Fall 12-2017

Perceived Ideal Traits of a Mentor as Viewed By African American Students In Science, Technology, Engineering, and Mathematics

Mary L. Smith
University of Southern Mississippi

REPORTED IDEAL TRAITS OF A MENTOR AS VIEWED BY AFRICAN AMERICAN STUDENTS IN SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS

by

Mary L. Smith

A Dissertation
Submitted to the Graduate School,
the College of Science and Technology,
and the Center for Science and Mathematics Education
at The University of Southern Mississippi
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy

August 2017

REPORTED IDEAL TRAITS OF A MENTOR AS VIEWED BY AFRICAN

AMERICAN STUDENTS IN SCIENCE, TECHNOLOGY,

ENGINEERING, AND MATHEMATICS

by Mary L. Smith

August 2017

Approved by:

____
Dr. Sherry Herron, Committee Chair
Associate Professor, Science and Mathematics Education

____
Dr. Kyna Shelley, Committee Member
Professor, Educational Studies and Research

____
Dr. Rich Mohn, Committee Member
Associate Professor, Educational Studies and Research

____
Dr. Sarah Morgan, Committee Member
Professor, School of Polymers and High Performance Materials

____
Dr. Chante Calhoun, Committee Member
Director, Cape Fear Community College

____
Dr. Sherry Herron
Chair, Department ofCenter for Science and Mathematics Education

____
Dr. Karen S. Coats
Dean of the Graduate School

Published by the Graduate School

THE UNIVERSITY OF
SOUTHERN
MISSISSIPPI®

ABSTRACT

REPORTED IDEAL TRAITS OF A MENTOR AS VIEWED BY AFRICAN AMERICAN STUDENTS IN SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS

by Mary L. Smith

August 2017

The purpose of this study was to examine undergraduate students majoring in science, technology, engineering, and math disciplines perception of traits an ideal mentor should possess, and to determine if these traits had positive results on their identification with science. With a large number of workers in STEM disciplines retiring, there is a projected need for more underrepresented minorities to fill these positions. In order to increase diversity in the workforce, efforts must be made to retain underrepresented minorities in STEM education beginning at the undergraduate level and continuing throughout the graduate level. This intervention should begin as early as the freshman year and continue beyond the sophomore year, considering this group of students lose interest in STEM, exhibit a sense of hopelessness which in turn leads to these students changing their majors and/or leaving the discipline altogether. Increasing the representation of individuals from underrepresented groups in STEM fields is a function of pipeline flow (McGee et al., 2012), which is measured as the rate at which trainees enter and advance through the pipeline to the workforce.

This study provided demographics of one hundred seventy five (175) students attending two private Historically Black institutions in the state of Alabama. Survey questions were structured to analyze quantitative data. This primary method of analysis utilized descriptive statistics to measure the most important indicators that influence students' perceptions of an ideal mentor. The collection of quantitative data was adapted from instruments designed by Dr. Gail Rose (2003) and Dr. Sylvia James (2007). Rose (2003) Guidance, Integrity, and Relationship subscales were used to assess values that students placed on each subscale. Dr. James' scale examined the role of identity and other sociocultural factors as causes of the science achievement gap for African American students. She further emphasized the importance of informal programs or non-school settings in promoting identities that are conducive to science learning in African Americans.

Three research questions were considered. The overarching research question was, what ideal traits do students report as being the most important in an ideal mentor that could be a contributing factor in their persistence in STEM? Research question one was: to what degree do African American STEM students at two HBCUs in Alabama identify as a scientist as determined by Science Identity Scale Scores (SIS)? Research question two was, what is the relationship of Ideal Mentor Scale Scores (IMS) and Science Identity Scale Scores (SIS) among African American STEM students at these HBCUs?

Frequency data and Pearson Correlation were used to analyze data that were obtained from the web-based surveys via Qualtrics. Findings from this study showed that students identified 11 of the 34 items from the Ideal Mentor Scale (Rose, 2003) as being 'very' and 'extremely important' as it relates to ideal traits of a mentor. However, in regards to research question one, study participants did not exhibit a strong identification with science. Research question two, when looking at the relationship between the Ideal Mentor Scale Scores and Science Identity Scale Scores, there was not a statistically significant relationship between the two, although there was a statistically significant relationship among the three subscales of guidance, relationship, and integrity, with students valuing integrity more so than guidance and relationship.

Findings from the study also showed that ninety-nine of the participants in the study currently do not have a mentor. Consequently these students demonstrated the ability to give their perception of an ideal mentor.

The two universities used in the research study were Tuskegee University and Stillman College. Recommendations from the study will be provided to both colleges and universities that have existing STEM mentoring programs as well as those that do not have STEM mentoring programs resulting from this data. Parents, and local, state, and federal government agencies will also benefit from the results of this study. Furthermore, the recommendations will provide said individuals with pertinent information describing the potential success of students when provided the appropriate support or intervention.

ACKNOWLEDGMENTS

First, words cannot describe my sincere gratitude to my committee chairman, Dr. Sherry Herron, for her genuine interest in my efforts in completing this program and her kind words of encouragement throughout my doctoral studies. I would like to extend a special thanks to my dissertation committee member Dr. Chante Calhoun whom I consider a mentor; for sharing her knowledge and assistance during my yearlong journey in my qualitative studies course and providing the necessary guidance when I began my career as a community college instructor. I would like to thank the remaining committee members — Dr. Kyna Shelley, Dr. Richard Mohn, and Dr. Sarah Morgan for not only serving on my committee but having a heightened interest in my study. Their expertise and professional advice in their designated academic enhanced my knowledge in the areas of educational and scientific research. Lastly, the former Administrative Secretary for the Center for Science and Mathematics Education at the University of Southern Mississippi, Mrs. Celia Young. I am thankful for her keen sense of knowledge in regards to the requirements in completing the doctoral program, her never-ending kind words when I was feeling distressed, pleasant personality and her lovely spirit.

DEDICATION

"We may encounter many defeats but we must not be defeated" – Maya Angelou. Embarking on this journey of obtaining my PhD was one of the most difficult challenges I had encountered. As I reflect over the number of years it took to acquire it, I could not help but to think about the number of times when I felt the agony of defeat and thoughts of quitting. The thought of my mother who is now an angel in heaven would appear and I would picture her smiling down at me, and the words she spoke that inspired me as a child: "anything worth having requires hard work. You can do whatever you set out to do." Which is why I am dedicating this dissertation to her. My mother played a pivotal role in my life for thirty plus years, molding me into this woman that I am today; one with strength, virtue, courage and the will to succeed in all aspects of my life. I would also like to dedicate this to my maker, Almighty God, who was that beacon of light that provided me with traveling grace as I traveled to and from Hattiesburg, Mississippi. I would also like to thank my better half, Mr. Marcus Ellison, who was placed in my life at the opportune time. The timing could not have been so perfect. His forceful exertion is what I needed when I felt exhausted and lacked the drive to take the time out of my busy schedule to write this dissertation.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

INTRODUCTION

Mentorship is often cited as a key strategy for exciting, supporting, and keeping students and young scientists and engineers in the fields of science, technology, engineering, and math (Jackson, Palepu, Szalacha, Caswell, &Carr, 2010, p. 70; NRC, 2007, 2011a, p. 10). This is particularly true for individuals who have not historically participated in these areas, such as young women and underrepresented minorities (Jackson, Palepu, Szalacha, Caswell, &Carr, 2010, p. 70; NRC, 2007, 2011a, p. 10).

Mentoring programs have become prevalent, and appear to be a widely utilized approach in intervention programs for minorities (Tsui, 2007). In designing intervention programs to increase interest and sustain persistence in STEM fields, Ginorio and Grignon (2000) recommended the consideration of the principle “each student needs at least one person to serve as a mentor, someone who has faith in them and will provide necessary information or support at key junctures involving choice.” In a White House briefing, President Obama stated:

> Every person in this room remembers a teacher or a mentor that made a difference in their lives. Every person remembers a moment in which an educator showed them something about the world–or something about themselves that changed their lives....And innovators...are made in those moments. Scientists and engineers are made in those moments.... (Obama, 2010).

Background

One of the most comprehensive theoretical perspectives concerning mentoring students has been proposed by Cohen (1995) who defined mentoring as a deliberate effort to provide support to minority students, both formally and informally, through frequent contact and interaction with mentors .According to Roberts (2000), the more successful African American college students had a mentor or group of mentors who not only encouraged them, but followed them throughout their graduate school experience and beyond to their professional careers.

The most widely studied outcome variables resulting from mentoring include everything from retention and graduation rates to comfort with the educational environment. Overall, findings have been positive and indicated a positive relationship on the impact of mentoring on student persistence and/or grade point averages of undergraduate students (Campbell & Campbell, 1997; Freeman, 1999; Kahveci et al., 2006; Mangold et al., 2003; Pagan & Edwards-Wilson, 2003; Ross-Thomas & Bryant, 1994; Salintri, 2005; Sorrentino, 2007; Wallace et al., 2000).

Graduate students conceptualize mentoring as having several roles involving academic, facilitative, professional development, career, and personal support (Faison, 1996). Similar findings were found with online doctoral students. These students perceived online mentoring relationships to involve both academic and social-emotional interactions (Edwards & Gordon, 2006). Studies have shown the impact of mentoring relationships on graduate student's retention, completion of the doctoral dissertation, and future opportunities in STEM careers.

Nonetheless, previous research has shown that mentoring increase minority students academic achievement, as well as enrollment and retention (Abriam-Yago, 2002; Tinto, 1993; DeFour& Hirsch, 1990; Terenzini& Wright, 1987; Van eps et al., 2006;Wilson et al., 2010; Yeager, 2000). Slaughter et al. (2006) of the Black Caucus of the Society for Research in Child Development stated that the needs and requirements for mentoring African American students included: (a) culturally appropriate and diverse instruction; (b) suitable role models from similar cultural backgrounds who were knowledgeable about academic content in their areas; (c) institutional forms of support, including financial assistance and infrastructures supportive of student life styles and goals as well as student visibility and participation; and (d) continued development of institutional norms for selection and retention, relative to the academic performance(s) of such students.

In order to provide African American students with a nurturing environment and needed support, a range of intervention programs have been created to operate on college and university campuses (Tsui, 2007). These programs were developed to address the race/ethnic disparity in STEM participation. Some of the programs have targeted the preparation STEM majors receive prior to enrolling in post-secondary programs; others focus on the experiences of STEM students on college or university campuses (Wilson, et. al, 2012).

Statement of the Problem

Although there is a great deal of research on mentoring, Tillman (2001) noted that the mentoring of African Americans is often grouped in the category of “women and minorities” because of their similar difficulty in finding mentors and establishing successful mentoring relationships.

Literature on mentoring indicates that effective mentors (those highly rated in student surveys) possess specific personality characteristics and interpersonal traits (Blackburn, Cameron, & Chapman, 1981; Clark et al., 2000; Cronan-Hillix et al., 1986; Gilbert, 1985; Sanders & Wong, 1985). In terms of personality, desirable mentors are intelligent, caring, and appropriately humorous. They are flexible, empathic, and patient. Good mentors are interpersonally supportive, encouraging, and poised. They appear to exude “emotional intelligence” (Goleman, 1995). In addition to demonstrating these qualities, highly rated mentors are ethical (Kitchener, 1992), psychologically well adjusted (Cronan-Hillix et al., 1986), intentional role models (Gilbert, 1985), and well-known as scholars and professionals (Blackburn et al., 1981; Sanders & Wong, 1985).

This study will attempt to identify some of the above traits of effective mentors. Therefore, this study will propose to describe perceived ideal traits a mentor should possess reported by African American students majoring in science, technology, engineering, and mathematics at HBCUs. This study will also examine students’ perception of themselves when it comes to science as well as how other perceive them when it comes to science.

Research Questions

Based upon the literature and research problem stated, several questions were developed for the purpose of this study. The researcher will examine African American students view on traits of an ideal mentor. The study will have one overarching research question divided into two sub-questions.

Overarching Research Questions

What ideal traits do students report as being the most important in an ideal mentor that could be a contributing factor in their persistence in STEM?

Specific Research Questions

1. To what degree do African American STEM students at HBCUs at two HBCUs in Alabama identify as a scientist as determined by Science Identity Scale Scores (SIS)?
2. What is the relationship of Ideal Mentor Scale Scores (IMS) and Science Identity Scale Scores (SIS) among African American STEM students at these HBCUs?

Definition of Terms

CMC– The process of using computer mediated communication to mentor.

COP – Acronym for culture of practice. The importance of engagement as a component of learning and the relationship between engagement and identity are paramount in culture of practice.

Culture– A group of norms, behaviors, beliefs and values that are specific to a certain group of individuals.

Formal mentoring – This form of mentoring typically has a third party who matches the mentor with the mentee.

HBCUs –Historically Black Colleges and Universities.

Ideal Mentor Scale (IMS) – A scale that was written to help students identify the relative importance of several mentor functions and characteristics. The Ideal Mentor Scale consists of 34 items that reflect aspects of a mentoring relationship that may or may not be important to students (Rose, 2005).

Informal mentoring– An informal mentoring relationship is typically defined as an intense relationship, lasting eight to ten years, in which a senior person oversees the career and psychosocial development of a junior person (Douglas,1997).

Institutional Culture– Defined by the set of shared attitudes, values, goals, and practices that characterizes the institution.

Marginalized–The process in which something or someone is pushed to the edge of a group and accorded lesser importance. This is predominantly a social phenomenon where a minority or sub-group is excluded, and their needs or desires are ignored (http://businessdictiionary.com).

Mentee –An often younger inexperienced individual that seeks guidance, support (i.e., social and career), advice, and knowledge from a more experienced individual in assisting them in reaching their desired educational goals.

Mentor– Someone of superior rank, prestige, and special achievements that counsel, instruct, guide, and facilitate the intellectual or career development of mentees (Dixon-Reeves, 2001).

Mentoring– A reciprocal relationship characterized by trust, respect, and commitment, in which a mentor supports the professional and personal development of another by sharing his or her life experiences, influence, and expertise.

Mentoring functions – The roles or behaviors demonstrated by the mentor within a mentoring relationship that enhance the career, personal, and academic development of the mentee.

Non-inclusive –An individual or group of individuals overlooked or deemed unimportant leading to a feeling of isolation.

Other-mothering–This word dates back to slavery as when children were displaced from their birth mothers and sold to slave owners; the responsibility of raising these children fell upon other mothers who were also bought by the same slave owner.

Peer mentor–A one-on-one relationship between an older youth and a younger youth. Through this special relationship, peer mentors provide advice and support and serve as role models for younger people.

Persistence – Firm or obstinate continuance in a course of action in spite of difficulty or opposition.

Pipeline flow – Pipeline flow is measured as the rate at which trainees enter and advance through the pipeline to the workforce.

Pipeline leak – A term that refers to the unintended loss of trainees from the disciplines.

Protégé – one who is protected or trained or whose career is furthered by a person of experience, prominence, or influence.

PWIs –Predominantly White Institutions.

Racial identity– Van Camp, Barden and Sloan (2010) defined racial identity as the quality and extent of identification a person has with his or her racial group.

SEM – Acronym for Science, Engineering and Mathematics.

Social Cognitive Career Theory (*SCCT)*– Examines the manner in which people develop and elaborate on career and academic interests, select and pursue choices based on interests, and perform and persist in their occupational and educational pursuits (Brown, 2000a; Hackett, 2000b;Lent, 1994).

Science Identity (SI) – Demonstrates the ability to understand and be competent with science content and exemplify the necessary skills that are related to particular disciplines or area of study. It also describes how students think science is related to who they think they are.

Science Identity Scale (SIS) – A scale that measures how students feel about themselves and their capabilities.

Social Identity Theory – A theory developed with the purpose of understanding how individuals make sense of themselves and other people in the social environment.

STEM –Acronym for Science, Technology, Engineering and Math Education. We focus on these areas together not only because the skills and knowledge in each discipline are essential for student success, but also because these fields are deeply intertwined in the real world and the most effective way in which students learn. If you compare the differences in perceptions within different disciplines; biology, chemistry, physics, physical science, engineering, and mathematics.

URM –Underrepresented minorities.

Assumptions of the Study

This research was conducted with the following assumptions:

1. The study participants are volunteers in the study.
2. Participants respond to the survey in an open and honest manner.

Rationale for the Study

In October of 2005, the United States General Accounting Office (GAO) released a report recommended that fostering mentoring was important for improving participation in STEM fields. This recommendation, however, is challenging to implement for a number of reasons. Not only is mentoring inconsistently defined in the literature, it often means different things to different people. In addition, little is known about students' perceptions of the importance of mentors for their own educational and professional development. Without knowing how students perceive mentoring, it is more challenging to be successful in explaining to students how and why they might benefit from mentors. In addition, knowledge about which aspects of mentoring relationships can lead to student retention is important for developing and strengthening mentoring program.

According to George et al. (2005), faculty and students in science, technology, engineering and mathematics (STEM) fields had varied views of both the definition and the perceptions of mentoring. Students, it was found, viewed the mentor relationship as a personal one and both students and faculty articulated a distinction between academic advising and mentoring. Students also agreed with the following definition of mentoring, an interaction between a more experienced person and a less experienced person (George & Neal, 2005). Mentoring provides guidance that motivates the mentored person to take action. The purpose of this study is to identify African American students in science, technology, engineering, and mathematics perceptions' of ideal traits of a mentor and their relationship and self-perception with science.

Summary

This chapter states the problem or rationale for the study and research questions studied, as well as lists the limitations, assumptions, and justification for the study's purpose. The following chapter will explain the role of HBCUs and effective mentoring in students' success in STEM. These factors will be further investigated within this study along with examples of findings from previous studies

REVIEW OF RELATED LITERATURE

Introduction

Vice Provost and professor emeritus at Ohio State University, asserted that “It is one thing to admit students into programs of higher education....it is quite another to “accept” them into a warming climate of inclusivity where they are supported through mentoring efforts. Lack of support and limited access to high quality undergraduate preparation may in turn influence the academic progress of some non-white students who aspire to join the professoriate” (Hale, 2004).

