossey-Bass.

Perna, L., Lundy-Wagner, V., Drezner, N., Gasman, M., Yoon, S., Bose, E., & Gary, S. (2009). The contribution of HBCUs to the preparation of African American women for STEM careers: A case study. *Research in Higher Education, 50*(1), 1-3. doi: 10.1007/s11162-008-9110-y

Prince, M. (2004). Does active learning work? A review of the research. *Journal Of Engineering Education, 93*(3), 223-231.

Reason, R. D. (2009). An examination of persistence research through the lens of a comprehensive conceptual framework. *Journal of College Student Development, 50*(6), 659-682.

Reeder, M. C., & Schmitt, N. (2013). Motivational and judgment predictors of African American Academic achievement at PWIs and HBCUs. *Journal of College Student Development, 54*(1), 29-42. Retrieved from http://search.proquest.com/docview/1323045218?accountid=12711

Schultz, W. P., Hernandez, P. R., Woodcock, A., Estrada, M., Chance, R. C., Aguilar, M., & Serpe, R. T. (2011). Patching the pipeline: Reducing educational disparities in the sciences through minority training programs. *Education Evaluation and Policy Analysis, 33*(1), 95-114.

Singer, S.R. (2011). STEM education: Time for integration. *AAC&U Peer Review*, Summer 2011, 4-7.

Schreiner, L. A., Noel, P., Anderson, E., & Cantwell, L. (2011). The impact of faculty and staff on high-risk college student persistence. *Journal of College Student Development, 52*(3), 321-338. Retrieved from http://search.proquest.com/docview/873114106?accountid=12711

Snyder, T. D., & Dillow, S.A. (2012). Digest of education statistics 2011 (NCES 2012-001). National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education. Washington, DC.

Soldner, M., Rowan-Kenyon, H., Inkelas, K. K., Garvey J., & Robbins, C. (2012). Supporting students' intentions to persist in STEM disciplines: The role of living-learning programs among other social-cognitive actors. *The Journal of Higher Education 83*(3), 311-336.

Southern Education Foundation. (2005). *Igniting potential: Historically Black Colleges and Universities and science, technology, engineering and mathematics*. Retrieved from http://www.southerneducation.org/getattachment/e12aa0f8-bcea-450f-af5e-7cfb2e7fdfcf/Igniting-Potential-Historically-Black-Colleges-and.aspx

St. John, E. P., Hu, S., Simmons, A., Carter, D. F., & Weber, J. (2004). What difference does a major make? The influence of college major field on persistence by African American and White students. *Research in Higher Education, 45*(3), 209-232.

Stage, F., & Kinzie, J. (2009). Reform in undergraduate science, technology, engineering, and mathematics: The classroom context. *The Journal of General Education*, *58*(2), 85-105. doi: 10.1353/jge.0.0038

Stine, D. D., & Matthews, C. M. (2009). The U.S. Science and Technology Workforce (RL34539). Congressional Research Reports for the People. Retrieved from http://assets.opencrs.com/rpts/RL34539_20090630

Strage, A. (2007). E is for effort: Correlates of college students' differential effort expenditure across academic contexts. *College Student Journal, 41*(4), 1225-1230.

Strayhorn, T., & DeVita, J. (2010). African American males' student engagement: A comparison of good practices by institutional type. *Journal of African American Studies, 14*, 87-105. doi 10.1007/s12111-009-9110-9

Strayhorn, T., Long, L. L., Kitchen, J. A., Williams, M. S., & Stentz, M. (June, 2013). *Academic and social barriers to Black and Latino male collegians' success in engineering and related STEM fields.* Paper presented at the American Society for Engineering Education Annual Conference and Exposition, Atlanta, Georgia.

The White House, Office of the Press Secretary. (2009). President Obama launches "Educate to Innovate" campaign for excellence in science, technology, engineering & math (Stem) education [Press release]. Retrieved from https://www.whitehouse.gov/the-press-office/president-obama-launches-educate-innovate-campaign-excellence-science-technology-en

Thiry, H., Laursen, S. L., & Hunter, A. (2011). What experiences help students become scientists?: A comparative study of research and other sources of personal and professional gains for STEM undergraduates. *The Journal of Higher Education, 82*(4), 357-388.

Thomas, M. R. (2003). *Blending qualitative & quantitative research methods in theses and dissertations.* Thousand Oaks, CA: Corwin Press.

Toldson, I. A. (2013). Historically black colleges and universities can promote leadership and excellence in STEM (editor's commentary). *The Journal of Negro Education, 82*(4), 359-367. Retrieved from http://search.proquest.com/docview/1498933425?accountid=12711

Toldson, I. A., & Esters, L. L. (2012). *The quest for excellence: Supporting the academic success of minority males in science, technology, engineering, and mathematics (STEM) disciplines.* Association of Public Land-Grant Universities. Retrieved from https://www.aplu.org/document.doc?id=3680.

Tsui, L. (2007) Effective strategies to increase diversity in STEM fields: A review of the research literature. *The Journal of Negro Education, 76*(4), 555-581.