Mentoring is not a new concept as it may date back as far as the Stone Age (Dickey, 1996). The origins of the word “mentor” stem from Greek methodology. In the Odyssey, the main character, Odysseus, entrusts his friend, Mentor, to help him prepare to fight in the Trojan War. Mentor serves as a wise, responsible and trusted advisor who guides Odysseus’ development (Miller, 2002). Despite its long history, there is currently an absence of a widely-accepted definition (Dickey, 1996; Johnson, 1989; Miller, 2002; Rodriguez, 1995; Zimmerman & Danette, 2007) and a lack of theory to explain what roles and functions are involved in a mentoring experience and how these experiences are perceived by college students (Jacobi, 1991; Merriam, 1983; Phillip & Hendry, 2000).

Crisp and Cruz (2009) identified the ambiguity when it comes to literature on mentoring, which is supported by the fact that there are over fifty definitions varying in scope and breadth (p. 527).Education researchers have not explicitly provided readers with an operational definition of mentoring (Boice, 1992; Borders & Arredondo, 2005; Cronan-Hillix et al., 1986; Lee, 1999; Mangold et al., 2003, Roger & Tremblay, 2003; Ross-Thomas & Bryant, 1994). Moreover, the literature includes definitions specific to, and reflective of the researcher's discipline (i.e., business, psychology, education).

Within the context of higher education, the absence of a consistent definition of mentoring has also been repeatedly recognized (Dickey, 1996; Johnson, 1989; Miller, 2002; Rodriguez, 1995). Existing definitions of mentoring offered have often been extremely broad or lacking entirely. Mentoring as defined by Brown et al. (1999) and Murray (2001) is a one-on-one relationship between an experienced and less experienced person for the purpose of learning or developing specific competencies.

Blackwell (1989) has defined mentoring in more specific terms, stating that mentoring "is a process by which persons of a superior rank, special achievements, and prestige, instruct, counsel, guide and facilitate the intellectual and/or career development of persons identified as protégés" (p. 9).According to Crisp and Cruz (2009), the open or lacking definition has understandably been described by researchers as an opportunity for the functions or characteristics of mentoring to be revealed by participants, allowing the definition to be reflective or representative of their own academic experience (p. 528).

Although there has been a large amount of disagreement when it comes to the definition of mentoring, many researchers are in agreement with Jacobi's (1991) findings on the basic functions of the mentoring relationship. A mentoring relationship focuses on:

1. Achievement or acquisition of knowledge.
2. Consists of the following three components: emotional and psychological support, direct assistance with career and professional development, and role modeling.
3. Is reciprocal, where both mentor and mentee derive emotional or tangible benefits.
4. Is personal in nature, involving direct interaction.
5. Emphasize the mentor's greater experience, influence, and achievement within a particular organization.

In conjunction with the above functions of a mentoring relationship, many researchers since Jacobi's (1991) findings also agree that such broad forms of assistance should include planned activities with a faculty member (Bernier et al., 2005; Campbell & Campbell, 1997; Collier & Morgan, 2006; Ishiyama, 2007; Kahveci et al., 2006; Salinitri, 2005).

On the contrary, there has been little agreement about what activities should be included in providing these broad forms of support to students. For example, Collier and Morgan (2006) utilized peer mentoring videos, weekly college adjustment tips, and participation in quarterly discussion groups, whereas

Ishiyama (2007) provided support to students in the form of participation in undergraduate research. According to Pagan and Edwards-Wilson (2003), mentoring activities were limited to two or more meetings and telephone conversations with a faculty member and letters from the program office. The personal aspects of a mentoring relationship have changed. Researchers since Jacobi (1991) have infused technology, namely the internet as part of the students' mentoring activities (Carlson & Single, 2000; Collier & Morgan, 2006; Edwards & Gordon, 2006).

Recent literature in business and academe builds on the findings of earlier studies, but rather than assigning a classification to mentoring, as in Sand et al.'s (1991) study, many authors divide the role of mentor into four subsidiary roles (sponsor, coach, role model, and counselor), attributing the collective functions of these roles to mentoring (Clutterbuck & Lane, 1999, 2004; Luecke, 2004; Murray, 2001). Daloz (1999) defined a mentor's role as "engendering trust, issuing a challenge, providing encouragement, and offering a vision for the journey" (p. 31). In addition, reciprocal respect (Alpert, Gardner &Tiukinhoy, 2003; Carr et al., 2003; Luecke, 2004), predictability and commitment (Alpert et al., 2003; Luecke, 2004; Luna & Cullen, 1995), as well as understanding and empathy (National Academy of Sciences, 1997) further shape the relationship. From this perspective, mentoring is a reciprocal learning relationship. It is characterized by trust, respect, and commitment, in which a mentor supports the professional and personal development of another, by sharing his or her life experiences, influence, and expertise.

Due to the difficult nature in reaching a consensus on an overall definition of mentoring, identifying the roles and functions of a mentor is even more complex. Krams's (1985) functions of mentoring was a good place to start in understanding the mentoring relationship. Kram (1985) expanded on earlier organizational studies and was the first to articulate the dual dimensions of mentoring: the career or technical functions and the psychosocial personal functions. According to Kram, career functions involve sponsorship, coaching, protection, challenge, exposure, and visibility. Psychosocial functions include role modeling, counseling, acceptance, confirmation, and friendship. One's external performance is influenced by the career or technical dimensions of mentoring, whereas the psychosocial dimensions address one's internal values and attitudes, clarify one's identity, and enhance one's feeling of competence (see Table 1).Subsequent studies have supported Kram's findings with regard to the career and psychosocial functions of mentoring (Chao, Walz & Gardner, 1992; Noe, 1988).

Table 1

Kram's Functions of Mentoring

Career	**Psychosocial**
Sponsorship	Role modeling
Exposure	Acceptance
Visibility	Counseling
Coaching	Confirmation
Protecting	Friendship
Challenge	

Notes: From: Zellers, D. F., Howard, V. M, & Barcic, M. (2008, September). Faculty Mentoring Program: Reinvisioning Rather Than Reinventing the Wheel. Educational Research, 78(3), 552-558. Doi: 10.3102/0034654308320966.

Conceptual Framework

Science Identity

Most STEM majors develop their interest in science during K–12 education and tend to lose interest in science during their college years (Russell et al., 2007; Schultz et al., 2011). According to Carlone and Johnson (2007), students may lose interest in STEM not only because of the difficulty of the STEM curriculum, but also because of a lack of satisfying social relationships surrounding STEM pursuits.

Carlone and Johnson (2007) developed a grounded model of science identity using research on successful women of color in science. Based on qualitative studies, they formulated the following perception, individuals with a strong science identity to be someone who demonstrates competence in the discipline through one's knowledge and understanding of science content. Such individuals also possess the necessary skills for the performance of relevant scientific practices (e.g., application of scientific tools, engage in scientific talk). Finally, these individuals achieve recognition by acknowledging oneself and being recognized by meaningful others as a "science person."

Findings from Lee (1998) and Merolla et al. (2012) have found that STEM enrichment programs such as mentoring can increase the salience of a science identity. These studies, according to Lee (1998) and Merolla et al. (2012), also support the idea that STEM enrichment programs have an effect on science identity because these programs provide students with social relationships based around scientific pursuits. For instance, Maton et al. (2000) noted that the most commonly reported positive aspect of training programs for participants in the Meyerhoff Program was being a part of the program community and having the chance to interact and develop relationships with other science students (Maton&Hrabowski, 2000).

Current research (Carlone& Johnson, 2007; Egan et al., 2012; Lee 1998, 2002; Merolla et al., 2012) provide evidence that students who participate in STEM enrichment programs are more likely to identify with science, exhibit positive attitudes toward science, and maintain an interest in a STEM career.

Numerous studies have supported the contention that persistence in STEM education not only requires mastering the technical skills needed to be a scientist, but also entails a social psychological process by which students begin to see science as a relevant part of their identities (Carlone& Johnson, 2007; Egan et al., 2012; Hanson, 1996; Hazari et al., 2010; Johnson et al., 2011; Lee, 1998, 2002; Merolla et al., 2012; Syed et al., 2011). Further evidence indicates that this outcome is particularly true for female and minority students who may encounter a “chilly climate” in which their opinions and efforts are discounted in scientific domains that are culturally constructed as masculine or white (Brickhouse & Porter, 2001; Lee, 1998, 2002).

Science Identity and STEM Outcomes

The bulk of research on the links between science identity and student outcomes has been conducted using advanced graduate students engaged in enrichment programs. According to Chemers et al. (2011) and Merolla et al. (2012), several studies have shown that science identity measures can serve as mediators of the effects enrichment program participation have on attitudinal outcomes. Empirical evidence indicate that science identity is an important aspect of sustained interest in science and science related fields, and may mediate enrichment program (mentoring) effects on such subjective outcomes. Science identity is related to students’ feelings about science, interest in STEM, and intention to continue in STEM (Chemers et al., 2011; Hazari et al., 2010; Lee, 1998, 2002; Merolla et al., 2012).

In sum, current research indicates that participation in STEM enrichment programs increase students identification with science. Moreover, research has found that identification with science is associated with attitudinal outcomes such as student interest and intention to pursue graduate school and science careers (Merolla & Serpe, 2013) However, a critical question remains as to whether science identity is related to the decision to enter a STEM graduate program, and whether science identity functions as a mechanism linking enrichment program participation to graduate school matriculation.

Contribution of Historically Black Colleges and Universities to Black College Student Success

Science, technology, engineering, and mathematics are areas designated as STEM disciplines. There is national and international attention being given to these fields, as they are the foundation for partnerships and alliances in the global economy. Education beyond high school is necessary to achieve desired levels of competency and efficiency in STEM fields. Despite the demonstrated need, there is a shortage of individuals trained in these areas, especially women and ethnic minorities (BHEF, 2006). Contributing to this shortage is the trend that roughly half of those students who display initial interest in majoring in science disciplines change their plans within the first two years of undergraduate study, and very few non-science aspirants become science majors (Center for Institutional Data Exchange Analysis, 2000). Historically Black Colleges and Universities (HBCUs) have contributed meaningfully to addressing the void of qualified STEM educators and researchers (Allen, 2002).

HBCUs have consistently produced the highest number of science baccalaureates for African Americans and Latina/os (Li, 2007; Provasnik&

Shafer, 2004; U.S. Department of Education, National Center for Education Statistics, 2002) and the National Institute of Health has typically funded undergraduate research programs in science at these institutions. What is distinct about student experiences in these contexts? First, Allen (1992) found that African American students were more satisfied with faculty-student contact at HBCUs. In addition, African American students at HBCUs tend to be more satisfied with their sense of community and student-to-student interactions relative to Black students at Predominantly White Institutions (Outcalt& Skewes-Cox, 2002). Also, according to (Abraham et al. 2002; Zamani, 2003), HBCUs have promoted more inclusive campus climates which increases the cultural continuity between minority students and the institution.

Success can be a struggle for college students of every race and ethnicity across the spectrum of institutions (Arum & Roksa, 2011; Tinto, 2012). However, struggle for success is particularly acute for a vast number of many African American students. Areas of concern include equitable access to college (Posselt et al., 2012), learning and overall development during college (Kimbrough & Harper, 2006; Museus et al., 2011), and graduation from college (Knapp et al., 2011).

Specific to students in the sciences, high institutional selectivity is typically associated with decreased retention in the field for all students but it is associated with increased URM retention in these fields at HBCUs (Chang et al., 2008). Chang et al. (2008) also argue:

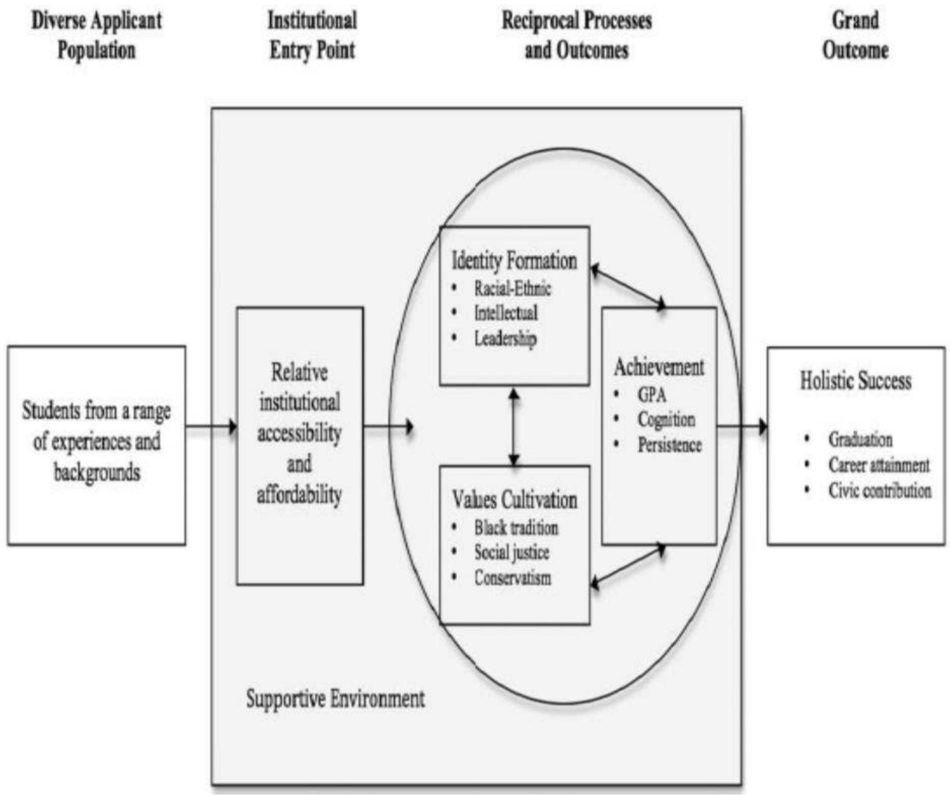
> More selective HBCUs appear to approach the process differently and seems to focus less on further 'weeding out' students. Once a rich talent pool has been identified, they seem to do a better job of socialization and cultivating that talent to improve students' chances of succeeding in the sciences.

Over recent years, scholars (Arroyo, 2010; Cokley&Chapman, 2008; Fleming et al., 2008; Guiffrida, 2005, 2006; Kuh& Love, 2000; Ladson-Billings, 1995; Museus&Quaye, 2009; Palmer et al., 2011; Petchauer, 2009; Steele, 1997; Watkins, 2005) have introduced many conceptual contributions of varying sophistication and significance with relevance to Black college student success. As a result, the literature provides a multifaceted theoretical base for working with this population. However, no extant conceptual work related to Black student success deals sufficiently with institutional responsibility. Many institutions appear to be content to practicing what Harper (2009) calls "institutional negligence" by failing to take seriously the education of Blacks beyond lip service.

According to Withman and Bensimon (2012), many institutions focus on the remediation of underachieving students as though they were ill, rather than focusing on what may be all so common, an institutional base issue whose primary aim should be to promote equitable student success. The deficit stereotype associated with these students is, they are viewed as substantial learners who are failing the institution when the reverse might be true; the institutions are failing them.

Rather than blaming so-called underperforming African American students, understanding the essential institutional components and processes for facilitating their success is imperative. Despite research that shows the significance of extra campus support systems such as family in encouraging African American students (Guiffrida, 2005; Harper, 2012; Palmer et al., 2011), over 20 years ago Allen (1992, p. 40) challenged educators that the setting itself could “either facilitate or frustrate the academic achievement of Black students,” and “current research suggests this has not changed” (Museus & Quaye, 2009).

This theory is unique in that it directs institutions in embracing their responsibility for the equitable success of Black students, because such a theory does not exist in the literature. There are existing theories, but they are either too focused on student responsibility or too Eurocentric in their institutional orientation.



Conceptual Model: An HBCU-Based Educational Approach for Black College Student Success

Figure 1 depicts an HBCU-based educational approach for Black college students' success. A supportive environment forms the framework of the model from which all other components are based upon.

Based on the original work of Fleming (1984), an environment is deemed as being supportive when:

a. Students have many opportunities for friendship with peers, faculty, staff, and counselors beyond the classroom.
b. Students are free to engage in extracurricular campus life, including satisfying positive, power motives and holding leadership positions.

c. Students feel a climate of academic development so that "an individual can achieve feelings of progress."

Current research continues to find a positive environment for Black students at HBCUs (Allen et al., 1991) despite Fleming's outdated work. There exists greater levels of campus interpersonal relationships and social networking (Davis, 1991), wellness (Spurgeon & Myers, 2010), and sense of family and brotherhood (Jett, 2013).

Figure 1 also posits that HBCUs welcome diverse applicant populations, which include students from a range of experiences and backgrounds, through relatively accessible tuition and admission policies. HBCUs concentrate on educating a variety of students alongside each other.

Evidence suggests that HBCUs offer competitive learning opportunities. Some have their own unique programs that could serve as replicable models (Brown, 2008), and others have formed partnerships with majority schools to advance their students education (Hammond & Davis, 2005; Oder, 2009; Stewart, 2011; Virginia Consortium, 2011; Walker et al., 2007). How are HBCUs able to contribute to achievement? Gallien and Peterson (2005) contend that HBCUs are different in the teaching process itself by incorporating traditional interventions for learning along with culturally relevant pedagogy (Boykin, 1983; Watkins, 2005).

In addition to achievement, another leading component of Figure 1 is identity formation. HBCUs generally seem to place emphasis on formation of student identity, and self-concept on at least three levels: race/ethnic, intellectual, and leadership. Cokley (2002) did a comparative study with PWIs finding HBCU students exhibited greater intellectual confidence when compared to PWI students. How is this accomplished? One way this is accomplished is by providing ample same-race role models. Also, Black instructors (Rucker &Gendrin, 2003; Jet, 2013) and external role models (Palmer & Gasman, 2008; Thompson, 2008), such as Black guest speakers, tend to make these students comfortable in their own skin and improve as intellectuals. HBCUs enhance student identity by affording them leadership opportunities on campus.

The final aspect of this theorized HBCU educational approach (Figure 1) is values cultivation. HBCUs place emphasis on cultivating a set of traditional African American moral principles and norms, with the goal of developing citizens of competence and character. By many accounts, the traditional HBCU values system combines conservative and progressive components. Progressivism is associated with the social piece at HBCUs. These institutions emphasize societal change (Sydnor et al., 2010). They focus on stakeholders, from students (Douglas, 2012; Lott, 2005) to presidents (Ricard & Brown, 2008), whereas PWIs focus on research and scholarship. HBCUs' view of conservatism (i.e. moral and social curriculum) is pivotal in their students' success.

Achievement, identity formation, values cultivation and the development of moral persons contributes to the holistic success of students attending HBCUs. According to the United Negro College Fund (2008), 70% of Black dentists and physicians, 50% of Black engineers, 50% of Black public school teachers, and 35% of Black attorneys, all graduated from an HBCU. It has also been reported that Blacks who go to earn a terminal degree in science or engineering are from HBCUs (Burelli & Rapoport, 2008). Based on this data, HBCUs have been deemed responsible for creating the Black middle class (Drewry & Doermann, 2001).

Retention Initiatives at Historically Black Colleges and Universities

Hikes's (2005) study found that for more than a century, historically Black institutions have successfully recruited, retained, and graduated leading professionals in countless fields. Accounts are plentiful of those with and without means who came to these institutions and were shaped and nurtured by those dedicated to their success. Absent the historical baggage of discrimination and incendiary campus climates, historically Black colleges and universities focused on a range of strategies to produce graduates who achieve. Second only to the Black church, HBCUs are one of the most highly respected institutions among African Americans (p. 27).

Over the years, the importance of HBCUs has come from a number of sources. According to Goldman (1963), Black institutions have close ties with the problems of their students which leads them to coming up with the necessary means to resolve them. McGrath (1965), on the other hand, found that psychological and social factors encourage students to attend Black institutions. Pifer (1973) asserts that some Black students simply seem happier at Black institutions. Gurin and Epps (1975, p. 28) found similar findings. They maintain that students opt to attend colleges where their personal development is fostered and conflict and isolation often experienced on White campuses, are minimized. Nonetheless, Watson and Kuh (1996) asserted that African Americans at HBCUs benefited more through campus involvement than their counterparts at PWIs.

Successful Mentoring Strategies Within Historically Black Institutions

Spence (2005), as cited in Instructing and Mentoring the African American College Students, noted that successful mentoring strategies employed by historically Black institutions cannot be fully discussed without a close examination of the history and mission of these distinct institutions. Successful mentoring is expected and practiced by faculty and staff at HBCUs. Their founding missions dictated that mentoring would be a core expectation and core activity.

During the beginning phase of historically Black institutions, the following educational opportunities were created: broad-based learning, attention to varying learning styles, basic remediation, and one-on-one tutoring. A common mission of HBCUs required the development of faculty/student relationships that expanded the role of teachers beyond mere purveyors' knowledge but to career and academic advisors, role models, personal consultants and surrogate parents. Since its inception, the teacher-as- mentor model was adopted and has prevailed as a very effective tool to transform the lives of those who enter these institutions as students. Teachers, founders, and staff of the early historically

Black institutions have incorporated character traits traditionally associated with mentoring into their work. These characteristics continue to run through the veins and arteries of today's distinguished HBCUs (Spence, 2005).

Both informal and formal mentoring, having gained popularity more than 150 years ago at HBCUs, have been in the business of developing students. Although educational opportunities have changed for Blacks over the years, only 16 percent of all Black college and university students who choose to attend college select historically Black institutions.

Spence (2005) also noted that the following historically Black institutions have had proven success when it comes to educating African American students in STEM: Xavier University, Spelman, and Morehouse College. Xavier University in New Orleans, Louisiana has been considered the nations' leader when it comes to sending African American women to medical school. Xavier University has also received notoriety in graduating the most African American students in physics, chemistry, and biology. When asked to explain the success formula at Xavier, faculty and staff expressed having belief in their students' ability to succeed. Their approach has been characterized as the "nurture and assist" model (Fletcher, 1997), a recognized mentorship model. The philosophy of nurture and assist is embraced at the top by the president and woven throughout the fabric of the institution. At Xavier, as well as most HBCUs, mentorship is tied to the formal advising program as well as other programs that are specifically designed as mentorship programs. Mentorship relationships are developed from the pairing of students with a faculty advisor representing their intended major upon entry. Faculty are encouraged to get to know the students beyond the framework of assisting them with class schedules and course sequencing.

Xavier University is also known for its peer mentorship program. This program pairs upper division students with incoming students that are pursuing the same majors and careers as the mentor. Throughout the academic year both structured and unstructured peer engagement opportunities are created. Peer mentors serve as guides for their younger counterparts as they navigate not only the academic environment but the social environment as well (Gallien, 2005).

At Spelman College, another prestigious HBCU, according to Spence (2005), women are told at the point of entry that they are expected to occupy the spectrum of the professional ranks and to take on the role of social change agents throughout their world communities. In light of the thousands of women that have preceded them, these ladies are expected to take on the mantle of those that came before them.

In addition to faculty advising, Spelman College has several structured mentorship programs designed to ensure a successful transition through and after college. Spence (2005) acknowledges that effective faculty/student research mentorships and peer mentorship programs continue to support initiatives designed to increase the number of Spelman women in graduate and professional schools. Also, ongoing collaboration among faculty and students lead to mentoring relationships that impact students' persistence throughout their tenure as undergraduates and when they enter graduate school. Faculty/student collaborations allow for mentoring relationships that sustain students throughout their tenure as undergraduates and when they enter graduate schools.

Throughout the Spelman environment, students and faculty work closely together in various configurations of mentorship. Faculty/student research mentorship programs create opportunities for faculty and students to work in a collegial manner around common interests. The relationships conform to the standard conceptual definitions of mentoring. The faculty mentor at Spelman College serves as a guide and/or guardian of the student as she develops and navigates the challenges and opportunities associated with the pursuit of higher education (Spence, 2005).

Dr. Benjamin Elijah Mays, President of Morehouse College from 1940 to 1967, was deemed by the late Dr. Martin Luther King, Jr. as his spiritual mentor. In awe of Dr. King, Dr. Mays wrote the following:

> Many times during his (Dr. King) four years at Morehouse, he would linger after my Tuesday morning address to discuss some point I made – usually with approval, but sometimes questioning or disagreeing. I was not aware how deeply he was impressed by what I said until he wrote *Stride Toward Freedom*, in which he indicated that I had influenced his life to a marked degree. In public addresses, he often referred to me as his spiritual mentor. (Carter, 1996)

This quote from Dr. Mays demonstrates that mentorship can be so informal that unstructured interactions between students and faculty and administrators can yield the same level of mutual bonding and engagement as very formal structured mentorship programs (p. 62).

Spelman College, Xavier University and Morehouse College have paired with various mentorship programs in an effort to ensure the success of their students. Personal and social adaptation concerns are recognized and addressed through formal and informal mentorship networks (Spence, 2005)

Types of Mentoring Relationships: Informal vs. Formal

Research has shown that mentoring relationships may be informal or formal, long-term or short-lived, planned or spontaneous (Luna & Cullen, 1995).

Informal Relationships

Informal mentoring relationships are not structured, managed, or formally recognized by the institution. Such a relationship typically develops "naturally," involving the mentor and mentee seeking each other out. This is considered a traditional view of mentoring. According to Murray (2001), those who cling to the traditional view of mentoring are few in number, and noted that these intensely close, informal relationships are rare in contemporary society.

Formal Relationships

Formal mentoring programs were introduced in the 1970s and 1980s, and are attributed to organizations (Gunn, 1995; Murray, 2001), and academic institutions (Davison, Vance, &Niemer, 2001; Tenner, 2004; Touchton, 2003) in an effort to improve cultural diversity within their ranks. These programs were designed exclusively for women and/or minorities to foster equitable treatment, promotion, and retention. This type of program is one approach to provide individuals with a venue to cultivate multiple mentoring relationships.

The most common formal mentoring model is a one-to-one arrangement (Chesler&Chesler, 2002; Daloz, 1999; Luecke, 2004; McCauley & Van Velsor, 2004; Murray, 2001). Mentees are assigned mentors or mentees select mentors from a pool of more senior candidates based on characteristics they have in common. Advocates of formal mentoring believe that mentees should select their mentors, because their developmental agenda will ultimately define the relationship (Allen, Eby, & Lentz 2006a; Wilson, Valentine, & Pereira, 2002). The drawback to formal mentoring programs is that, there is less interaction between formal pairs and the duration for formal relationships tend to be shorter (Noe, 1988).

Current Trends in Mentoring

The evolution of mentoring has its roots in the business sector. In the past decade, many American businesses have formalized their employee mentoring practices in recognition of how organizational context has changed in the three decades since Kanter (1977) identified the benefits of informal mentoring among managers and professionals. However, the business sector is not alone in its concern for the development and retention of its human assets and sustaining a competitive advantage; academics face similar challenges.

The role of mentor has not always been limited to faculty as many of the core functions of mentoring have been shown to be provided by college and university staff, senior or graduate students, peers, friends, religious leaders and/or family (Kram & Isabella, 1985; Zalaquett & Lopez, 2006). According to Philip and Hendry (2000), there are four types of naturally occurring mentoring relationships adolescents and young adults may experience: (1) classic mentoring (one-on-one relationships between an experienced adult and a younger person), (2) individual-team (young group of people look to an individual or a few individuals for advice), (3) friend-to-friend (provides a safety net, common among women friends), (4) peer-group (among a group of friends, often when exploring an issue).

Peer Mentoring

Peer mentoring is a model in which participants are equals or colleagues of comparative status. Peer-to-peer mentoring capitalizes on the empathy that is derived from shared experiences (Chesler, Single, &Mikic, 2003; Luecke, 2004), but the drawback is that participants are limited in their depth and breadth of experiences (Chesler&Chesler, 2002; McCauley & Van Velsor, 2004).

E-mentoring

E-mentoring, the process of using computer-mediated communication (CMC) technology as the primary means of communication between mentors and mentees, is one of the most widely used forms of mentoring to date. Computer-mediated technology may be in the form of e-mail, instant messaging, and related technologies. E-mentoring is an ongoing, mutually beneficial relationship, whereby a more experienced partner transmits mentoring functions via electronic means to a less experienced partner (Ensher& Murphy, 2007; Godshalk, 2007). This form of mentoring mimics the traditional style of mentoring, except it is done through the use of technology. Also, according to Hamilton and Scandura (2003), e-mentoring involves far less real face-time between mentor and mentee.

The functions received in e-mentoring relationships, such as career development (coaching, sponsoring, increasing exposure and visibility, and offering protection), as well as psychosocial support (offering acceptance and providing counseling, guidance, friendship and emotional support) parallel those found in traditional relationships (Kram, 1985; Ragins & Kram, 2007; Scandura, 1992). Career development and psychosocial support are just as effective as traditional face-to-face mentoring (Hamilton & Scandura, 2003).

Wanberg et al. (2003) expanded on Koberg's et al. (1988) model. He stated the following characteristics may affect mentoring functions and learning outcomes: (1) knowledge and skills, (2) demographics, (3) frequency of interaction, and (4) experience in mentoring relationships. The choices of these variables and/or characteristics are rooted in a myriad of literature, particularly the social network theory (Dobrow et al., 2012; Higgins et al., 2007) and CMC theory (Carlson & Zmud, 1999; Walther, 1996). Frequent interaction has been found to be related to both mentor and mentee perceptions of success (Van

Emmerik, 2004a; Waters et al., 2002). Also, interaction frequency has been found to increase self-efficacy (DiRenzo, Linneham, Shao, & Rosenberg, 2010).

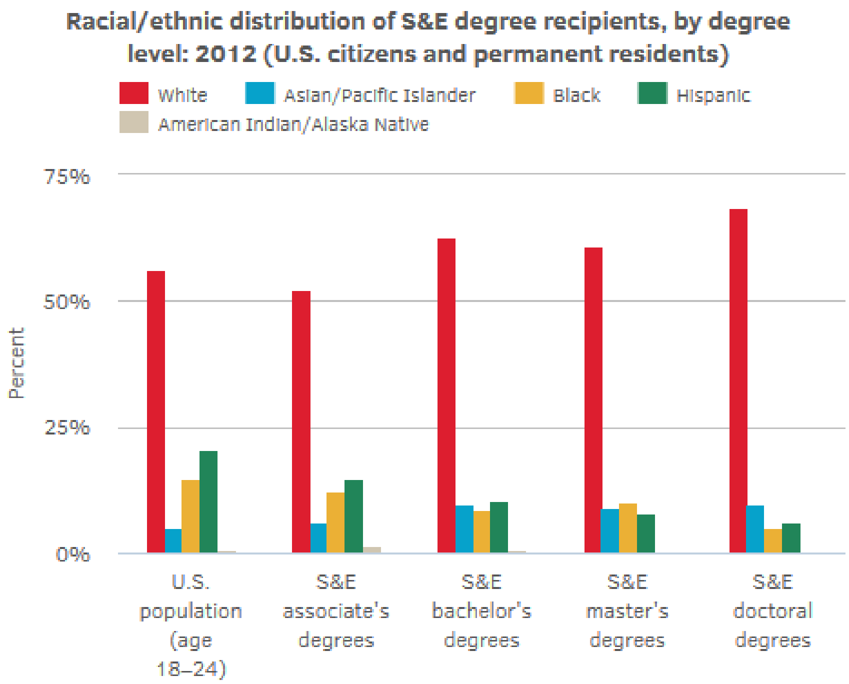
A Leaky Pipeline

Racial and ethnic population changes in the United States continue to reshape the American identity and the composition of its workforce. Despite efforts over the past 30 years, only modest improvements in workforce diversity in the sciences have been achieved (Antonio, 2002; Mervis, 2005; Villalpando & Delgado Bernal, 2002). Ironically, the United States' role as a STEM field leader, along with its rapidly changing demographics, makes it uniquely qualified to address the challenges of achieving STEM field diversity that can serve as an example for other nations. The increasing challenge to the United States leadership position in STEM disciplines functions as the driving force for improving STEM education and training outcomes (NRC, 2007, 2011a).

There are barriers and leaks in the pipeline when it comes to underrepresented minorities. However, in order to increase workforce diversity, considerable efforts must be made to retain underrepresented minorities (URM) in STEM education beginning at the undergraduate level and continuing throughout the graduate level. Interventions should begin as early as the freshman year and continue beyond the sophomore year, considering the underrepresentation of minorities typically begins at the graduate level.

Increasing the representation of individuals from underrepresented groups in STEM fields is a function of pipeline flow (McGee et al., 2012), which is measured as the rate at which trainees enter and advance through the pipeline to the workforce. The STEM pipeline analogy represents the long-standing logical framework, describing how trainees advance through the scientific educational and training process, with success measured by movement from precollege levels to more advanced postgraduate levels. The ongoing challenge of achieving the desired level of STEM workforce diversity leads us to reimagining this pipeline as a vertical structure that is subject to the laws of physics, where downward forces, such as poor or insufficient mentorship, oppose the upward flow of STEM trainee progression, resulting in STEM attrition.

It has long been recognized that the STEM pipeline is *leaky* — a term that refers to the unintended loss of trainees from the disciplines. The data below was retrieved from the National Science Foundation. The population data include all United States residents, regardless of citizenship status. The bar graph below is a clear indication of the severe lag of Black students to their White counterparts when it comes to earning degrees in science and engineering. According to the National Science Foundation, this group of individuals' remains underrepresented at every degree level to their proportion in the U.S. college-age population in 2012. This is particularly so at the doctoral level, with Blacks earning only 5% of those degrees. Whites, on the other hand, are overrepresented among recipients of bachelor's, master's and doctoral degrees.



Racial/Ethnic Distribution of S & E Degree Recipients by Degree Level: 2012 (U.S. Citizens and Permanent Residents)

If doctoral programs focused on the program completion of students, the leaky pipeline of underrepresented minorities would be repaired, and the numbers of faculty of color would increase (Denecke et al., 2009).

Summary

There is a great deal of literature on workforce diversification and underrepresentation of African Americans in STEM-related fields and mentoring. The underrepresentation of minorities in STEM has plagued this nation for decades with very little progress made when it comes to African Americans. Research has focused on the following factors: low test scores, high school grades, and not taking advanced science courses. These factors are viewed as impeding the progress of these students. Researchers are now focusing on science identity combined with intervention and/or enrichment programs such as mentoring in playing a role on the retention, persistence and academic success of these students in STEM fields. There also exists empirical research on the contributions historically Black colleges and universities (HBCUs) have made on the success of African American students.

METHODOLOGY

Introduction

This chapter presents the methods for collection of data on undergraduate African American STEM students who were enrolled in STEM programs at Stillman College and Tuskegee University. The questions and hypotheses are presented first, followed by descriptions of the demographics of the students. These descriptions will be followed by the statistical methods used to investigate the research questions. This study offered the opportunity to examine differences in expectations of traits of an ideal mentor of this particular population. This study had two primary goals; to explore and compare. It was exploratory in that it sought to determine students' perception of an ideal mentor and it is comparative in that it looked at the relationship between the Ideal Mentor Scale Scores and Science Identity Scale Scores.

Research Questions

The general research questions and their respective hypothesis are listed below.

Overarching Research Question: What ideal traits do students report as being the most important in an ideal mentor that could be a contributing factor in their persistence in STEM?

Specific Research Question One: To what degree do African American STEM students at HBCUs identify as a scientist?

Specific Research Question Two: What is the relationship of IMS scores and science identity among African American STEM students at HBCUs?

Target Population

The target population of the study were African American undergraduate students who were currently majoring in STEM-related disciplines.

Sampling Procedures

The participants for this study consisted of a non-random sampling of African American students in STEM-related disciplines recruited from two private Historically Black Colleges and Universities in the state of Alabama. Selecting participants from these HBCUs was due to their large percentage of African American students in various STEM-related disciplines. Only students who fit this criteria were invited to participate in this study. These students had to have access to the internet and email. The participants had to be 18 years of age or older, so no parental permission was required.

Research Design

This study employed a quantitative survey method and a cross-sectional method using Qualtrics. Variables included age, major, gender, classification, gender of the mentor, if the student currently had a mentor, and lastly, if the student lacked a mentor or had ever been exposed to mentoring.