Vogt, W. P. (1999). *Dictionary of statistics & methodology: A nontechnical guide for the social sciences (2nd ed.).* Thousand Oaks, CA: SAGE Publications.

Wiggins, G. P., & McTighe, J. (1998). *Understanding by design.* Alexandria, VA: Association for Supervision and Curriculum Development. Retrieved from http://library.ncat.edu/search~S2?/.b1771648/.b1771648/1,1,1,B/l856~b1771648&FF=&1,0,,1,0

Wolf-Wendel, Ward, K., & Kinzie, J. (2009). A tangled web of terms: The overlap and unique contribution of involvement, engagement, and integration to understanding college student success. *Journal of College Student Development*, *50*(4), 407-428.

Wolniak, G. C., Mayhew, M. J., & Engberg, M. E. (2012). Learning's *Weak* Link to Persistence. *The Journal of Higher Education, 83*(6), 795-823.

Wyatt, G., Saunders, D., & Zelmer, D. (2005). Academic preparation, effort and success: A comparison of student and faculty perceptions. *Educational Research Quarterly, 29*(2), 29-36.

Appendix A

Frequencies of STEM Students

Age Category

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	19 or younger	108	67.9	89.3	89.3
	20-23	5	3.1	4.1	93.4
	24-29	4	2.5	3.3	96.7
	30-39	3	1.9	2.5	99.2
	40-55	1	.6	.8	100.0
	Total	121	76.1	100.0	
Missing	System	38	23.9		
Total		159	100.0		

Student reported: Your sex

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	50	31.4	41.7	41.7
	Female	70	44.0	58.3	100.0
	Total	120	75.5	100.0	
Missing	System	39	24.5		
Total		159	100.0		

What is your racial or ethnic identification? (Select only one.)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Black or African American	96	60.4	80.0	80.0
	White (non-Hispanic)	7	4.4	5.8	85.8
	Other Hispanic or Latino	1	.6	.8	86.7
	Multiracial	6	3.8	5.0	91.7
	Other	4	2.5	3.3	95.0
	I prefer not to respond	6	3.8	5.0	100.0
	Total	120	75.5	100.0	
Missing	System	39	24.5		
Total		159	100.0		

Appendix A

Cont.

Which of the following best describes where you are living now while attending college (university)?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Dormitory or other campus housing (not fraternity/sorority house)	93	58.5	79.5	79.5
	Residence (house, apartment, etc.) within WALKING DISTANCE of the institution	5	3.1	4.3	83.8
	Residence (house, apartment, etc.) within DRIVING DISTANCE of the institution	15	9.4	12.8	96.6
	None of the above	4	2.5	3.4	100.0
	Total	117	73.6	100.0	
Missing	System	42	26.4		
Total		159	100.0		

What is the highest level of education that your MOTHER completed?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Did not finish high school	7	4.4	6.0	6.0
	Graduated from high school	22	13.8	19.0	25.0
	Attended college but did not complete degree	21	13.2	18.1	43.1
	Completed an associate's degree (A.A., A.S., etc.)	15	9.4	12.9	56.0
	Completed a bachelor's degree (B.A., B.S., etc.)	36	22.6	31.0	87.1
	Completed a master's degree (M.A., M.S., etc.)	13	8.2	11.2	98.3
	Completed a doctoral degree (Ph.D., J.D., M.D., etc.)	2	1.3	1.7	100.0
	Total	116	73.0	100.0	
Missing	System	43	27.0		
Total		159	100.0		

Appendix A

Cont.

What is the highest level of education that your FATHER completed?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Did not finish high school	10	6.3	8.8	8.8
	Graduated from high school	35	22.0	30.7	39.5
	Attended college but did not complete degree	20	12.6	17.5	57.0
	Completed an associate's degree (A.A., A.S., etc.)	9	5.7	7.9	64.9
	Completed a bachelor's degree (B.A., B.S., etc.)	22	13.8	19.3	84.2
	Completed a master's degree (M.A., M.S., etc.)	13	8.2	11.4	95.6
	Completed a doctoral degree (Ph.D., J.D., M.D., etc.)	5	3.1	4.4	100.0
	Total	114	71.7	100.0	
Missing	System	45	28.3		
Total		159	100.0		

Majors

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Engineering	67	42.1	42.1	42.1
	Biology	44	27.7	27.7	69.8
	Physical Sciences	14	8.8	8.8	78.6
	Computer Sciences	12	7.5	7.5	86.2
	Agriculture	22	13.8	13.8	100.0
	Total	159	100.0	100.0	

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Non Persisters	28	17.6	23.9	23.9
	Persisters	89	56.0	76.1	100.0
	Total	117	73.6	100.0	
Missing	System	42	26.4		
Total		159	100.0		