Instrumentation

In order to determine the ideal traits of a mentor as reported by African American students, two surveys were used: the Ideal Mentor Scale (IMS) survey

(Rose, 2003; see Appendix A) and the Science Identity Scale (SIS) survey (James, 2007; see Appendix B). The IMS consists of 28 items on a five-point Likert scale that ranks importance, where 1 represents not at all important and 5 represents extremely important. It was designed to address Anderson and Shannon's (1988) five aspects of mentoring: teaching, sponsoring, encouraging, counseling, and befriending. It was developed specifically for mentoring in the context of doctoral education, from the perspective of the student's perception of the ideal mentor. Therefore questions #3, 4, and 17 were removed due to the questions not being relevant to undergraduates. The IMS consists of three subscales that were determined by factor analysis: integrity, guidance, and relationship (Rose, 2003). On each of these subscales, a higher score indicates students' increased valuing of the ideal characteristics represented in that subscale. The Integrity subscale measures the importance of a mentor to exhibit virtue and principled action and be seen as someone to emulate as a role model. This subscale consists of 14 items that reflect a humanistic expression of care and concern.

Table 2

Integrity Subscale of the IMS

Integrity Questions
Presently at this stage in my matriculation, My ideal mentor would…
3. Help me to realize my life vision.
5. Prefer to cooperate with others than compete with them.
7. Respect the intellectual property rights of others.
8. Be a role model.
10. Be calm and collected in times of stress.
12. Treat me as an adult who has a right to be involved in decisions that affect me.
14. Inspire me by his or her example and words.
17. Accept me as a junior colleague.
19. Advocate for my needs and interests.
21. Generally try to be thoughtful and considerate.
23. Value me as a person.
26. Believes in me.
29. Recognize my potential.
32. Work hard to accomplish his/her goals.

The Guidance subscale measures the importance of a mentor who provides practical assistance through the assigning of tasks and activities typical of graduate study (Rose, 2003). This subscale includes 10 items and reflects a mentoring style based on practical, hands-on help with tasks and activities.

Table 3 *Guidance Subscales of the IMS*

Guidance Questions
Presently at this stage in my matriculation, my ideal mentor would…
1. Show me how to employ research techniques.
2. Give me specific assignments related to my research problem.
6. Help me to maintain a clear focus on my research objectives.
9. Brainstorm solutions to a problem concerning my research project.
13. Help me plan the outline for a presentation of my research.
16. Help me investigate a problem I am having with research design.
27. Meet with me on a regular basis.
31. Help me plan a timetable for my research.
33. Provide information to help me understand the subject matter I am researching.
34. Be generous with time and other resources

Finally, Rose (2003) described the Relationship subscale as measuring the importance of a mentor's ability to form a personal relationship including sharing of personal concerns, social activities, and worldview. This scale includes 10 items.

Table 4

Relationship Subscale of the IMS

Relationship Questions
Presently at this stage in my matriculation, My ideal mentor would…
4. Take me out for dinner and/or drink.
11. Be interested in speculating on the nature of the universe or the human condition.
15. Rarely feel fearful or anxious.
18. Be seldom sad or depressed.
20. Talk to me about his or her personal problems.
22. Be cheerful, high-spirited person.
24. Have coffee or lunch with me on occasion.
25. Keep his or her workspace neat and clean.
28. Relate to me as if he/she is a responsible, admirable older sibling.
30. Help me to realize my life vision.

Seven demographic items were added to determine age, major, gender, classification, gender of the mentor, if the student currently had a mentor, and lastly, if the student lacked a mentor or had ever been exposed to mentoring.

The SIS was developed to determine the influence of science enrichment programs on students' social identity as a learner of science (referred to as science identity). SIS items were modeled after Oyserman's (2001) Racial and Ethnic Identity subscales and includes questions that emphasize connectedness, embedded achievement, and awareness of racism, as they pertain to science learning. The scale consists of 13 questions on a seven-point Likert scale that ranks importance, where 1 represents strongly disagree and 7 represents strongly agree. Eight of the questions were from the original researcher. This researcher included five additional questions (#2, 3, 11, 12, and 13) to address important aspects of the current study: persistence, STEM, mentoring, and HBCUs.

Procedures

Upon approval from the University of Southern Mississippi's IRB Department, the researcher contacted via email the department chair from Stillman College and the vice-president of data management (VP of DM) from Tuskegee University asking permission to recruit participants from various STEM courses for this study. The email included the researcher's approval letter from the Institutional Review Board (IRB) at the University of Southern Mississippi, an invitation detailing the aspects of the study, and the Qualtrics link to both surveys. Consequently, the department chair at Stillman College emailed the IRB approval letter, invitation to the study and the link to both surveys to STEM professors asking each of them to allow their students majoring in STEM to participate in the study.

The researcher was advised by the IRB director at Tuskegee University to forward the link to both surveys to the VP of DM. The VP of DM then contacted the researcher via email asking for additional information: what classification level was needed, if the researcher was seeking only STEM majors, and the number of participants needed for the study. Once the researcher provided the answers; the VP of DM informed the researcher that she would contact STEM professors and forward the link containing both surveys to them.

Students were administered the IMS and SI surveys through Qualtrics (Qualtrics, Provo, UT) in October and November, 2017. Student participation was voluntary and they could drop out of the study without any penalty at any time. To maintain confidentiality, students identified themselves with their own personal passwords associated with their email accounts.

The researcher collaborated via email with both the department chair at Stillman College and the VP of DM at Tuskegee University with updates pertaining to the response rate. The final results for the surveys from both institutions were gathered in late November.

Data Analysis

SPSS version 23 was used to analyze the data. Descriptive and statistical comparisons of means were used to answer the Overarching Research Question and Specific Research Question 1. Relationships among variables were examined utilizing Pearson’s correlation to answer Specific Research Question 2.

PRESENTATION AND ANALYSIS OF DATA

This chapter is a presentation and analysis of data used to answer three research questions.

1. Overarching Research Question: What ideal traits do students report as being the most important in an ideal mentor that could be a contributing factor in their persistence in STEM?
2. Specific Research Question One: To what degree do African American STEM students at two HBCUs in Alabama identify as a scientist as determined by Science Identity Scale Scores (SIS)?
3. Specific Research Question Two: What is the relationship of Ideal Mentor Scale Scores (IMS) and Science Identity Scale Scores (SIS) among African American STEM students at these HBCUs?

Statistical analysis was conducted using Qualtrics survey software through the University of Southern Mississippi and later transported into IBM SPSS statistics version 23 to be analyzed. Data was exported from Qualtrics into an Excel spreadsheet where the data were cleaned. Data were visually analyzed for missing data, inconsistencies, and outliers. Missing data were coded as 999. After initial cleaning, data were exported into SPSS for analysis. Each instrument was scored. The IMS was scored according to the scoring protocol established by Rose (2003). The three subscales (Integrity, Guidance, and Relationship) were identified and scored by averaging the items for each scale. The SIS score was calculated by averaging the responses of each category for each item.

Data were initially analyzed using measures of central tendencies (mean, median, mode, range, and standard deviation) and to further check for outliers (there were none). Data analysis also included Pearson Correlation to determine the relationship between IMS and SIS scores.

A total of 175 students from both data collection sites participated: 98 from Tuskegee University and 77 from Stillman College, both in the State of Alabama. No item was answered at 100%. Only 164 participants disclosed their classification: 118 (72%) of the participants classified themselves as freshmen, 18 (11%) as sophomores, 12 (7%) as juniors and 16 (10%) as seniors. Of the 164 participants, 118 (72%) identified as female, and 46 (28%) identified as male. Of the 164 participants, 66 (40%) were biology majors, 29 (18%) were computer science majors, 25 (15%) were non-STEM majors, 11 (7%) were animal science majors, 10 (6%) were mechanical engineering majors. Twenty-three (14%) of the participants were majoring in chemistry, mathematics, environmental science, marine biology, aerospace engineering, chemical engineering, electrical engineering, and microbiology.

The IMS includes an item that asked participants to identify whether or not they currently had a mentor. Sixty-five of 164 participants (40%) reported that they did, 99 (60%) reported that they did not (see Appendix D). Table 8 shows these data.

In response to the question, ‘Have you ever had a mentor,’ 99 of 164 participants (60%) responded yes (definitely or probably), 22 (13%) responded might or might not, and 43 (26%) responded probably not or definitely not. More of the participants reported that at some point they had interacted with a mentor figure, regardless as to whether or not they were able to identify the relationship as a mentor-mentee relationship (see .Appendix D). Table 9 shows these data.

In response to the question about the gender of the participant’s ideal mentor. Ninety-four of 143 participants (66%) reported that the preferred gender was female, while 49 (34%) reported that it was male (see Appendix D). Table 10 shows these data.

Tables 11 through 20 in Appendix D reveal student responses for questions exploring specific traits that students consider important for a mentor who could be a contributing factor in their persistence in STEM. Table 11 provides data regarding teaching them how to use relevant research techniques; Table 12 provides data regarding specific assignments related to their research; Table 13 provides data regarding maintaining a clear focus on research objectives; Table 14 provides data regarding being a role model to them; Table 15 provides data regarding the mentor’s ability to remain calm and collected during times of stress; Table 16 provides data regarding the mentor's ability to value them as a person; Table 17 provides data regarding the mentor's belief in the student's worth; Table 18 provides data regarding the mentor's recognition of the student's potential; Table 19 provides data regarding the mentor's help in realizing his or her life's vision; and Table 20 provides data regarding the mentor's commitment to work hard to help him or her accomplish goals. Students could select how important specific traits of a mentor were to them using the Ideal Mentor Scale, a five-point Likert scale ranging from 'not at all important' to 'extremely important'.

One hundred thirty-nine (83%) reported that an ideal mentor should show him or her how to employ relevant research techniques (see Appendix D). Table 11 shows these data.

One hundred twenty-four (74%) reported that an ideal mentor should give him or her specific assignments related to their research problem. (see Appendix D). Table 12 shows these data.

One hundred forty-nine (90%) reported that an ideal mentor should help him or her to maintain a clear focus on their research objectives (see Appendix D). Table 13 shows these data.

One hundred thirty-seven (82%) reported that it an ideal mentor should be his or her role model. (see Appendix D). Table 14 shows these data.

One hundred twenty-five (74%) reported that an ideal mentor should be calm and collected in times of stress (see Appendix D). Table 15 shows these data.

One hundred thirty-eight (84%) reported that an ideal mentor should value him or her as a person (see Appendix D). Table 16 shows these data.

One hundred fifty-two (92%) reported that an ideal mentor should believe in him or her (see Appendix D). Table 17 shows these data.

One hundred forty-two (87%) reported that an ideal mentor should recognize his or her potential (see Appendix D). Table 18 shows these data.

One hundred twenty-one (74%) reported that an ideal mentor should help him or her to realize their life vision (see Appendix D). Table 19 shows these data.

One hundred thirteen (69%) reported that an ideal mentor should work hard to help him or her to accomplish their goals (see Appendix D). Table 20 shows these data.

Fifty-three (31%) reported that an ideal mentor should rarely feel fearful or anxious (see Appendix D). Table 21 shows these data.

The second research question “to what degree do African American STEM students at HBCUs identify as a scientist?” was analyzed and answered using frequency data as shown in Tables 22 through 26. Students could select how they identified as a scientist using the Science Identity Scale, a seven-point scale ranging from ‘strongly disagree’ to ‘strongly agree’.

Sixty-two (45%) reported that he or she felt like a scientist when conducting science activities in a mentoring program (see Appendix D). Table 22 shows these data.

Eighty three (61%) reported that it was important to their family and African American community that he or she succeed in science (see Appendix D). Table 23 shows these data.

Eighty- four (60%) reported that people might have negative ideas about his or her ability to do science because of their ethnicity (see Appendix D). Table 24 shows these data

Eighty-five (62%) reported that if he or she worked hard and got good grades, they could become a scientist (see Appendix D). Table 25 shows these data.

Ninety-one of (66%) reported that if he or she succeeded in their science courses, they would persist and graduate in STEM (see Appendix D). Table 26 shows these data.

Research question three “what is the relationship of IMS scores and SIS scores among African American STEM students at HBCUs” was analyzed using a Pearson Correlation analysis of scores from each of the instruments (IMS and SIS). Pearson r revealed a positive strong to moderate relationship between the IMS subscales (integrity, guidance, and relationship). The three were also statistically significant. Pearson r did not reveal a relationship between the three

IMS subscales and SIS scores, neither was there a statistically significant relationship between the two (see Appendix D). Table 27 shows these data.

Table 5

Correlation of the Ideal Mentor Scale Subscales and Science Identity Scale Score.

		Integrity	Guidance	Relationship	SIS score
Integrity	Pearson Correlation	1	.80**	.56**	.10
	Sig. (2-tailed)		.00	.00	.19
	N	170	170	170	170
Guidance	Pearson Correlation	.79**	1	.52**	.05
	Sig. (2-tailed)	.00		.00	.55
	N	170	170	170	170
Relationship	Pearson Correlation	.56**	.52**	1	.06
	Sig. (2-tailed)	.00	.00		.47
	N	170	170	170	170
SIS score	Pearson Correlation	.10	.05	.06	1
	Sig. (2-tailed)	.19	.55	.47	
	N	170	170	170	170

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

A moderate positive relationship was found between 'do you currently have a mentor' and 'have you ever had a mentor. The two were also statistically significant. The relationship between 'do you currently have a mentor' and SIS score was a negative, weak correlation. This indicates that not having a mentor does have a negative impact on the science identity scale scores, but it is not a strong relationship. There was not a relationship between 'have you ever had a mentor' and SIS score, neither were the two statistically significant (see Appendix D). Table 28 shows these data.

Table 6

Correlations for Mentoring Relations.

		Do you currently have a mentor?	Have you ever had a mentor?	SIS score
Do you currently have a mentor?	Pearson Correlation	1	.42**	-.23**
	Sig. (2-tailed)		.000	.003
	N	164	163	164
Have you ever had a mentor?	Pearson Correlation	.42**	1	-.09
	Sig. (2-tailed)	.000		.24
	N	163	164	164
SIS score	Pearson Correlation	-.23**	-.09	1
	Sig. (2-tailed)	.003	.24	
	N	164	164	170

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

The purpose of this chapter was to provide an analysis of the data. The data were analyzed utilizing SPSS and the following analytical tests, descriptive statistics and Pearson's Correlation. This data analysis was designed to answer three research questions relating to ideal mentorship and science identity as it relates to STEM students at two Historically Black Colleges and Universities in the state of Alabama.

DISCUSSION

Overview

Chapter five presents a summary of the study's research design, a discussion of the findings, implications, limitations, and recommendations for future research and practice. Limitations are presented to help readers understand why results may have been affected. Recommendations for future research are addressed to provide readers with an overview of how to expand and utilize the results.

The purpose of this chapter is to summarize and discuss the research findings for a sample of 175 African American students who were majoring in STEM-related disciplines during fall semester 2017 at two private HBCUs in the state of Alabama. It begins with a summary of the research findings followed by a comparison of findings with general mentoring and science identity literature. An additional focus of this chapter is to identify and discuss the implications that the findings may have for improving educational experiences as it relates to mentoring and science identity, ultimately leading to an increase in students advancing and graduating in their designated disciplines.

Summary of the Study

This study was guided by the Ideal Mentor Scale and the conceptual framework of the Science Identity scale. This study examined undergraduate STEM majors' perception of an ideal mentor. This study also focused on students' perception of themselves as identifying with science as well as how society perceives them as it relates to science. The Ideal Mentor Scale and Science Identity scales were used in order to discover approaches for STEM programs and directors, STEM professors, and administrators to retain, graduate and offer beneficial relationships within such programs in order that these students may obtain baccalaureate degrees in STEM.

Despite the fact there is no clearly defined definition of a mentor nor recognizable traits or characteristics of a mentor, the participants in this study expressed their personal perception of what is deemed important when it comes to ideal traits of a mentor. Consequently they also have a perception of what it takes to succeed in their fields as it relates to science identity.

FINDINGS OF THE STUDY

Participants Classification

One hundred-eighteen (72%) of the participants were freshman and 18 (11%) were sophomores. According to research, this group of students are the most likely to exit the pipeline. Therefore, it is imperative to intervene and provide these students with the support they need in order for them to persist in science, technology, engineering, and math (STEM). According to Wineke and Certain (1990), minority students cannot earn graduate STEM degrees if they do not first achieve and persist in these disciplines at the undergraduate level. Many freshmen with declared or intended STEM majors attend large, lecture-based, fast-paced, hierarchically formatted classes (Wineke & Certain, 1990). These classes are part of a system within the science, education, and math disciplines that limits access to degrees by “weeding out” those whose academic abilities are allegedly not equal to the challenge (Massey, 1992; Seymour & Hewitt, 1997, p. 6). These classes are frequently described as difficult, unmotivating, and unrelated to whatever initiated a student’s intrinsic interest in science (Duderstadt, 1990; Gainen, 1995; Treisman, 1992). Even many well-prepared and bright students receive very low grades in these classes (Seymour & Hewitt, 1997). “From freshman to sophomore year, nearly 50 percent of college students who are interested in STEM drop their major and go to something else,” said Diandra Prescod (2016, p. 1), assistant professor of counselor education at Pennsylvania State University. While students’ reasons for leaving a STEM major vary, Prescod said there is one commonality: students do not adequately research their major to understand what it entails.

Participants Major and Gender

Sixty-six (40%) of the participants in the study were biology majors. This was an interesting finding because 118 (72%) of the participants were females. Only 46 (28%) of the participants were males. This study supported the findings of other studies that concluded females are now attending college and graduating at a higher rate than males (Holder, 2009). Also, literature states that females are more likely to major in biology, life science, and chemistry (Farenga & Joyce, 1999). This is a significant finding because there appears to be a relationship between biology majors and the female students in this study.

Science, technology, engineering and mathematics (STEM) fields are traditionally heavily dominated by males, which is of great concern to universities as they try to improve student retention and achievement. According to Zahra et al. (2013), females are much more interested in biology and chemistry than in physics, whereas the difference is not as extreme for males. Although men still outnumber females in engineering and math, one exception to that trend is in the field of biology. More than 60 percent of biology majors are female and about half of bioscience graduate students are women (Eddy, 2014). According to Holder (2009), at the University of California, Davis, like many colleges and universities across the United States and in other parts of the industrialized world, “the University of California, Davis no longer looks like your father’s campus that was heavily populated with males, but it very well may be your daughter’s” says Holder (2009, p. 1).

In the span of a single generation, undergraduate enrollment switched from predominantly male to predominantly female. The gender gap is even wider among students from low-income families and among underrepresented minorities — more than 60 percent of African American and Hispanic students at UC Davis are female. Why are there so fewer men attending college now verses females? According to Buchmann (2009), one of the biggest splits occur in families with a father who had little education or was absent — with sons much less likely than their sisters to go to college. Buchmann also indicated that girls have long gotten better grades in school than boys, but in the 1960s and 70s, many either did not go to college or dropped out to get married. With declining discrimination and a rising divorce rate, women have outpaced men in college graduation rates since 1982. “The generation of women who were born in the 1960s were the first to see their mothers getting divorced and having few options in the labor market,” Buchmann said. “Many of these women were likely thinking they wanted to avoid that situation by getting a college degree” (p. 3). In 2004, women received 58 percent of all bachelor’s degrees in the United States, compared to 35 percent in 1960.

Current and Past Status of a Mentor

Ninety-nine (60%) reported that he or she did not currently have a mentor, whereas sixty-five (40%) of the participants reported having a mentor. This finding indicates that perhaps the female students in the study had not identified or connected with a mentor, preferably one of like gender. In support of research on mentoring, there is a disparity of women mentors in STEM fields, particularly in academics which could be a major factor in these students not currently having a mentor. This, in turn, can lead to African American female students being at a crossroad because many of them prefer same-gender mentors. One must also take into consideration that the majority of the participants were freshmen whom have not made the connection with an otherwise faculty or peer mentor at their institutions.

Thomas and Hollenshead (2001) noted that for women of color in the academy, the establishment of mentoring relationships was minimal at best.

Those who have mentors often go beyond their academic area to find such support. One of the earliest studies of mentoring among African American graduate students was contributed by Blackwell (1983). His findings revealed that women were less likely to have mentoring relationships in comparison to their male counterparts.

Sixty-two of the (38%) reported with a definitely yes that he or she have had a mentor in the past. On the other hand, 37 (23%) responded yes (probably), 22 (13%) responded might or might not, and 43 (26%) responded probably and definitely not. Some of the participants appeared to be unsure of ever being involved in a mentor-mentee relationship although they had interacted with a mentor figure. This, in turn, adds to the body of knowledge provided by other studies which states that students in STEM fields have varied perceptions of both the definition and the perception of mentoring (George et al. 2005).

Ninety-four (66%) reported that having a female mentor in the past closely matched his or her definition of an ideal mentor, whereas only 49 (34%) stated that a male mentor closely matched their definition of an ideal mentor. Taking into account that 118 (72%) of the participants were female, this indicates that same gender mentors were highly rated for females in particular. Studies indicated that female students tend to identify and have a feeling of comfort with female mentors. Heinrich (1995) examined the mentoring relationships of doctoral recipients. Some of the participants in that study referred to mentoring relationships with women as a form of mothering. Their relationships with their advisors resembled the “warm relationships” they had with their parents (p. 512). Heinrich (1995) also indicated that women “unconsciously transferred aspects of their earliest relationships with mothering figures to their relationships with women dissertation committee members” (p. 447).

In another study, Neumark and Gardecki (1998) explored female doctoral students and the effects of mentoring by female faculty on the success of these students. They found strong evidence to support the idea that having a female faculty mentor reduced the amount of time to degree completion for women.

Reported Ideal Traits of a Mentor

Measures of central tendencies were done for the subscales. Statistical findings of the study indicated that a significant percent of the students with regard to the overarching research question: What ideal traits do students report as being the most important in an ideal mentor that could be a contributing factor in their persistence in STEM? The participants identified 11 of the 34 items in the Ideal Mentor Scale (IMS) as being very and extremely important.

Integrity Subscale

Participants were more interested in integrity than the guidance and relationship subscales in regards to mentoring relationships. According to Rose (2003), integrity relates to what students need as a mentee. The participants in this study valued five of the fourteen items on the integrity subscale of the IMS as being, very and extremely important. The items are listed in their order of importance:

1) One-hundred fifty-two (92%) reported than an ideal mentor should believe in him or her.
2) One hundred forty-two (87%) reported that an ideal mentor should recognize his or her potential.
2) One hundred thirty-eight (84%) reported that an ideal mentor should value him or her as a person.
3) One hundred thirty-seven (82%) reported that an ideal mentor should be his or her role model.
4) One hundred twenty-five (74%) reported that an ideal mentor should be calm and collected in times of stress.
5) One hundred thirteen (69%) reported that an ideal mentor should work hard to help him or her to accomplish their goals.

One hundred fifty-two (92%) reported that an ideal mentor should believe in him or her. When it comes to mutual respect and trust, a study done on a group of undergraduates and first year graduate students by Eller et al. (2014) noted that it was important to “respect, trust and appreciate each other.” Phrases used to describe important qualities of mentors included the words “honest,” “trusting,” and “respectful.” One student stated, “Mentors should believe in the student and trust the student’s ability” (p. 6).

One hundred forty-two (87%) reported that an ideal mentor should recognize his or her potential. Good mentors are able to identify potential strengths and limitations in their mentees and promote their career development.

For example, a good mentor “understands what the mentee is trying to accomplish in their career, and what their limitations are” (Strauss, et al., 2013, p. 5).

One hundred thirty-eight (84%) reported that an ideal mentor should value him or her as a person. According to Ambrose et al. (1997) and Muller (1999), one of the primary characteristics of effective mentoring includes the ability and willingness to value the mentee as a person.

Kram (1985) reported role modeling as the most frequently reported mentoring function. Jacobi (1991) also stated that one of the basic functions of a mentoring relationship was role modeling. One hundred thirty seven (82%) of the participants in this study approved this finding by agreeing that an ideal mentor should be his or her role model. Many authors divide the role of mentor into four subsidiary roles (sponsor, coach, role model, and counselor), attributing the collective functions of these roles to mentoring (Clutterbuck & Lane, 2004; Luecke, 2004; Murray, 2001).

According to Slaughter et al. (2006) of the Black Caucus and the Society for Research in Child Development, one of the needs and requirements for mentoring African American students includes suitable role models from similar cultural backgrounds who are knowledgeable about academic content in their areas.

One hundred twenty-five (74%) reported that an ideal mentor should be calm and collected in times of stress. According to Williams (2017), one of the qualities of a good mentor is to be calm. If you have a mentor that is stressed says (Williams), the student will be stressed. This in turn could create an environment that is not conducive to learning.

One hundred thirteen (67%) reported that an ideal mentor should work hard to help him or her to accomplish their goals. Ramirez (2012) reports that when it comes to college students, a mentor's role is to encourage the students to attain their goals, which may immediately involve graduating, securing a job, or pursuing postgraduate education in whatever area that has ignited their passion. Chapter two discusses the role and importance of peer mentoring among African American students. Heinrich (1995) completed a study on African American female graduate students. She stated that when they participated in peer-to-peer mentoring with fellow students, the students found their peers to be encouraging and they also helped them to reach their goals.

Jones (2013) reported that based on Rose's (2003) study, women scored higher than men on the Integrity scale. However, females were the majority in this study. According to Chickering and Reisser (1993), the development of integrity begins in young adults and continues throughout their lifetime. A mentor is particularly instrumental in helping students appreciate whether the values they espouse align with the behaviors they exhibit. A mentor's personal integrity is likely to be his or her students' most important inspiration to develop integrity in their own lives.

Guidance Subscale

The universal qualities of the ideal mentor can be defined as those qualities that almost every student agree are central to the definition of a mentor (Rose, 2003). On the IMS, these qualities were represented by those items that were rated by most students as being very and extremely important.

Statistical findings of the study indicated that the majority of the students identified three of the ten items on the guidance subscale as being very and extremely important. These items are numbered in order of importance:

1) One hundred forty-nine (90%) reported that an ideal mentor should help him or her to maintain a clear focus on his or her research objectives.
2) One hundred thirty-nine (83%) reported that an ideal mentor should help him or her to employ relevant research techniques.
3) One hundred twenty-four (74%) reported that an ideal mentor should give him or her specific assignments related to their research problem.

Ishiyama (2007) examined how first-generation, low-income, and/or African American students perceived a formal research-based mentoring relationship. Participants were asked about their perceptions of a mentor's role, to describe the benefits of a mentoring relationship, and to describe what they felt was a good mentoring relationship. Ishiyama also noted that expectations about the mentor’s role varied from student to student. Roles such as ‘gives advice about careers and graduate school’, ‘guides my research techniques’, ‘listens to my ideas', 'helps me find research literature', 'stands up for me and works on my behalf' are considered very important. Whereas 'helps me find internship opportunities', 'guides selection of my research topic',' listens to my personal concerns', 'is my friend' are somewhat important. Also, as discussed in chapter two (p. 28), faculty/student research mentorship programs create opportunities for faculty and students to work in a collegial manner around common interests.

On the other hand, Ramirez (2012) stated it was very appropriate for a student just being introduced to a mentor's research program to require frequent sessions in guiding the mentee in the project. He further states that a mentor's job is to become superfluous to some extent as the mentee becomes equipped to solve problems arising in the research project, though the mentee should have enough humility to know when to ask the mentor for guidance.

Relationship Subscale

The relationship subscale held less value than the guidance and integrity subscales. Relationship subscale items relate to personal interactions such as outings (i.e., dinner), and personal characteristics of a mentor. The participants valued two of the ten items on the ideal mentor scale as being very and extremely important: 1) one hundred twenty-one (74%) reported that an ideal mentor should help him or her to realize their life vision, and 2) fifty-three (32%) reported that an ideal mentor should rarely feel fearful or anxious.

One hundred twenty-one (74%) reported that an ideal mentor should help him or her to realize their life vision. Mentors must learn what students want in a career, what they want for their personal lives, and how their backgrounds might be different from their own. That information can then guide the mentor's advice and actions. Some students come to a mentor with clear ideas of what they need but may not articulate it clearly. Others may not even realize what areas they need to develop or strengthen. Listening carefully to subtext can help mentors understand what a mentee needs to succeed.

Fifty-three (32%) reported than an ideal mentor should rarely feel fearful or anxious. As indicated in The Mentoring Partnership of Southwestern Pennsylvania Program (1995), both the mentor and mentee may experience anxiety during the building stage of the peer mentoring. Very little research has been done on dysfunctional mentoring relationships. However, fear and anxiety, also known as "toxic relationships", have been described as psychological distress experienced among one or both parties in the mentoring relationship (Darling, 1985; Myers & Humphreys, 1985). Marshall (1994) also states fear and anxiety are not drawn from the mentoring literature, but rather from literature in psychology on abusive relationships.

The ideal traits revealed by these students in this study clearly shows the value they place on certain traits when it comes to mentoring. Also, in agreement with Crisp and Cruz (2009), "The open or lacking definition has understandably been described by researchers as an opportunity for the functions or characteristics of mentoring to be revealed by participants, allowing the definition to be reflective or representative of their own academic experience" (p. 528).

Science Identity

In regards to specific research question one: “To what degree do African American STEM students at two HBCUs in Alabama identify as a scientist as determined by Science Identity Scale Scores (SIS)”, results of frequency data indicated that students did not have a strong perception of themselves as scientists. This is important because ninety-nine (60.4%) reported he or she did not currently have a mentor. This can be traced back to the critical theme in this study of the science identity framework which states that students who have mentors are more likely to identify with science which will subsequently have an impact on increasing their interest in STEM. Recent scholars note that in addition to improving students' academic performance and providing students access to research experience with faculty mentors, the success of STEM enrichment programs is also enhanced by social psychological processes by which students come to identify as scientists (Carlone & Johnson, 2007; Egan et al., 2012; Lee, 1998, 2002; Merolla et al. 2012). Lee (1998) and Merolla et al. (2012) also support the idea that STEM enrichment programs have an effect on science identity because these programs provide students with social relationships based around scientific pursuits. Race, gender and ethnic identity influence one's science identity. To date, most studies linking science identity to student outcomes focus on attitudinal outcomes such as student interest in science or student intention to continue in scientific pursuits rather than behavioral outcomes such as entering a STEM graduate program (Lee, 1998, 2002; Merolla et al., 2012).

I Feel I am Part of a Science Community

Sixty-two (45%) reported that he or she felt that they were a part of a science community when they do science activities in the mentoring program (i.e. research, presentations, etc.). Vast amounts of literature report that when students are in a social environment with students that have like or similar interest, it can lead to a heightened interest in science, increased self-confidence, increased social skills, a sense of belonging, and academic success. The importance of engagement as a component of learning and the relationship between engagement and identity are paramount in culture of practice (COP) according to Wenger (1998):

> As we participate in the social aspects of learning by being a part of a group, our own ideas become incorporated into the community. As we learn and become more and more engaged, individual identity is altered and we begin to see ourselves as members of the community. (Wenger, 1998, p. 38)

How learning communities have become prevalent at many colleges and universities particularly HBCUs, was discussed in chapter two. The Meyerhoff Program at the University of Maryland Baltimore County received notoriety for its success rate in retaining and graduating students in STEM. According to Hrabowski, et al. (2000), students placed a high emphasis on the importance of summer research internships and mentoring as contributing factors to their academic success. The internships provided hands-on, meaningful research that gave students a realistic look at what scientists do. For many Meyerhoff students, these experiences helped them confirm their desire to pursue the Ph.D.

As stated by Dr. Ferguson, Distinguished Service Professor and Chair of Technology and Society and the College of Engineering and Applied Mathematics at Stony Brook University, cultural organizations such as the National Society of Black Engineers (NSBE) play a pivotal role in helping students to combat feelings of isolation. However, he believes these programs are not enough to provide the long term or sustainable support these students' need in order to succeed in STEM. Another successful program is the Long Island Group Advancing Science Education. Intervention for this program begins in grade school and continues through graduate school. It has had an immense impact on the majority of the student participants. The majority have enrolled in PhD and MD/PhD programs in some of the country's best universities.

Negative Ideas about My Ability to Do Science Due to My Ethnicity

Eighty-four (61%) reported that others have negative ideas about his or her ability to do science due to their ethnicity. These students are well aware of the stigma that underrepresented minorities face when they enter a STEM-related discipline. Science identity is based on how students view themselves and believe others view them as they participate in scientific endeavors. Students participate in multiple social communities where they must negotiate their identities back and forth along the rules and values set up by these communities (Furman & Calabrese Barton, 2006; Lave & Wenger, 1991). Researchers have characterized the language of STEM as reflecting White, middle-class, masculine norms, which may be at odds with norms of expression more likely found among women and students from historically underrepresented groups (Brandt, 2008; Lemke, 2001; Olitsky, 2006); this disconnect can prevent them from identifying with STEM (Carleone & Johnson, 2007; Olitsky, 2006; Ong, 2005).

Modern science as we have come to know it, and as it is viewed in many families and schools, has been and is still largely shaped by the ideas, experiences, and biases of European middle class males (Aschbacher, Li, & Roth, 2010). Thus, we recognize that student science identity involves how one sees oneself in relation to this culturally based and biased science, which is generally accepted and reproduced in schools and society states (Aschbacher, Li, & Roth, 2010). Findings by Bowen and Bok (1998) reflect that some Black students "reported to have lost their academic focus by devoting too much emotional energy to concerns about what other people were thinking and feeling about them" (p. 83). According to Hyde and Mertz (2009), negative race and gender stereotypes about ability are particularly salient in STEM fields and may convey signals around the inherent or fixed nature of ability. For instance, research has noted the "undervaluing" of females and minorities in STEM, with lower expectation of their presence among geniuses (Hyde & Mertz, 2009, p. 67). Also, students from historically underrepresented backgrounds may be particularly likely to experience low expectations exacerbated by bias and small numbers of students from their group (their token status) in the field (Crisp & Cruz, 2009). In STEM fields, underrepresented minorities and women may be particularly vulnerable to disengagement (leaving a STEM field of study) due to beliefs about their ability to succeed in STEM, even when accounting for prior academic preparation (Litzler et al., 2014). When it comes to negative stereotypes, students typically become unmotivated and fail to persist which impacts their academic performance.

It is possible that repeated exposure to stereotype threat in STEM courses among underrepresented students who intend to earn a STEM degree leads these students to "dis-identify" with STEM while at the same time retaining their connections to education and college more generally. In doing so, they still may be successful in attaining a college degree in another major area, but they would be less likely to attain STEM degrees or aspire to pursue STEM graduate degrees or careers (Crocker & Major, 1989; Osborne, 1997, 1999; Steele, 1997).

Important that I Succeed in Science

Eighty-three (61%) reported that it is important to their family as well as the African American community that he or she succeed in science. Hypothetically, the students in the study may have parents and family members in STEM-related fields that have encouraged them or had an impact on these students in pursuing a degree in STEM. Also, former teachers and peers may have influenced these students or perhaps there may have been other factors that sparked their interest in STEM. In other words, not only is their success important to them but also to those that may have motivated or encouraged them to pursue a STEM-related discipline. The literature provides little doubt that students are influenced by their relationships and daily social interactions with important people around them (Aschber, et al., 2009).

In order for students to succeed, researchers have identified a number of factors that are pivotal to the success of these students, such as insight into factors in K–12 that support the preparedness of minorities in STEM. These factors include early exposure to STEM (Seymour & Hewitt, 1997), self-efficacy in mathematics and science (Colbeck, Cabrera & Terezini, 2001; Perna et al., 2009), and culturally relevant teaching (Ladson-Billings & Tate, 1995). High parental involvement also plays a role in student success (Hrabowski & Maton, 1998). A supportive environment is theorized to form the foundation of HBCU's contributions to black student success (Arroyo & Gasman, 2014).

Research suggests that contact with faculty outside the classroom, and the development of mentoring relationships, including with minority faculty, can decrease academic isolation, and contribute to positive outcomes (Allen, 1992; Hilton, Hsia, Solorzano, & Benton, 1989; McHenry, 1997; Nettles, 1988; Redmond, 1990; Seymour & Hewitt, 1997). Furthermore, increasing the number of like-minded, highly able Black student peers can substantially enhance peer academic and social support, reduce perceptions of racism, and increase cultural comfort in science education and math (SEM) classes contributing to SEM academic persistence and success (Brazziel & Brazziel, 1997; Fries-Britt, 1994; Gandara & Maxwell-Jolly, 1999; Garrison, 1987; Nettles, 1988).