Appendix B

NSSE Benchmark Variables

Level of Academic Challenge

1	readasgn	Number of assigned textbooks, books, or book-length packs of course readings
2	writemor	Number of written papers or reports of 20 pages or more
3	writemid	Number of written papers or reports between 5 and 19
4	writesml	Number of written papers or reports of fewer than 5 pages
5	analyze	Analyzing the basic elements of an idea, experience, or theory, such as examining a particular case or situation in depth and considering its components
6	synthesz	Synthesizing and organizing ideas, information, or experiences into new, more complex interpretations and relationships
7	evaluate	Making judgements about the value of information, arguments, or methods, such as examining how others gathered and interpreted data and assessing the soundness of their conclusions
8	applying	Applying theories or concepts to pratical problems or in new situations
9	workhard	Worked harder than you thought you could to meet an instructor's standards or expectations
10	acadpr01	Preparing for class (studying, reading, writing, doing homework or lab work, analyzing data, rehearsing, and other academic activities)
11	envschol	Spending significant amounts of time studying and on academic work

Active and Collaborative Learning

1	clqust	Asked questions in class or contributed to class discussions
2	clpresen	Made a class presentation
3	classgrp	Worked with other students on projects during class
4	occgrp	Worked with classmates outside of class to prepare class assignments
5	tutor	Tutored or taught other students (paid or voluntary)
6	commproj	Participated in a community-based project (e.g., service learning) as part of a regular course
7	oocideas	Discussed ideas from your reading or classes with others outside of class (students, family members co-workers, etc.)

Student-Faculty Interaction

1	facgrade	Discussed grades or assinments with an instructor
2	facideas	Discussed ideas from your readings or classes with faculty members outside of class
3	facplans	Talked about career plans with a faculty member or advisor
4	facfeed	Received prompt written or oral feedback from faculty on your academic performance

Appendix B

Cont.

5	facother	Worked with faculty members on activities other than coursework (committees, orientation, student life activities, etc.)
6	resrch04	Work on a research project with a faculty member outside of course or program requirements

Enriching Educational Experiences

1	cocurr01	Had serious conversations with students who are very different from you in terms of their religious beliefs, political opinions, or person values
2	divrstud	Had serious conversations with students of a different race or ethnicity than yours
3	envdivrs	Encouraging contact among students from different economic, social, and racial or ethnic backgrounds
4	cocurr01	Participating in co-curricular activities (organizations, campus publications, student government, fraternity or sorority, intercollegiate or intramural sports, etc.)
5	itacadem	Used an electronic medium (listserv, chat group, Internet, instant messaging, etc.) to discuss or complete an assignment
6	intern04	Practicum, internship, field experience, co-op experience, or clinical assignment
7	volntr04	Community service or volunteer work
8	lrncom04	Participate in a learning community or some other formal program where groups of students take two or more classes together
9	forlng04	Foreign language coursework
10	stdabr04	Study abroad
11	indstd04	Independent study or self-designed major
12	snrx04	Culminating senior experience (capstone course, senior project or thesis, comprehensive exam, etc.

Supportive Campus Environment

1	envsocal	Providing the support you need to thrive socially
2	envsuprt	Providing the support you need to help you succeed academically
3	envnacad	Helping you cope with your non-academic responsibilities (work, family, etc.)
4	envstu	Relationships with other students
5	envfac	Relationships with faculty members
6	envadm	Relationships with administrative personnel and offices

Source: NSSE's Psychometric Portfolio, available online at nsse.iub.edu/psychometric_portfolio

Appendix C

National Survey of Student Engagement (2008 and 2011)

National Survey of Student Engagement 2008

The College Student Report

1 In your experience at your institution during the current school year, about how often have you done each of the following? Mark your answers in the boxes. Examples: ☒ or ■

	Very often	Often	Some-times	Never
a. Asked questions in class or contributed to class discussions	☐	☐	☐	☐
b. Made a class presentation	☐	☐	☐	☐
c. Prepared two or more drafts of a paper or assignment before turning it in	☐	☐	☐	☐
d. Worked on a paper or project that required integrating ideas or information from various sources	☐	☐	☐	☐
e. Included diverse perspectives (different races, religions, genders, political beliefs, etc.) in class discussions or writing assignments	☐	☐	☐	☐
f. Come to class without completing readings or assignments	☐	☐	☐	☐
g. Worked with other students on projects **during class**	☐	☐	☐	☐
h. Worked with classmates **outside of class** to prepare class assignments	☐	☐	☐	☐
i. Put together ideas or concepts from different courses when completing assignments or during class discussions	☐	☐	☐	☐
j. Tutored or taught other students (paid or voluntary)	☐	☐	☐	☐
k. Participated in a community-based project (e.g., service learning) as part of a regular course	☐	☐	☐	☐
l. Used an electronic medium (listserv, chat group, Internet, instant messaging, etc.) to discuss or complete an assignment	☐	☐	☐	☐
m. Used e-mail to communicate with an instructor	☐	☐	☐	☐
n. Discussed grades or assignments with an instructor	☐	☐	☐	☐
o. Talked about career plans with a faculty member or advisor	☐	☐	☐	☐
p. Discussed ideas from your readings or classes with faculty members outside of class	☐	☐	☐	☐
q. Received prompt written or oral feedback from faculty on your academic performance	☐	☐	☐	☐
r. Worked harder than you thought you could to meet an instructor's standards or expectations	☐	☐	☐	☐
s. Worked with faculty members on activities other than coursework (committees, orientation, student life activities, etc.)	☐	☐	☐	☐
t. Discussed ideas from your readings or classes with others outside of class (students, family members, co-workers, etc.)	☐	☐	☐	☐
u. Had serious conversations with students of a different race or ethnicity than your own	☐	☐	☐	☐
v. Had serious conversations with students who are very different from you in terms of their religious beliefs, political opinions, or personal values	☐	☐	☐	☐