If I work hard and get good grades, I can become a scientist

Eighty-five (62%) reported that if he or she worked hard and got good grades they could become a scientist. Adding to the growing body of knowledge, one of the factors that is important to African American students is the notion that good grades usually equates to persistence which equates to graduation. Due to the high percentage of freshmen level students in this study, they have probably been exposed to 'gatekeeper' STEM courses. Perhaps the rigor and intense nature of these courses have increased students' realization that they've got to work hard in order to get good grades. Multiple studies have shown significant positive effects of interventions that target students' beliefs about their ability to succeed in STEM by suggesting that the causes of low grades are unstable (i.e., related to effort rather than ability) (Snipes et al., 2012). For example, in an intervention developed by Wilson and Linville (1985), some struggling first-year college students were shown videos of college seniors discussing how their grades were low in their first year but had improved over time through hard work (Snipes et al., 2012). Ferguson (2002) completed a study with over 40,000 students with one of his findings being that African American students reported that their friends believed it was "very important" (56%) "to study hard and get good grades" (p. 35).

If I succeed in my science courses I will persist and graduate in my STEM discipline

Ninety-one (66%) reported if he or she succeed in their science courses they would persist and graduate in their STEM discipline. Scholars have uncovered numerous interrelated correlates of persistence in STEM, which can be categorized as family background characteristics/socio-economic status (SES), academic history, and level of interest in STEM (Merolla & Serpe, 2013). Therefore, it would be interesting to know from this study the number of students that are first-generation college students and those that are from households with college educated parents. Several studies have indicated that first-generation college students are more likely to persist in STEM and go on to graduate school. According to Benderly (2015), the desire to earn a good income and improve their financial status motivates first-generation college students more strongly than it does students with college-educated parents. First-generation college students (i.e., those from families in which neither parent attained any education beyond high school) were less likely to choose a math or science major according to Chen and Carroll (2005). On the other hand, most research literature indicates that students from families with higher incomes and more highly educated parents are more likely to persist in education compared to their less advantaged counterparts (Goyette & Mullen, 2006; Grandy, 1998; Lee, 2005; Paulsen & St. John, 2002; Sirin, 2005; Vartanian et al., 2007).

The Relationship between the IMS and the SIS Scores

In regard to specific research question two: “What is the relationship between IMS scores and SIS scores among African American STEM students at these HBCUs,” one hundred seventy-five students from two HBCUs were surveyed about their perception of an ideal mentor based on the assessed values of the IMS subscales; guidance, integrity and relationship. In order to find the relationship between the IMS scores and SIS scores, Pearson r Correlation was done. The Pearson r data analysis revealed a strong to moderate positive correlation between integrity, guidance, and relationship, but not with SIS score. There was a statistically significant relationship between the IMS subscales: integrity, guidance and relationship. However, there was not a statistically significant relationship between the IMS subscales and SIS scores. A positive strong correlation was revealed between integrity and guidance. A positive strong to moderate correlation was revealed between integrity and relationship. A positive strong to weak correlation was found between integrity and the SIS score. Pearson r analysis revealed a strong to moderate positive correlation between guidance and relationship. A strong but weak positive relationship existed between guidance and SIS score respectively. The Pearson r analysis revealed a moderate to weak positive correlation between relationship and SIS score. Because there is a relationship between the IMS subscales, this confirms previous studies that students value the importance of mentoring in STEM-related disciplines (see Appendix D). Table 27 shows these data.

Findings from Lee (1998) and Merolla et al. (2012) have found that STEM enrichment programs such as mentoring can increase the salience of a science identity. If the findings were accurate, the IMS subscales would have a positive effect on science identity. However, causality could not be inferred due to there not being enough evidence to support the findings of this study. A number of other factors should be taken into account such as decreased response rates on the SIS (138 respondents). The scale was originally designed for graduate students which could have made some of the questions difficult to answer; also, the students may not have understood how science identity is defined or what it entails. The participants' responses to both scales may not have been from the same participants. Because the majority of the participants were freshmen it is highly likely they do not have a faculty mentor in their respective discipline.

Correlation for Mentoring Relations and Science Identity Scale Scores

In order to find the relationship between 'Do you currently have a mentor,' 'Have you ever had a mentor' and SIS score, Pearson r correlation was done. The Pearson r analysis revealed a strong to moderate positive correlation between 'Do you currently have a mentor' and 'Have you ever had a mentor'. There was also a statistically significant relationship between the two. The Pearson r analysis revealed a strong but negative weak correlation between 'Do you currently have a mentor' and SIS score. Pearson r analysis revealed a statistically significant relationship between 'Do you currently have a mentor' and SIS score respectively. The Pearson r analysis revealed a moderate to negative weak correlation between ‘Have you ever had a mentor’ and SIS score nor was there a statistically significant relationship between the two (see Appendix D). Table 28 shows these data.

Summary

According to the Science Identity Framework used in this study, students exposed to STEM intervention programs with a mentoring component, tend to be motivated, confident, have an increased interest in STEM, and display enhanced social skills from interacting with other students in STEM-related disciplines. Also, these students tend to persist in STEM. All of the above factors are related to students’ identifying with science. According to the literature, the bulk of research on the links between science identity and student outcomes has been conducted using advanced graduate students or students engaged in enrichment programs (Carlone & Johnson, 2007; Ong, 2005). Therefore, my contribution to the research on science identity gives readers an opportunity to understand the relationship between mentoring and science identity among undergraduate students attending HBCUs.

The researcher can do a follow-up study with the freshmen and sophomore students during their junior and/or senior year in order to get an accurate assessment of their academic success and persistence.

Limitations of the Study

The following limitations are acknowledged for this study:

1. The IMS was extensively long, consisting of thirty-four items. This could have impacted the completion of it by participants, which likely affected full participation in the thirteen items of SIS.
2. The study was limited to students attending two HBCUs in the state of Alabama. Therefore, the results cannot be generalized to all African Americans and/or all students majoring in STEM.
3. The study did not include a proportionate number of males (forty-nine) and females (one hundred-eighteen), nor a proportionate number of freshmen (one hundred-eighteen), sophomore (eighteen), junior (twelve) and senior level students (sixteen), which can impact evidence of the validity and reliability of this study.
4. In regards to those students who currently have mentors and those who had contact with a mentor figure in the past, the length of the mentoring relationship was not addressed nor was the quantity and frequency of contact between the mentor and mentee. This was needed to see if students benefited from the mentoring relationship.
5. One of the disadvantages of a questionnaire is that the respondents may not understand a question adequately.
6. Freshmen- and sophomore-level students' perception of an ideal mentor may differ from junior- and senior-level students.
7. Lastly, perceptions of an ideal mentor of female students may differ from male students.

Recommendations for Future Research

The following recommendations are made for future research:

1. Utilize the IMS and SIS across all ethnic groups.
2. Conduct more studies using SIS. According to Hazari, et al. (2013), there are very few studies that explore science identity at the college level.
3. Conduct more studies using SIS specific for each discipline (i.e. Biology identity, Chemistry identity, Math identity, etc.) according to (Basu, Barton, Clairmont, & Locke, 2009; Hazari, Sonnert, Adler, & Shanahan, 2010).
4. Conduct qualitative research on science identity with focus groups and personal interviews. This would offer more information and opportunity from students to express what science identity means to them, when and at what point does a specific culture identify with science and why.
5. Conduct qualitative research on mentoring with focus groups and personal interviews. This would offer more information and insight by allowing students to verbalize their perception of a mentor in order to recognize traits of an ideal mentor. As stated in the rationales of this study by George et al. (2005), both faculty and students in science, technology, engineering, and mathematics fields had varied views of both the definition and perceptions of mentoring. It was further stated in the literature review that the open or lacking definition has

understandably been described by researchers as an opportunity for the functions or characteristics of mentoring to be revealed by participants, allowing the definition to be reflective or representative of their own academic experience (Crisp & Cruz, 2009).

APPENDIX A – Ideal Mentor Scale

Research indicates strong agreement among Ph.D. candidates that the *ideal mentor* would exhibit the following attributes:

- Be experienced in his or her field.
- Have a lot of intellectual curiosity.
- Always be counted on to follow through when he or she makes a commitment.
- Treat research data in an ethical fashion.
- Communicate openly, clearly, and effectively.
- Be available to students to discuss academic problems.
- Challenge students to explore alternative approaches to a problem.
- Provide honest feedback (both good and bad) to students about their work.
- Express a belief in the student's capabilities.

While the above attributes are **central** to an *ideal mentoring relationship*, we know that often such relationships can encompass a wider variety of functions. Furthermore, there are individual differences among undergraduate STEM candidates with respect to the type of mentoring functions they prefer.

The Ideal Mentor Scale was written to help students identify the relative importance of several additional mentor functions and characteristics.

The Ideal Mentor Scale consists of 34 items that reflect aspects of a mentoring relationship that may or may not be important to you. Please rate each item according to how **important** that mentor attribute is to you now, at your current stage of your undergraduate program.

In the CURRENT column please rate your CURRENT ADVISOR/MENTOR attributes or function.

In the IDEAL column please rate what your IDEAL ADVISOR/MENTOR attributes or functions would be

Ideal Mentor Scale Scoring Protocol

All items are to be scored on a 5-point rating scale ranging from:

1 Not at all important

2

3 Moderately important

4

5 Extremely important

To calculate the score for each scale, simply add the scores for each item on that scale and divide by the number of items.

Integrity item numbers (14 items):3, 5, 7, 8, 10, 12, 14, 17, 19, 21, 23, 26, 29, 32

Guidance item numbers (10 items):1, 2, 6, 9, 13, 16, 27, 31, 33, 34

Relationship item numbers (10 items): 4, 11, 15, 18, 20, 22, 24, 25, 28, 30

Interpretation

INTEGRITY:

High scores indicate a preference for a mentoring style characterized by respectfulness for self and others and empowerment of protégés to make deliberate, conscious choices about their lives. Students who score high on Integrity desire a mentor who exhibits virtue and principled action and can be emulated as a role model.

GUIDANCE:

High scores indicate a preference for a mentoring style characterized by helpfulness with the tasks and activities typical of graduate study.

RELATIONSHIP:

High scores indicate a preference for a mentoring style characterized by the formation of a personal relationship involving sharing such things as personal concerns, social activities, and life vision or worldview.

Answer each item by circling a number 1-5 according to the following importance rating:

Not at all Important	Slightly Important	Moderately Important	Very Important	Extremely Important
1	2	3	4	5

	Ideal	Current
1. . . . show me how to employ relevant research techniques.	1 2 3 4 5	1 2 3 4 5
2. . . . give me specific assignments related to my research problem.	1 2 3 4 5	1 2 3 4 5
3. . . . prefer to cooperate with others than compete with them.	1 2 3 4 5	1 2 3 4 5
4. . . . help me to maintain a clear focus on my research objectives.	1 2 3 4 5	1 2 3 4 5
5. . . . respect the intellectual property rights of others.	1 2 3 4 5	1 2 3 4 5
6. . . . be a role model.	1 2 3 4 5	1 2 3 4 5
7. . . . brainstorm solutions to a problem concerning my research project.	1 2 3 4 5	1 2 3 4 5
8. . . . be calm and collected in times of stress.	1 2 3 4 5	1 2 3 4 5
9. . . . treat me as an adult who has a right to be involved in decisions that affect me.	1 2 3 4 5	1 2 3 4 5
10. . . . help me plan the outline for a presentation of my research.	1 2 3 4 5	1 2 3 4 5
11. . . . inspire me by his or her example and words.	1 2 3 4 5	1 2 3 4 5
12. . . . rarely feel fearful or anxious.	1 2 3 4 5	1 2 3 4 5
13. . . . help me investigate a problem I am having with research design.	1 2 3 4 5	1 2 3 4 5
14. . . . be seldom sad or depressed.	1 2 3 4 5	1 2 3 4 5
15. . . . advocate for my needs and interests.	1 2 3 4 5	1 2 3 4 5
16. . . . generally try to be thoughtful and considerate.	1 2 3 4 5	1 2 3 4 5
17. . . . be a cheerful, high-spirited person.	1 2 3 4 5	1 2 3 4 5
18. . . . value me as a person.	1 2 3 4 5	1 2 3 4 5
19. . . . keep his or her workspace neat and clean.	1 2 3 4 5	1 2 3 4 5
20. . . . believe in me.	1 2 3 4 5	1 2 3 4 5
21. . . . meet with me on a regular basis.	1 2 3 4 5	1 2 3 4 5
22. . . . relate to me as if he/she is a responsible, admirable older sibling.	1 2 3 4 5	1 2 3 4 5
23. . . . recognize my potential.	1 2 3 4 5	1 2 3 4 5
24. . . . help me to realize my life vision.	1 2 3 4 5	1 2 3 4 5
25. . . . help me plan a timetable for my research.	1 2 3 4 5	1 2 3 4 5
26. . . . work hard to accomplish his/her goals.	1 2 3 4 5	1 2 3 4 5
27. . . . provide information to help me understand the subject matter I am researching.	1 2 3 4 5	1 2 3 4 5
28. . . . be generous with time and other resources.	1 2 3 4 5	1 2 3 4 5

29. What is your major (Circle One)?

Biology **Chemistry** **Physics** **Physical Science** **Engineering** **Mathematics**

30. What is your classification (Circle One)? **Freshman** **Sophomore** **Junior** **Senior**

31. What is your gender (Circle One)? **Male** **Female**

32. Do you currently have a mentor (Circle One)? **Yes** **No**

33. What is the gender of your mentor? **Male** **Female**

34. Have you ever had a mentor? **Yes** **No**

35. What was the gender of your mentor that most closely matched your definition of an ideal mentor? **Male** **Female**

APPENDIX B – Science Identity Scale

All items are to be scored on a 7-point rating scale ranging from:

1	2	3	4	5	6	7
Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree Nor Disagree	Somewhat Agree	Agree	Strongly Disagree

Science Subscale Questions

1. I have a lot of pride in what African Americans have done and achieved in science
2. I feel close to other African Americans that have the same major as myself.
3. I feel that I am part of a science community because I do science activities in the mentoring program (i.e. research, presentations, etc.).
4. I feel that I am part of a science community because I do science activities in school.
5. It is important for my family and the African American community that I succeed in science.
6. If I work hard and get good grades in science, other African Americans will respect me.
7. It helps me when other African Americans do well in science.
8. People might have negative ideas about my ability to do science because I am an African American.
9. If I work hard and get good grades, I can become a scientist.
10. Having a mentor will help me to succeed in science.
11. Not having a mentor I will succeed in science.
12. If I succeed in my science courses, I will persist and graduate in my STEM discipline.
13. If I attend an HBCU (i.e., Historically Black College and University) my ability to do science will increase because the majority of my peers and faculty are of the same race.

James (2007)

APPENDIX C – Dr. Sylvia James Approval Letter

Ms. Smith:

Please use this email as documentation that I have granted permission for you to use the science identify scale developed for my 2007 dissertation (Identity and science learning in African American students in informal science education contexts by James, Sylvia M. Ed.D., Morgan State University, 2007, 222 pages; AAT 3300822) in your dissertation research on the relationship between mentor and science identity. I appreciate the courtesy that you have extended in making this request and wish you much success with your work. Feel free to share the results of your dissertation with me when you have completed your studies. Thank you.

Sylvia James

Sylvia M. James, Ed.D.
National Science Foundation
Director, Division of Human Resource Development (HRD)
Directorate for Education and Human Resources (EHR)
4201 Wilson Blvd., Suite 815
Arlington, VA 22230

Voice: (703) 292-5333
E-mail: sjames@nsf.gov<mailto:sjames@nsf.gov>

APPENDIX D – Descriptive Statistics Tables

Table 5

What is your classification?

	Frequency	Percent
Freshman	118	72.0
Sophomore	18	11.0
Junior	12	7.3
Senior	16	9.8
Total	164	100.0

Table 6

What is your gender?

	Frequency	Percent
Male	46	28.0
Female	118	72.0
Total	164	100.0

Table 7

What is your major?

	Frequency	Percent
Biology	66	40.2
Marine Biology	1	.6
Chemistry	1	.6
Environmental Science	8	4.9
Mathematics	5	3.0
Aerospace Engineering	4	2.4
Chemical Engineering	1	.6
Mechanical Engineering	10	6.1
Electrical Engineering	2	1.2
Computer Science	29	17.7
Animal Science	11	6.7
Microbiology	1	.6
Other	25	15.2
Total	164	100.0

Table 8

Do you currently have a mentor?

	Frequency	Percent
Yes	65	39.6
No	99	60.4
Total	164	100.0

Table 9

Have you ever had a mentor?

	Frequency	Percent
Definitely yes	62	37.8
Probably yes	37	22.6
Might or might not	22	13.4
Probably not	14	8.5
Definitely not	29	17.7
Total	164	100.0

Table 10

What was the gender of your mentor that closely matched your definition of an ideal mentor?

	Frequency	Percent
Male	49	34.3
Female	94	65.7
Total	143	100.0

Table 11

An ideal mentor shows me how to employ relevant research techniques.

	Frequency	Percent
Not at all important	3	1.8
Slightly important	5	3.0
Moderately important	21	12.5
Very important	75	44.6
Extremely important	64	38.1
Total	168	100.0

Table 12

An ideal mentor gives me gives me specific assignments related to my research problem.

	Frequency	Percent
Not at all important	2	1.2
Slightly important	7	4.2
Moderately important	34	20.4
Very important	75	44.9
Extremely important	49	29.3
Total	167	100.0

Table 13

An ideal mentor helps me to maintain a clear focus on my research objectives.

	Frequency	Percent
Slightly important	4	2.4
Moderately important	13	7.8
Very important	60	36.1
Extremely important	89	53.6
Total	166	100.0

Table 14

An ideal mentor should be a role model

	Frequency	Percent
Not at all important	3	1.8
Slightly important	5	3.0
Moderately important	22	13.2
Very important	32	19.2
Extremely important	105	62.9

Table 15

An ideal mentor should be calm and collected in times of stress.