2 During the current school year, how much has your coursework emphasized the following mental activities?

	Very much	Quite a bit	Some	Very little
a. **Memorizing** facts, ideas, or methods from your courses and readings so you can repeat them in pretty much the same form	☐	☐	☐	☐
b. **Analyzing** the basic elements of an idea, experience, or theory, such as examining a particular case or situation in depth and considering its components	☐	☐	☐	☐
c. **Synthesizing** and organizing ideas, information, or experiences into new, more complex interpretations and relationships	☐	☐	☐	☐
d. **Making judgments** about the value of information, arguments, or methods, such as examining how others gathered and interpreted data and assessing the soundness of their conclusions	☐	☐	☐	☐
e. **Applying** theories or concepts to practical problems or in new situations	☐	☐	☐	☐

3 **During the current *school year*, about how much reading and writing have you done?**

a. Number of assigned textbooks, books, or book-length packs of course readings

None	1-4	5-10	11-20	More than 20
☐	☐	☐	☐	☐

b. Number of books read on your own (not assigned) for personal enjoyment or academic enrichment

None	1-4	5-10	11-20	More than 20
☐	☐	☐	☐	☐

c. Number of written papers or reports of **20 pages or more**

None	1-4	5-10	11-20	More than 20
☐	☐	☐	☐	☐

d. Number of written papers or reports **between 5 and 19 pages**

None	1-4	5-10	11-20	More than 20
☐	☐	☐	☐	☐

e. Number of written papers or reports of **fewer than 5 pages**

None	1-4	5-10	11-20	More than 20
☐	☐	☐	☐	☐

4 **In a *typical week*, how many homework problem sets do you complete?**

	None	1-2	3-4	5-6	More than 6
a. Number of problem sets that take you **more** than an hour to complete	☐	☐	☐	☐	☐
b. Number of problem sets that take you **less** than an hour to complete	☐	☐	☐	☐	☐

5 **Mark the box that best represents the extent to which your examinations during the current school year have challenged you to do your best work.**

Very little						Very much
☐	☐	☐	☐	☐	☐	☐
1	2	3	4	5	6	7

6 **During the current school year, about how often have you done each of the following?**

	Very often	Often	Some-times	Never
a. Attended an art exhibit, play, dance, music, theater, or other performance	☐	☐	☐	☐
b. Exercised or participated in physical fitness activities	☐	☐	☐	☐
c. Participated in activities to enhance your spirituality (worship, meditation, prayer, etc.)	☐	☐	☐	☐
d. Examined the strengths and weaknesses of your own views on a topic or issue	☐	☐	☐	☐
e. Tried to better understand someone else's views by imagining how an issue looks from his or her perspective	☐	☐	☐	☐
f. Learned something that changed the way you understand an issue or concept	☐	☐	☐	☐

7 **Which of the following have you done or do you plan to do before you graduate from your institution?**

	Done	Plan to do	Do not plan to do	Have not decided
a. Practicum, internship, field experience, co-op experience, or clinical assignment	☐	☐	☐	☐
b. Community service or volunteer work	☐	☐	☐	☐
c. Participate in a learning community or some other formal program where groups of students take two or more classes together	☐	☐	☐	☐
d. Work on a research project with a faculty member outside of course or program requirements	☐	☐	☐	☐
e. Foreign language coursework	☐	☐	☐	☐
f. Study abroad	☐	☐	☐	☐
g. Independent study or self-designed major	☐	☐	☐	☐
h. Culminating senior experience (capstone course, senior project or thesis, comprehensive exam, etc.)	☐	☐	☐	☐

8 **Mark the box that best represents the quality of your relationships with people at your institution.**

a. Relationships with **other students**

Unfriendly, Unsupportive, Sense of alienation						Friendly, Supportive, Sense of belonging
☐	☐	☐	☐	☐	☐	☐
1	2	3	4	5	6	7

b. Relationships with **faculty members**

Unavailable, Unhelpful, Unsympathetic						Available, Helpful, Sympathetic
☐	☐	☐	☐	☐	☐	☐
1	2	3	4	5	6	7

c. Relationships with **administrative personnel and offices**

Unhelpful, Inconsiderate, Rigid						Helpful, Considerate, Flexible
☐	☐	☐	☐	☐	☐	☐
1	2	3	4	5	6	7

9 **About how many hours do you spend in a typical 7-day week doing each of the following?**

a. Preparing for class (studying, reading, writing, doing homework or lab work, analyzing data, rehearsing, and other academic activities)

☐ 0 ☐ 1-5 ☐ 6-10 ☐ 11-15 ☐ 16-20 ☐ 21-25 ☐ 26-30 ☐ More than 30
Hours per week

b. Working for pay **on campus**

☐ 0 ☐ 1-5 ☐ 6-10 ☐ 11-15 ☐ 16-20 ☐ 21-25 ☐ 26-30 ☐ More than 30
Hours per week

c. Working for pay **off campus**

☐ 0 ☐ 1-5 ☐ 6-10 ☐ 11-15 ☐ 16-20 ☐ 21-25 ☐ 26-30 ☐ More than 30
Hours per week

d. Participating in co-curricular activities (organizations, campus publications, student government, fraternity or sorority, intercollegiate or intramural sports, etc.)