	Frequency	Percent
Not at all important	3	1.8
Slightly important	5	3.0
Moderately important	35	20.8
Very important	53	31.5
Extremely important	72	42.9
Total	168	100.0

Table 16

An ideal mentor should value me as a person.

	Frequency	Percent
Not at all important	2	1.2
Slightly important	6	3.7
Moderately important	18	11.0
Very important	49	29.9
Extremely important	89	54.3
Total	164	100.0

Table 17

An ideal mentor believes in me.

	Frequency	Percent
Slightly important	2	1.2
Moderately important	11	6.7
Very important	38	23.0
Extremely important	114	69.1
Total	165	100.0

Table 18

An ideal mentor recognizes my potential.

	Frequency	Percent
Not at all important	2	1.2
Slightly important	5	3.1
Moderately important	14	8.6
Very important	53	32.5
Extremely important	89	54.6
Total	163	100.0

Table 19

An ideal mentor helps me to realize my life vision.

	Frequency	Percent
Not at all important	3	1.8
Slightly important	9	5.5
Moderately important	30	18.4
Very important	56	34.4
Extremely important	65	39.9
Total	163	100.0

Table 20

An ideal mentor should work hard to help me accomplish my goals.

	Frequency	Percent
Not at all important	1	.6
Slightly important	12	7.3
Moderately important	38	23.2
Very important	69	42.1
Extremely important	44	26.8
Total	164	100.0

Table 21

An ideal mentor rarely feels fearful and anxious.

	Frequency	Percent
Not at all important	19	11.4
Slightly important	39	23.4
Moderately important	56	33.5
Very important	35	21.0
Extremely important	18	10.8
Total	167	100.0

Table 22

I feel as though I am a part of a science community because I do science activities in the mentoring program (i.e. research, presentations, etc.).

	Frequency	Percent
Strongly disagree	1	.7
Disagree	9	6.5
Somewhat disagree	6	4.3
Neither agree nor disagree	33	23.9
Somewhat agree	27	19.6
Agree	32	23.2
Strongly agree	30	21.7
Total	138	100.0

Table 23

It is important for my family and the African American community that I succeed in science.

	Frequency	Percent
Strongly disagree	2	1.5
Disagree	5	3.6
Somewhat disagree	5	3.6
Neither agree nor disagree	22	16.1
Somewhat agree	20	14.6
Agree	41	29.9
Strongly agree	42	30.7
Total	137	100.0

Table 24

People may have negative ideas about my ability to do science because I am an African American

	Frequency	Percent
Strongly disagree	3	2.2
Disagree	5	3.6
Somewhat disagree	6	4.3
Neither agree nor disagree	15	10.8
Somewhat agree	26	18.7
Agree	25	18.0
Strongly agree	59	42.4
Total	139	100.0

Table 25

If I work hard and get good grades, I can become a scientist.

	Frequency	Percent
Strongly disagree	1	.7
Disagree	2	1.5
Somewhat disagree	4	2.9
Neither agree nor disagree	15	10.9
Somewhat agree	30	21.9
Agree	32	23.4
Strongly agree	53	38.7
Total	137	100.0

Table 26

If I succeed in my science courses I will persist and graduate in my STEM discipline.

	Frequency	Percent
Strongly disagree	2	1.4
Disagree	3	2.2
Somewhat disagree	5	3.6
Neither agree nor disagree	15	10.9
Somewhat agree	22	15.9
Agree	37	26.8
Strongly agree	54	39.1
Total	138	100.0

Table 27

Correlation for Ideal Mentor Scale Subscales and Science Identity Scale Score

CHAPTER II		Integrity	Guidance	Relationship	SIS score
Integrity	Pearson Correlation	1	.80**	.56**	.10
	Sig. (2-tailed)		.00	.00	.19
	N	170	170	170	170
Guidance	Pearson Correlation	.79**	1	.52**	.05
	Sig. (2-tailed)	.00		.00	.55
	N	170	170	170	170
Relationship	Pearson Correlation	.56**	.52**	1	.06
	Sig. (2-tailed)	.00	.00		.47
	N	170	170	170	170
SIS score	Pearson Correlation	.10	.05	.06	1
	Sig. (2-tailed)	.19	.55	.47	
	N	170	170	170	170

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

Table 28

Correlations for Mentoring Relations.

		Do you currently have a mentor?	Have you ever had a mentor?	SIS score
Do you currently have a mentor?	Pearson Correlation	1	.42**	-.23**
	Sig. (2-tailed)		.000	.003
	N	164	163	164
Have you ever had a mentor?	Pearson Correlation	.42**	1	-.09
	Sig. (2-tailed)	.000		.24
	N	163	164	164
SIS score	Pearson Correlation	-.23**	-.09	1
	Sig. (2-tailed)	.003	.24	
	N	164	164	170

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

Descriptive Statistics

	N	Mean	Std. Deviation
Science Identity Scale (SIS)			
I have a lot of pride in what African Americans have done and achieved in science.	138	6.04	1.337
If I work hard and get good grades, I can become a scientist.	137	5.77	1.296
If I succeed in my science courses I will persist and graduate in my STEM discipline.	138	5.75	1.404
Not having a mentor I will still succeed in science.	137	5.67	1.335
People might have negative ideas about my ability to do science because I am an African American.	139	5.64	1.560
Having a mentor will help me to succeed in science.	138	5.62	1.363
It is important for my family and the African American community that I succeed in science.	137	5.51	1.466
I feel close to other African Americans that have the same major as myself.	137	5.47	1.345
I feel that I am part of a science community because I do science activities in school.	139	5.26	1.590
If I work hard and get good grades in science, other African Americans will respect me.	138	5.25	1.514
It I attend an HBCU (i.e. Historically Black College and University), my ability to do science will increase because the majority of my peers and faculty are of the same race.	79	5.25	1.597
It helps me when other African Americans do well in science.	137	5.12	1.549
I feel that I am part of a science community because I do science Activities in the mentoring program (i.e. research, presentations, etc.).	138	5.12	1.490

	N	Mean	Std. Deviation

Ideal Mentor Scale (IMS)			
An ideal mentor believes in me.	165	4.60	.670
An ideal mentor helps me to maintain a clear focus on my research objectives.	166	4.41	.739
An ideal mentor should be a role model.	167	4.38	.949
An ideal mentor respects the intellectual property rights of others.	168	4.36	.815
An ideal mentor recognizes my potential.	163	4.36	.859
An ideal mentor should value me as a person.	164	4.32	.899
An ideal mentor should treat me as an adult who has a right to be involved in decisions that affect me.	167	4.23	.905
An ideal mentor should inspire me by his or her example and words.	167	4.19	.855
An ideal mentor shows me how to employ relevant research techniques.	168	4.14	.877
An ideal mentor should be calm and collected in times of stress.	168	4.11	.954
An ideal mentor helps me to realize my life vision.	163	4.05	.986
An ideal mentor provides information to help me understand the subject matter I am researching.	164	4.04	.926
An ideal mentor prefers to cooperate with others rather than compete with them.	166	3.99	1.036
An ideal mentor generally tries to be thoughtful and considerate.	165	3.98	.956
An ideal mentor gives me specific assignments related to my research problem.	167	3.97	.881
An ideal mentor should work hard to help me accomplish my goals.	164	3.87	.914
An ideal mentor helps me to investigate a problem I am having with my research design.	167	3.87	.922
An ideal mentor is generous with his/her time and other resources.	164	3.85	.963
	N	Mean	Std. Deviation

An ideal mentor helps me to plan a timetable for my research.	163	3.73	1.054
An ideal mentor should be a cheerful, high-spirited person.	164	3.71	1.073
An ideal mentor is an advocate for my needs and interests.	166	3.68	1.039
An ideal mentor should meet with me on a regular basis.	165	3.66	1.085
An ideal mentor should brainstorm solutions to problems concerning my research project.	167	3.63	1.015
An ideal mentor should accept me as a junior colleague.	168	3.61	1.003
An ideal mentor should keep his or her work space neat and clean.	165	3.39	1.151
An ideal mentor should help me plan an outline for a presentation of my research.	168	3.37	1.086
An ideal mentor should relate to me as if he/she is a responsible, admirable older sibling.	166	3.18	1.309
An ideal mentor rarely feels fearful or anxious.	167	2.96	1.156
An ideal mentor is seldom sad or depressed.	165	2.47	1.295
An ideal mentor should have coffee or lunch with me on occasion.	165	2.25	1.146
An ideal mentor talks to me about his or her personal problems.	165	2.07	1.175
An ideal mentor takes me out for dinner after work,	167	1.72	1.097
Valid N (listwise)	170		

APPENDIX E – Dr. Gail Rose Permission Letter

The University of Vermont

HEALTH BEHAVIOR RESEARCH CENTER
DEPARTMENT OF PSYCHIATRY
UNIVERSITY HEALTH CENTER, OLD HALL 3
BURLINGTON, VT 05401
TEL (802)-847-6860 FAX (802)-847-1446

October 26, 2015

Mary Smith
Instructor of Biology
3060 Wilson Road, S.W.
Birmingham, Alabama 35221

Dear Ms. Smith,

You have my permission to use the Ideal Mentor Scale [©The University of Iowa] with minor modifications. Be sure to attribute authorship of the original Ideal Mentor Scale to me as follows:

> Rose, G.L. (1999). *What do doctoral students want in a mentor? Development of the ideal mentor scale.* Unpublished doctoral dissertation, The University of Iowa.

Keep in mind that the psychometric properties of the instrument extend only to the original instrument, and not necessarily to any revisions. When administering the IMS in a modified fashion, or to a different population than the one in which it was developed, or – most importantly – if any factor analysis is to be done, my recommendation is to administer the core items from the cover page of the instrument (shown below) along with the rest of the instrument. This is because these items were found to be universally valued to *PhD students at research intensive universities* but will not necessarily be universally valued by other populations.

Core attributes of the Ideal Mentor:

- Be experienced in his or her field
- Have a lot of intellectual curiosity
- Always be counted on to follow through when he or she makes a commitment
- Treat research data in an ethical fashion
- Communicate openly, clearly, and effectively
- Be available to students to discuss academic problems
- Challenge students to explore alternative approaches to a problem
- Provide honest feedback (both good and bad) to students about their work
- Express a belief in the student's capabilities

Best wishes,

Gail Rose

Gail Rose

APPENDIX F IRB Approval Letter

THE UNIVERSITY OF
SOUTHERN MISSISSIPPI

INSTITUTIONAL REVIEW BOARD
118 College Drive #5147 | Hattiesburg, MS 39406-0001
Phone: 601.266.5997 | Fax: 601.266.4377 | www.usm.edu/research/institutional.review.board

NOTICE OF COMMITTEE ACTION

The project has been reviewed by The University of Southern Mississippi Institutional Review Board in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services (45 CFR Part 46), and university guidelines to ensure adherence to the following criteria:

- The risks to subjects are minimized.
- The risks to subjects are reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequate and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- Any unanticipated, serious, or continuing problems encountered regarding risks to subjects must be reported immediately, but not later than 10 days following the event. This should be reported to the IRB Office via the "Adverse Effect Report Form".
- If approved, the maximum period of approval is limited to twelve months. Projects that exceed this period must submit an application for renewal or continuation.

PROTOCOL NUMBER: 12345678
PROJECT TITLE: How to Achieve IRB Approval at USM
PROJECT TYPE: New Project
RESEARCHER(S): Jonas Doe
COLLEGE/DIVISION: College of Education and Psychology
DEPARTMENT: Psychology
FUNDING AGENCY/SPONSOR: N/A
IRB COMMITTEE ACTION: Expedited Review Approval
PERIOD OF APPROVAL: 01/02/2015 to 01/01/2016
Lawrence A. Hosman, Ph.D.
Institutional Review Board

REFERENCES

Abriam-Yago, K. (2002). Mentoring to empower. *Minority Nurse*, 64–65. Retrieved from http://minoritynurse.com/mentoring-to-empower/

Abraham J. P., Lujan S. S., López E. E., &Walker M. T. (2002). Graduating students' perceptions of outcomes of college experiences at a predominantly Hispanic university. *Journal of Hispanic Higher Education, 1*(3), 267–276.

Abu-Bader, S. (2006). *Using statistical methods in social work practice: A complete SPSS guide.* Chicago, IL: Lyceum Books.

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

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

Allen, W., Epps, E., & Haniff, N. (Eds.). (1991). *College in black and white: African American students in predominantly white and in historically black public universities*. New York: SUNY Press.

Allen, T. D., Eby, L. T., & Lentz, E. (2006a). Mentorship behaviors and mentorship quality associated with formal mentoring programs: Closing the gap between research and practice. *Journal of Applied Psychology, 97*(3), 567–578.

Alpert, J. S., Gardner, T. J., & Tiukinhoy, S.D. (2003). *The mentoring relationship. Mentoring handbook* (pp. 1–20). Dallas: American Heart Association.

Ambrose, S. A., Dunkle, K. L., Lazarus, B. B., Nair, I., & Harkus, D. A. (1997). *Journeys of women in science and engineering: No universal constants.* Philadelphia: Temple University Press.

Amelink, C. T. (2008). *Overview: Mentoring and women in engineering*. Retrieved from http://www.aweonline.org

Anderson, E. M., & Shannon, A. L. (1988). Toward a conceptualization of mentoring. *Journal of Teacher Education, 39*(1), 38–42.

Antonio, A. L. (2002). Faculty of color reconsidered: Reasoning contributions to scholarship. *Journal of Higher Education, 73,* 582–602.

Aronson J., Fried, C., & Good, C. (2002). Reducing the effects of stereotype threat on African American college students by shaping theories of intelligence. Journal of Experimental Social Psychology, *38*, 113–125.

Arroyo, A. (2010). It's not a colorless classroom: Teaching religion online to Black college students using transformative, postmodern pedagogy. *Teaching Theology and Religion, 13*(1), 35–50.

Arroyo, A. T., & Gasman, M. (2014). An HBCU-based educational approach for black college student success: Toward a framework with implications for all institutions. *American Journal of Education, 121*(1) 57–85. https://doi.org/10.1086/678112

Arum, R., & Josipa, R. (2011). *Academically adrift: Limited learning on college campuses*. Chicago: University of Chicago Press.

Aschbacher, P. R., Li, E., Roth, E .J. (2010). Is science me? High school students' identities, participation and aspirations in science, engineering, and medicine. *Journal of Research in Science Teaching, 47*(5), 564-582.

Atkins, S., & Williams, A. (1995). Registered nurses' experiences of mentoring undergraduate nursing students. *Journal of Advanced Nursing, 21,* 1006–1015.

Bandura, A. (1977). *Self-efficacy: The exercise of control*. New York: W. H. Freeman and Company.

Barlow, A., & Villarejo, M. (2004). Making a difference in minorities: Evaluation of an educational enrichment program. *Journal of Research in Science Teaching, 41*(9), 861–881.

Basu, S. J., Barton, A. C., Clairmont, N., & Locke, D. (2009). Developing a framework for critical science agency through case study in a conceptual physics context. *Cultural Studies of Science Education*, 4, 345-371.

Beauboeuf-Lafontant, T. (1999). A movement against and beyond boundaries: Politically relevant teaching among African American teachers. *Teacher's College Record, 100*(4), 702–703.

Benderly, B. (2015). Minority Ph.D. students: Where do they go? Science. Posted in: Blog, Workplace Diversity, Academic, United States. DOI: 10.1126/science.caredit.a1500098.

Bernier, A., Larose, S., & Soucy, N. (2005). Academic mentoring in college: The interactive role of students' and mentor's interpersonal dispositions. *Research in Higher Education, 46*(1), 29–51.

Blackwell, J. E. (1983). Networking and mentoring: A study of cross-generational experiences of black graduate and professional schools. Atlanta, GA: Southern Education Foundation.

Blackwell, J. E. (1989). Mentoring: An action strategy for increasing minority faculty. *Academe, 75*(5), 8–14.

Blackburn, R. T., Cameron, S. M., & Chapman, D. W. (1981). "Cloning" in academia: Mentorship and academic careers. *Research in Higher Education, 15,* 315–327.

Boice, R. (1992). Lessons learned about mentoring. *New Directions for Teaching and Learning, 50,* 51–56.

Bordes, V., & Arredondo, P. (2005). Mentoring and 1st year Latino/a college students. *Journal of Hispanic Higher Education*, *4*(2), 114–133.

Bowen, W. G., & Bok, D. (1998). *The shape of the river: Long-term consequences of considering race in college and university admissions.* Princeton, NJ: Princeton University Press.

Boykin, A. W. (1983). On academic task performance and Afro-American children. In J. Spence (Ed.), *Achievement and achievement motives: Psychological and sociological approaches.* San Francisco: W. H. Freeman.

Boyle, P., & Boyce, B. (1998). Systematic mentoring for new faculty teachers and graduate teaching assistants. *Innovations in Higher Education*, *22*, 157–159.

Brainard, S.G., & Carlin, L. (1998). A six-year longitudinal study of undergraduate women in engineering and science. *Journal of Engineering Education*, *87*(4), 369-375.

Brandt, C.B. (2008). Discursive geographies in science: Space, identity, and scientific discourse among indigenous women in higher education. *Cultural Studies in Science Education*, *3*, 703–730.

Brawer, F. B. (1996). *Retention-attrition in the nineties*. Washington, DC: Office of Educational Research and Improvement. (ERIC Document Reproduction Service No. ED 393 510).

Brazziel, W.F., & Brazziel, M.E. (1997). Distinctives of high producers of science and engineering doctoral starts. *Journal of Science Education and Technology*, *6*, 145- 153.

Brickhouse, N. W. (2001). Embodying science: A feminist perspective on learning. *Journal of Research in Science Teaching, 38(3),* 282–295.

Brickhouse, N. W., Lowery, P., & Schultz, K. (2000). What kind of girl does science? The construction of school science identities. *Journal of Research in Science Teaching, 37*(5), 441–458.

Brickhouse, N. W., & Potter, J. T. (2001). Young women's scientific identity formation in an urban context. *Journal of Research in Science Teaching, 38*(8), 965–980.

Brown, M. C., Davis, G. L., & McClendon, S. A. (1999). Mentoring graduate students of color: Myths, models, and modes. *Peabody Journal of Education, 74*(2), 105–118.