☐ 0 ☐ 1-5 ☐ 6-10 ☐ 11-15 ☐ 16-20 ☐ 21-25 ☐ 26-30 ☐ More than 30
Hours per week

e. Relaxing and socializing (watching TV, partying, etc.)

☐ 0 ☐ 1-5 ☐ 6-10 ☐ 11-15 ☐ 16-20 ☐ 21-25 ☐ 26-30 ☐ More than 30
Hours per week

f. Providing care for dependents living with you (parents, children, spouse, etc.)

☐ 0 ☐ 1-5 ☐ 6-10 ☐ 11-15 ☐ 16-20 ☐ 21-25 ☐ 26-30 ☐ More than 30
Hours per week

g. Commuting to class (driving, walking, etc.)

☐ 0 ☐ 1-5 ☐ 6-10 ☐ 11-15 ☐ 16-20 ☐ 21-25 ☐ 26-30 ☐ More than 30
Hours per week

10 **To what extent does your institution emphasize each of the following?**

	Very much	Quite a bit	Some	Very little
a. Spending significant amounts of time studying and on academic work	☐	☐	☐	☐
b. Providing the support you need to help you succeed academically	☐	☐	☐	☐
c. Encouraging contact among students from different economic, social, and racial or ethnic backgrounds	☐	☐	☐	☐
d. Helping you cope with your non-academic responsibilities (work, family, etc.)	☐	☐	☐	☐
e. Providing the support you need to thrive socially	☐	☐	☐	☐
f. Attending campus events and activities (special speakers, cultural performances, athletic events, etc.)	☐	☐	☐	☐
g. Using computers in academic work	☐	☐	☐	☐

11 **To what extent has your experience at this institution contributed to your knowledge, skills, and personal development in the following areas?**

	Very much	Quite a bit	Some	Very little
a. Acquiring a broad general education	☐	☐	☐	☐
b. Acquiring job or work-related knowledge and skills	☐	☐	☐	☐
c. Writing clearly and effectively	☐	☐	☐	☐
d. Speaking clearly and effectively	☐	☐	☐	☐
e. Thinking critically and analytically	☐	☐	☐	☐
f. Analyzing quantitative problems	☐	☐	☐	☐
g. Using computing and information technology	☐	☐	☐	☐
h. Working effectively with others	☐	☐	☐	☐
i. Voting in local, state, or national elections	☐	☐	☐	☐
j. Learning effectively on your own	☐	☐	☐	☐
k. Understanding yourself	☐	☐	☐	☐
l. Understanding people of other racial and ethnic backgrounds	☐	☐	☐	☐
m. Solving complex real-world problems	☐	☐	☐	☐
n. Developing a personal code of values and ethics	☐	☐	☐	☐
o. Contributing to the welfare of your community	☐	☐	☐	☐
p. Developing a deepened sense of spirituality	☐	☐	☐	☐

12 **Overall, how would you evaluate the quality of academic advising you have received at your institution?**

☐ Excellent
☐ Good
☐ Fair
☐ Poor

13 **How would you evaluate your entire educational experience at this institution?**

☐ Excellent
☐ Good
☐ Fair
☐ Poor

14 **If you could start over again, would you go to the *same institution* you are now attending?**

☐ Definitely yes
☐ Probably yes
☐ Probably no
☐ Definitely no

15 Write in your year of birth: 1 9 _ _

16 Your sex:
- ☐ Male
- ☐ Female

17 Are you an international student or foreign national?
- ☐ Yes
- ☐ No

18 What is your racial or ethnic identification? (Mark only one.)
- ☐ American Indian or other Native American
- ☐ Asian, Asian American, or Pacific Islander
- ☐ Black or African American
- ☐ White (non-Hispanic)
- ☐ Mexican or Mexican American
- ☐ Puerto Rican
- ☐ Other Hispanic or Latino
- ☐ Multiracial
- ☐ Other
- ☐ I prefer not to respond

19 What is your current classification in college?
- ☐ Freshman/first-year
- ☐ Senior
- ☐ Sophomore
- ☐ Unclassified
- ☐ Junior

20 Did you begin college at your current institution or elsewhere?
- ☐ Started here
- ☐ Started elsewhere

21 Since graduating from high school, which of the following types of schools have you attended other than the one you are attending now? (Mark all that apply.)
- ☐ Vocational or technical school
- ☐ Community or junior college
- ☐ 4-year college other than this one
- ☐ None
- ☐ Other

22 Thinking about this current academic term, how would you characterize your enrollment?
- ☐ Full-time
- ☐ Less than full-time

23 Are you a member of a social fraternity or sorority?
- ☐ Yes
- ☐ No

24 Are you a student-athlete on a team sponsored by your institution's athletics department?
- ☐ Yes
- ☐ No (Go to question 25.)

On what team(s) are you an athlete (e.g., football, swimming)? Please answer below:

25 What have most of your grades been up to now at this institution?
- ☐ A
- ☐ B+
- ☐ C+
- ☐ A-
- ☐ B
- ☐ C
- ☐ B-
- ☐ C- or lower

26 Which of the following best describes where you are living now while attending college?
- ☐ Dormitory or other campus housing (not fraternity/sorority house)
- ☐ Residence (house, apartment, etc.) within walking distance of the institution
- ☐ Residence (house, apartment, etc.) within driving distance of the institution
- ☐ Fraternity or sorority house

27 What is the highest level of education that your parent(s) completed? (Mark one box per column.)

Father	Mother	
☐	☐	Did not finish high school
☐	☐	Graduated from high school
☐	☐	Attended college but did not complete degree
☐	☐	Completed an associate's degree (A.A., A.S., etc.)
☐	☐	Completed a bachelor's degree (B.A., B.S., etc.)
☐	☐	Completed a master's degree (M.A., M.S., etc.)
☐	☐	Completed a doctoral degree (Ph.D., J.D., M.D., etc.)

28 Please print your major(s) or your expected major(s).

a. Primary major (Print only one.):

b. If applicable, second major (not minor, concentration, etc.):

THANKS FOR SHARING YOUR RESPONSES!

After completing the survey, please put it in the enclosed postage-paid envelope and deposit it in any U.S. Postal Service mailbox. Questions or comments? Contact the National Survey of Student Engagement, Indiana University, 1900 East Tenth Street, Eigenmann Hall Suite 419, Bloomington IN 47406-7512 or nsse@indiana.edu or www.nsse.iub.edu.

National Survey of Student Engagement 2011

The College Student Report

1 **In your experience at your institution during the current school year, about how often have you done each of the following? Mark your answers in the boxes. Examples: ☒ or ■**

	Very often	Often	Some-times	Never
a. Asked questions in class or contributed to class discussions	☐	☐	☐	☐
b. Made a class presentation	☐	☐	☐	☐
c. Prepared two or more drafts of a paper or assignment before turning it in	☐	☐	☐	☐
d. Worked on a paper or project that required integrating ideas or information from various sources	☐	☐	☐	☐
e. Included diverse perspectives (different races, religions, genders, political beliefs, etc.) in class discussions or writing assignments	☐	☐	☐	☐
f. Come to class without completing readings or assignments	☐	☐	☐	☐
g. Worked with other students on projects **during class**	☐	☐	☐	☐
h. Worked with classmates **outside of class** to prepare class assignments	☐	☐	☐	☐
i. Put together ideas or concepts from different courses when completing assignments or during class discussions	☐	☐	☐	☐
j. Tutored or taught other students (paid or voluntary)	☐	☐	☐	☐
k. Participated in a community-based project (e.g., service learning) as part of a regular course	☐	☐	☐	☐
l. Used an electronic medium (listserv, chat group, Internet, instant messaging, etc.) to discuss or complete an assignment	☐	☐	☐	☐
m. Used e-mail to communicate with an instructor	☐	☐	☐	☐
n. Discussed grades or assignments with an instructor	☐	☐	☐	☐
o. Talked about career plans with a faculty member or advisor	☐	☐	☐	☐
p. Discussed ideas from your readings or classes with faculty members outside of class	☐	☐	☐	☐
q. Received prompt written or oral feedback from faculty on your academic performance	☐	☐	☐	☐
r. Worked harder than you thought you could to meet an instructor's standards or expectations	☐	☐	☐	☐
s. Worked with faculty members on activities other than coursework (committees, orientation, student life activities, etc.)	☐	☐	☐	☐
t. Discussed ideas from your readings or classes with others outside of class (students, family members, co-workers, etc.)	☐	☐	☐	☐
u. Had serious conversations with students of a different race or ethnicity than your own	☐	☐	☐	☐
v. Had serious conversations with students who are very different from you in terms of their religious beliefs, political opinions, or personal values	☐	☐	☐	☐

2 **During the current school year, how much has your coursework emphasized the following mental activities?**

	Very much	Quite a bit	Some	Very little
a. **Memorizing** facts, ideas, or methods from your courses and readings so you can repeat them in pretty much the same form	☐	☐	☐	☐
b. **Analyzing** the basic elements of an idea, experience, or theory, such as examining a particular case or situation in depth and considering its components	☐	☐	☐	☐
c. **Synthesizing** and organizing ideas, information, or experiences into new, more complex interpretations and relationships	☐	☐	☐	☐
d. **Making judgments** about the value of information, arguments, or methods, such as examining how others gathered and interpreted data and assessing the soundness of their conclusions	☐	☐	☐	☐
e. **Applying** theories or concepts to practical problems or in new situations	☐	☐	☐	☐

3 **During the current *school year*, about how much reading and writing have you done?**

	None	1-4	5-10	11-20	More than 20
a. Number of assigned textbooks, books, or book-length packs of course readings	☐	☐	☐	☐	☐
b. Number of books read on your own (not assigned) for personal enjoyment or academic enrichment	☐	☐	☐	☐	☐
c. Number of written papers or reports of **20 pages or more**	☐	☐	☐	☐	☐
d. Number of written papers or reports **between 5 and 19 pages**	☐	☐	☐	☐	☐
e. Number of written papers or reports of **fewer than 5 pages**	☐	☐	☐	☐	☐

4 **In a *typical week*, how many homework problem sets do you complete?**

	None	1-2	3-4	5-6	More than 6
a. Number of problem sets that take you **more** than an hour to complete	☐	☐	☐	☐	☐
b. Number of problem sets that take you **less** than an hour to complete	☐	☐	☐	☐	☐

5 **Mark the box that best represents the extent to which your examinations during the current school year have challenged you to do your best work.**

Very little						Very much
☐	☐	☐	☐	☐	☐	☐
1	2	3	4	5	6	7

6 **During the current school year, about how often have you done each of the following?**

	Very often	Often	Some-times	Never
a. Attended an art exhibit, play, dance, music, theater, or other performance	☐	☐	☐	☐
b. Exercised or participated in physical fitness activities	☐	☐	☐	☐
c. Participated in activities to enhance your spirituality (worship, meditation, prayer, etc.)	☐	☐	☐	☐
d. Examined the strengths and weaknesses of your own views on a topic or issue	☐	☐	☐	☐
e. Tried to better understand someone else's views by imagining how an issue looks from his or her perspective	☐	☐	☐	☐
f. Learned something that changed the way you understand an issue or concept	☐	☐	☐	☐

7 **Which of the following have you done or do you plan to do before you graduate from your institution?**

	Done	Plan to do	Do not plan to do	Have not decided
a. Practicum, internship, field experience, co-op experience, or clinical assignment	☐	☐	☐	☐
b. Community service or volunteer work	☐	☐	☐	☐
c. Participate in a learning community or some other formal program where groups of students take two or more classes together	☐	☐	☐	☐
d. Work on a research project with a faculty member outside of course or program requirements	☐	☐	☐	☐
e. Foreign language coursework	☐	☐	☐	☐
f. Study abroad	☐	☐	☐	☐
g. Independent study or self-designed major	☐	☐	☐	☐
h. Culminating senior experience (capstone course, senior project or thesis, comprehensive exam, etc.)	☐	☐	☐	☐

8 **Mark the box that best represents the quality of your relationships with people at your institution.**

a. Relationships with **other students**

Unfriendly, Unsupportive, Sense of alienation						Friendly, Supportive, Sense of belonging
☐	☐	☐	☐	☐	☐	☐
1	2	3	4	5	6	7

b. Relationships with **faculty members**

Unavailable, Unhelpful, Unsympathetic						Available, Helpful, Sympathetic
☐	☐	☐	☐	☐	☐	☐
1	2	3	4	5	6	7

c. Relationships with **administrative personnel and offices**

Unhelpful, Inconsiderate, Rigid						Helpful, Considerate, Flexible
☐	☐	☐	☐	☐	☐	☐
1	2	3	4	5	6	7

9 **About how many hours do you spend in a typical 7-day week doing each of the following?**

a. Preparing for class (studying, reading, writing, doing homework or lab work, analyzing data, rehearsing, and other academic activities)

0	1-5	6-10	11-15	16-20	21-25	26-30	More than 30
☐	☐	☐	☐	☐	☐	☐	☐

Hours per week

b. Working for pay **on campus**

0	1-5	6-10	11-15	16-20	21-25	26-30	More than 30
☐	☐	☐	☐	☐	☐	☐	☐

Hours per week

c. Working for pay **off campus**

0	1-5	6-10	11-15	16-20	21-25	26-30	More than 30
☐	☐	☐	☐	☐	☐	☐	☐

Hours per week

d. Participating in co-curricular activities (organizations, campus publications, student government, fraternity or sorority, intercollegiate or intramural sports, etc.)

0	1-5	6-10	11-15	16-20	21-25	26-30	More than 30
☐	☐	☐	☐	☐	☐	☐	☐

Hours per week

e. Relaxing and socializing (watching TV, partying, etc.)

0	1-5	6-10	11-15	16-20	21-25	26-30	More than 30
☐	☐	☐	☐	☐	☐	☐	☐

Hours per week

f. Providing care for dependents living with you (parents, children, spouse, etc.)

0	1-5	6-10	11-15	16-20	21-25	26-30	More than 30
☐	☐	☐	☐	☐	☐	☐	☐

Hours per week

g. Commuting to class (driving, walking, etc.)

0	1-5	6-10	11-15	16-20	21-25	26-30	More than 30
☐	☐	☐	☐	☐	☐	☐	☐

Hours per week

10 **To what extent does your institution emphasize each of the following?**

	Very much	Quite a bit	Some	Very little
a. Spending significant amounts of time studying and on academic work	☐	☐	☐	☐
b. Providing the support you need to help you succeed academically	☐	☐	☐	☐
c. Encouraging contact among students from different economic, social, and racial or ethnic backgrounds	☐	☐	☐	☐
d. Helping you cope with your non-academic responsibilities (work, family, etc.)	☐	☐	☐	☐
e. Providing the support you need to thrive socially	☐	☐	☐	☐
f. Attending campus events and activities (special speakers, cultural performances, athletic events, etc.)	☐	☐	☐	☐
g. Using computers in academic work	☐	☐	☐	☐

11 **To what extent has your experience at this institution contributed to your knowledge, skills, and personal development in the following areas?**

	Very much	Quite a bit	Some	Very little
a. Acquiring a broad general education	☐	☐	☐	☐
b. Acquiring job or work-related knowledge and skills	☐	☐	☐	☐
c. Writing clearly and effectively	☐	☐	☐	☐
d. Speaking clearly and effectively	☐	☐	☐	☐
e. Thinking critically and analytically	☐	☐	☐	☐
f. Analyzing quantitative problems	☐	☐	☐	☐
g. Using computing and information technology	☐	☐	☐	☐
h. Working effectively with others	☐	☐	☐	☐
i. Voting in local, state, or national elections	☐	☐	☐	☐
j. Learning effectively on your own	☐	☐	☐	☐
k. Understanding yourself	☐	☐	☐	☐
l. Understanding people of other racial and ethnic backgrounds	☐	☐	☐	☐
m. Solving complex real-world problems	☐	☐	☐	☐
n. Developing a personal code of values and ethics	☐	☐	☐	☐
o. Contributing to the welfare of your community	☐	☐	☐	☐
p. Developing a deepened sense of spirituality	☐	☐	☐	☐

12 **Overall, how would you evaluate the quality of academic advising you have received at your institution?**

- ☐ Excellent
- ☐ Good
- ☐ Fair
- ☐ Poor

13 **How would you evaluate your entire educational experience at this institution?**

- ☐ Excellent
- ☐ Good
- ☐ Fair
- ☐ Poor

14 **If you could start over again, would you go to the *same institution* you are now attending?**

- ☐ Definitely yes
- ☐ Probably yes
- ☐ Probably no
- ☐ Definitely no

15 Write in your year of birth: 1 9 _ _

16 Your sex:
- ☐ Male
- ☐ Female

17 Are you an international student or foreign national?
- ☐ Yes
- ☐ No

18 What is your racial or ethnic identification? (Mark only one.)
- ☐ American Indian or other Native American
- ☐ Asian, Asian American, or Pacific Islander
- ☐ Black or African American
- ☐ White (non-Hispanic)
- ☐ Mexican or Mexican American
- ☐ Puerto Rican
- ☐ Other Hispanic or Latino
- ☐ Multiracial
- ☐ Other
- ☐ I prefer not to respond

19 What is your current classification in college?
- ☐ Freshman/first-year
- ☐ Senior
- ☐ Sophomore
- ☐ Unclassified
- ☐ Junior

20 Did you begin college at your current institution or elsewhere?
- ☐ Started here
- ☐ Started elsewhere

21 Since graduating from high school, which of the following types of schools have you attended other than the one you are attending now? (Mark all that apply.)
- ☐ Vocational or technical school
- ☐ Community or junior college
- ☐ 4-year college other than this one
- ☐ None
- ☐ Other

22 Thinking about this current academic term, how would you characterize your enrollment?
- ☐ Full-time
- ☐ Less than full-time

23 Are you a member of a social fraternity or sorority?
- ☐ Yes
- ☐ No

24 Are you a student-athlete on a team sponsored by your institution's athletics department?
- ☐ Yes
- ☐ No (Go to question 25.)

On what team(s) are you an athlete (e.g., football, swimming)? Please answer below:

25 What have most of your grades been up to now at this institution?
- ☐ A
- ☐ A-
- ☐ B+
- ☐ B
- ☐ B-
- ☐ C+
- ☐ C
- ☐ C- or lower

26 Which of the following best describes where you are living now while attending college?
- ☐ Dormitory or other campus housing (not fraternity/sorority house)
- ☐ Residence (house, apartment, etc.) within walking distance of the institution
- ☐ Residence (house, apartment, etc.) within driving distance of the institution
- ☐ Fraternity or sorority house
- ☐ None of the above

27 What is the highest level of education that your parent(s) completed? (Mark one box per column.)

Father	Mother	
☐	☐	Did not finish high school
☐	☐	Graduated from high school
☐	☐	Attended college but did not complete degree
☐	☐	Completed an associate's degree (A.A., A.S., etc.)
☐	☐	Completed a bachelor's degree (B.A., B.S., etc.)
☐	☐	Completed a master's degree (M.A., M.S., etc.)
☐	☐	Completed a doctoral degree (Ph.D., J.D., M.D., etc.)

28 Please print your major(s) or your expected major(s).

a. Primary major (Print only one.):

b. If applicable, second major (not minor, concentration, etc.):

SAMPLE

THANKS FOR SHARING YOUR RESPONSES!

After completing the survey, please put it in the enclosed postage-paid envelope and deposit it in any U.S. Postal Service mailbox. Questions or comments? Contact the National Survey of Student Engagement, Indiana University, 1900 East Tenth Street, Suite 419, Bloomington IN 47406-7512 or nsse@indiana.edu or www.nsse.iub.edu.