Brown, B. A., Reveles, J. M., & Kelly, G. J. (2005). Science literacy and discursive identity: A theoretical framework for understanding science learning. *Science Education, 89,* 779–802.

Buchmann, C. (2009). Gender gap: More female students than males attending universities. *UC Davis Magazine.*

Buchmann, C., DiPrete, T. A., & McDaniel, A. (2008). Gender inequalities in education. *Annual Review of Sociology, 34*, 319–337. https://doi.org/10.1146/annurev.soc.34.040507.134719.

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

Business Higher Education Forum (BHEF). (2006). The American competitive initiative: Addressing the STEM teacher shortage and improving student academic readiness. Retrieved on December 20, 2010 from http://www.bhef.com/brief3_s06.pdf

Calabrese, Barton, A., & Yankg, K. (2000). The culture of power and science education: Learning from Miguel. *Journal of Research in Science Teaching, 37(8),* 871–889.

Campbell, T. A., & Campbell, D. E. (1997). Faculty/student mentor programs: Effects on academic performance and retention. *Research in Higher Education 38*(6), 727–742.

Carleone, H. B., & Johnson, A. (2007). Understanding the science experiences of successful women of color: Science identity as an analytic lens. *Journal of Research in Science Teaching, 44*(8), 1187–1218.

Carlson, J. R., & Zmud, R. W. (1999). Channel expansion theory and the experiential nature of media richness perceptions. *Academy of Management Journal*, *42*, 153–170.

Carlson, W. S., & Single, P. B. (2000). *Factors related to success in electronic mentoring of female college engineering students by mentors by working in industry.* Paper presented at the annual meeting of the National Association for Research in Science Teaching, New Orleans, LA.

Carr, P. L., Bickel, J., & Inui, T. S. (2003). *Taking root in a forest clearing: A resource guide for medical faculty.* Boston: Boston University School of Medicine.

Carter, F. Mandell, M., & Maton, K. (2009). The influence of on-campus, academic year undergraduate research on stem PhD outcomes: Evidence from the Meyerhoff Scholarship Program. *Educational Evaluation and Policy Analysis, 31*(4), 441–465.

Case, K. I. (1997). African American other mothering in the urban elementary school. *The Urban Review, 29,* 25–39.

Center for Institutional Data Exchange Analysis. (2000). 1999–2000 SMET retention report. Norman, OK: University of Oklahoma.

Chao, G. T., Walz, P. M., & Gardner, P. D. (1992). Formal and informal mentorships: A comparison on mentoring functions and contrast with nonmentored counterparts. *Personnel Psychology, 45*(3), 619–636.

Chang, M.J., Cerna, O.S., Han, J., & Sáenz, V. (2008). The contradictory roles of institutional status in retaining underrepresented minorities in biomedical and behavioral science majors. *The Review of Higher Education. 31*(4), 433–464.

Chang, M. J., Eagan, M., Lin, M. H., & Hurtado, S. (2011). Considering the impact of racial stigmas and science identity: Persistence among biomedical and behavioral science aspirants. *Journal of Higher Education, 82*(5), 564–596.

Chao, G. T. (1997). Mentoring phases and outcomes. *Journal of Vocational Behavior, 51*, 15–28.

Chemers, M .M., Zurbiggen E., Barbara Goza, M. S., &Bearman, S. (2011). The role of efficacy and identity in science career commitment among underrepresented minority students. *Journal of Social Issues*, *67*(3), 469–491.

Chen, X., & Carroll. D. (2005). First-generation students in postsecondary education: A look at their college transcripts. Postsectondary Education Descriptive Analysis Report. National Center for Education Statistics, 171.

Chesler, M., & Chesler, N. (2002). Gender-informed mentoring strategies for women engineering scholars: On establishing a caring community. *Journal of Engineering Education, 97,* 49–55.

Chesler, N., Single, P., & Mikic, B. (2003). On belay: Peer-mentoring and adventure education for women faculty in engineering. *Journal of Engineering Education, 92,* 257–262.

Chickering, A. W., & Reisser, L. (1993). *Education and identity.* San Francisco, CA: Jossey-Bass.

Clark, K. (2009, February). Why Black colleges might be the best bargains. *U.S. News and World Report*. Retrieved from http://www.usnews.com/education/ articles/2009/02/09/why-Black-colleges-might-be-the-best-bargains

Clark, R. A., Harden, S. L., & Johnson, W. B. (2000). Mentor relationships in clinical psychology doctoral training: Results of a national survey. *Teaching of Psychology, 27,* 262–268.

Clifford, M. W. (2009). *Exploring mentoring experiences in college student affairs: A Q methodology study*. UNF Theses and Dissertations. Paper 201. http://digitalcommons.unf.edu/etd/201.

Cloward, R. D. (1976). Teenagers as tutors of academically low-achieving children: Impact on tutors and tutees. In V. L. Allen (Ed.), *Children as teachers: Theory and research on tutoring* (pp. 219–229). New York: Academic Press.

Clutterbuck, D., & Lane, G. (Eds.). (2004). *The situational mentor: An international review of competencies and capabilities in mentoring.* Burlington VT: Gower.

Cohen, N. H. (1995). The principles of adult mentoring scale. *New Directions for Adult and Continuing Education, 66,* 15–32.

Cokley, K. (2002). The impact of college racial composition on African American students' academic self-concept: A replication and extension. *Journal of Negro Education*, *71,* 288–296.

Cokley, K. O., & Chapman, C. (2008). The roles of ethnic identity, anti-white attitudes, and academic self-concept in African American student achievement. *Social Psychology of Education 11*(4), 349–365.

Colbeck, C., Alberto, L., Cabrera, F., & Terenzini, P. T. (2001). Learning professional confidence: Linking teaching practices, students' self-perceptions, and gender. *The Review of Higher Education, 24*(2), 173–191.

Collier, P. J., & Morgan, D. L. (2006, August). *Students' first mentoring project: Using role theory to improve low-income, first generation student retention.* Paper presented at the annual meeting of the American Sociological Association, Montreal Convention Center, Montreal, Quebec.

Collins, M. (1992). *Ordinary children, extraordinary teachers*. Charlottesville, VA: Hampton Roads.

Collins, P. H. (2000*). Black feminist thought: Knowledge, consciousness, and the politics of empowerment.* New York*:* Rutledge.

Committee on Institutional Cooperation (CIC). (2004a). *Summer research opportunity program.* Champaign, IL: Committee on Institutional Cooperation.

Committee on Institutional Cooperation (CIC). (2004b). CIC 2004–2007*: Taking collaboration to the next level.* Champaign, IL: Committee on Cooperation.

Costello, C. Y. (2005). *Professional identity crisis: Race, class, gender, and success at professional schools.* Nashville, TN: Vanderbilt University Press.

Crisp, G. (2009). Conceptualization and initial validation of the college student mentoring scale (CSMS). *Journal of College Student Development, 50*(2), 177–194.

Crisp, G., & Cruz, I. (2009). Mentoring college students: A critical review of the literature between 1990 and 2007. *Research in Higher Education, 50*, 525–545. DOI: 10.1007/s1162-009-9130-2.

Crocker, J., & Major, B. (1989). Social stigma and self-esteem: The self-protective properties of stigma. Psychological Review, *96*, 608–630.

Cronan-Hillix, T., Genshewimer, L. K., Cronan-Hillix, W. A., & Davidson, W. S. (1986). Students' views of mentors in psychology graduate training. *Teaching of Psychology, 13*(3), 123–127.

Cross, K. P. (1998). Why learning? Why now? *About Campus, 5,* 4–11.

Daloz-Reeves, R. A. (2001). *The survey of the characteristics and dimensions of mentoring: An investigation of the mentoring experience of African American graduate students in departments of sociology*. (Unpublished doctoral dissertation). University of Chicago.

Darke, K., Clewell, B. C., & Sevo, R. (2002). Meeting the challenge: The impact of the national science foundation's program for women and girls. *Journal of Women and Minorities in Science and Engineering, 8*(31), 1–20.

Darling, L. W. (1985). What to do about toxic mentors. *The Journal of Nursing Administrators*, 15:43-44

Davidson, V. J., Vance, J. M., & Niemer, D. A. (2001, July). *Women in engineering leadership institute: Academic leadership development plans*. Paper presented at ICWES12 12th Conference of Women Engineers and Scientists. Ottawa, Canada. Retrieved from http://www.weli.eng.iastate.edu/Documents/pdf/0215_ fullpaper.pdf

Davis, R. (1991). Social support networks and undergraduate student academic-success-related outcomes: A comparison of Black students on Black and White campuses. In W. R. Allen, E. G. Epps, & N. Z. Haniff (Eds.), *College in black and white: African American students in predominantly white and in historically black public universities* (pp. 143–157). Albany, NY: State University of New York University Press.

DeFour, D., & Hirsch, B.J. (1990). The adaption of Black graduate students: Asocial network approach. *American Journal of Community Psychology*, *18*, 487–503.

Denecke, D. D., Frasier, H. S., & Redd, K. E. (2009). The council of graduate schools' PhD completion project. In R. G. Ehrenberg & C. V. Kuh (Eds.), *Doctoral education and the faculty of the future* (pp. 35–52). Ithaca, NY: Cornell University Press.

Dickey, C. (1996). *Mentoring women of color at the University of Minnesota: Challenges for organizational transformation*. Minneapolis: University of Minnesota. (ERIC) Document Reproduction Service No. ED399838).

DiRenzo M. S., Linnehan, F. Shao, P., & Rosenberg, W. L. (2010). A moderated mediation model of e-mentoring. *Journal of Vocational Behavior, 76,* 292–305.

Dirks, C., & Cunningham, M. (2006). Enhancing diversity in science: Is teaching science process skills the answer? *CBE--Life Sciences Education, 5,* 218–226.

Dobrow, S. R., Chandler, D. E., Murphy, W. M., & Kram, K. E. (2012). A review of developmental networks: Incorporating a mutuality perspective. *Journal of Management*, *38*, 210–242.

Dodge, L., & Kendall, M. (2004). Learning communities. *College, 52,* 150–155.

Douglas, C. (1997). Formal mentoring and cultural diversity in academic setting. *American Behavioral Science, 38,* 188–200.

Douglas, T. R M. O. (2012). HBCUs as sites of resistance: The malignity of materialism, western masculinity, and spiritual malefaction. *Urban Review*, *44*(3), 378–400.

Drewry, H., & Humphrey D. (2001). *Stand and prosper: Private Black colleges and their students*. Princeton, NJ: Princeton University Press.

Duderstadt, J. J. (1990). America at the crossroads: The challenge of science education. In W. R. Wineke & P. Certain (Eds.), *The freshman year in science and engineering: Old problems, new perspectives for research universities* (pp. 21–27). University Park, PA: Alliance for Undergraduate Education.

Eddy, S. (2014). More than half of biology majors are women, yet gender gaps remain in science classrooms. Science Daily. Arizona State University

Edwards, J. L., & Gordon, S. M. (2006). *You should–I should: Mentoring responsibilities as perceived by faculty, alumni, and students.* Paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA.

Egan, M. K., Hurtado, S., Garibay, J., & Herrera, F. (2012). *Accentuating advantage: Developing science identity during college.* Paper presented at American Educational Research Association Conference. Vancouver, BC, Canada.

Eller, L. S., Lev, E. L., & Feurer, A. (2014). Key components of an effective mentoring relationship: A qualitative study. *Nursing Education Today*, *34*(5), 815–820. Doi: 10.1016/j.nedt.2013.07.020.

Ensher, E. A., & Murphy, S. E. (2007). E-mentoring: Next-generation research and strategies. In B. R. Ragins & K. E. Kram (Eds.), *The handbook of mentoring at work: Theory, research and practice* (pp. 299–322). Thousand Oaks, CA: Sage.

Erikson, E. H. (1994).*Identity: Youth and crisis*. Oxford England: Norton & Co.

Fadigan, K. A., & Hammrich, P. L. (2004). A longitudinal study of the educational and career trajectories of female participants of an urban informal science education program. *Journal of Research in Science Teaching, 41*(8), 835–860.

Farenga, S. J., & Joyce, B. A. (1999).Intentions of young students to enroll in science courses in the future: An examination of gender differences. *Science Education, 83,* 55–75.

Ferguson, R. F. (2002). Addressing racial disparities in high achieving suburban schools. North Central Regional Educational Laboratory, Policy Issues #13.

Ferguson, D. L. (2004). Building a community of minority scholars in science, technology, engineering and mathematics. Stony Brook University.

Fiason, J. J. (1996). *The next generation: The mentoring of African American graduate students on predominantly white university campuses.* Paper presented at the annual meeting of the American Educational Research Association, New York.

Fleming, J. (1984). *Blacks in college: A comparative study of students' success in black and in white institutions*. San Francisco: Jossey-Bass.

Flemming, J., Tezeno, A., & ZaMORA, S. (2008). The retention and planning process at Texas Southern University: A case study. In M. B. Gasman & C. L. Tudico (Eds.), *Historically black colleges and universities.* New York: Palgrave McMillian.

Freeman, H.A. III. Transforming the Educational Experience of young men of color. NOSCA: National office for School Counselor Advocacy, (1), 28-31.

Freeman, K. (1999). No services needed? The case for mentoring high-achieving african american students. *Peabody Journal of Education*, *74*(2), 15-26.

Fries-Britt, S. (1998). Moving beyond black achiever isolation: Experiences of gifted black collegians. *The Journal of Higher Education, 69*(5), 556–576.

Fries-Britt, S. L. (1994). *A test of Tinto's retention theory on the Meyerhoff Scholars: A case study analysis.* Unpublished doctoral dissertation, University of Maryland, College Park.

Fries-Britt, S., & Turner, B. (2002). Uneven stories: Successful black collegians at a black and white campus. *The Review of Higher Education, 25*(3), 315–330.

Furman, M., & Calabrese Barton, A. (2006). Capturing urban student voices in the creation of a science minidocumentary. *Journal of Research in Science Teaching, 43*(7), 667–694.

Gainen, J. (1995). Barriers to success in quantitative gateway courses. In J. Gainen & E. Willemsen (Eds.), Fostering success in quantitative gateway courses. San Francisco: Jossey- Bass.

Gallien, L., & Peterson S. M. (2005). *Instructing and mentoring the African American college student: Strategies for success in higher education*. Boston: Allyn & Bacon.

Gandara, P., & Maxwell-Jolly, J. (1999). *Priming the pump: Strategies for increasing the achievement of underrepresented minority undergraduates.* NY: The College Board.

Garrison, H. H. (1987). Undergraduate science and engineering education for Blacks and Native Americans. In L. S. Dix (Ed.), *Minorities: Their underrepresentation and career differentials in science and engineering.* Proceedings of a workshop. Washington, DC: National Academy Press.

Gasman, M. (2010). Bolstering African-American success in the STEM fields. *Chronicle of Higher Education*.

Gasman, M., & Arroyo, A.T. (2014). An HBCU-based educational approach for black college student success: Toward a framework with implications for all institutions. *American Journal of Education, 121*(1), 57–85. http://dx.doi.org/10.1086/678112

Gattis, D. M. S. (2008). *Mentoring doctoral students: Ideal mentors, perceived mentoring benefits, and relational health.* Doctoral Dissertation, University of Oklahoma, Norman, OK.

Gay, L., Mills, G., & Airasian, P. (2006). *Educational research competencies for analysis and applications* (8th ed.). New Jersey: Pearson.

General Accounting Office (GAO). (2005). Higher education: Federal science, technology, engineering, and mathematics programs and related trends. GAO Highlights (GAO-06-114), a report to the Chairman, Committee on Rules, House of Representatives.

George, Y.S., & Neale, D. (2005). Project report. Washington, DC: American Association for the Advancement of Science (AAAS).

Gilbert, L. A. (1985). Dimensions of same-gender student-faculty role model relationships. *Sex Roles, 12,* 111–123.

Ginorio, A. B., & Grignon, J. (2000). The transition to and from high school of ethnic minority students. In G. Campbell, R. Denes, & C. Morrison (Eds.), *Access denied: Race, ethnicity, and the scientific enterprise* (pp. 151–173). New York: Oxford University Press.

Godshalk, V. M., & Sosik, J. J. (2000). Does mentor-protégé agreement on mentor leadership style influence the quality of mentoring relationships? *Group & Organization Management, 25,* 291–317.

Godshalk, V. M. (2007). Social implications of e-mentoring: Why might e-mentoring work? In F. Li (Ed.), *Social implications and challenges of e-business* (pp. 31–45). Hershey, PA: Idea Group.

Gokhale, A. A. (1995). Collaborative learning enhances critical thinking. *Journal of Technology Education, 7,* 22–30.

Goleman, D. (1995). *Emotional intelligence.* New York: Bantam Books.

Good, C. (2012). Why do women opt out? Sense of belonging and women's representation in mathematics. *Journal of Personality and Social Psychology*, *102*(4), 700–717.

Goyette, K., & Mullen A. (2006). Who studies the arts and sciences? Social background and the choice and consequences of undergraduate field of study. *Journal of Higher Education*, *77*(3), 497–538.

Grandy, J. (1998). Persistence in science of high-ability minority students: Results of a longitudinal study*. Journal of Higher Education, 69*(6), 589–620.

Grantham, T. C., & Ford, D. Y. (2003). Beyond self-concept and self-esteem for African American students: Improving racial identity improves achievement. *High School Journal, 87,* 4–7.

Guiffrida, D. (2005). To break away or strengthen ties to home: A complex issue for African American college students attending a predominantly White institution. *Equity and Excellence in Education 38*(1), 49–60.

Guiffrida, D. (2006). Toward a cultural advancement of Tinto's theory. *Review of Higher Education 29*(4), 451–472.

Gunn, E. (1995). Mentoring: The democratic version. *Training, 32*(8), 64.

Hale, F. W. (2004). Introduction: The complications and challenges in the championing of diversity. In F. W. Hale (Ed.), *What makes racial diversity work in higher education: Academic leaders present successful policies and strategies* (pp. 3–23). Sterling, VA: Stylus Publishing.

Haley, K., Jaeger, A., & Levin, J. (in press). To be or not to be: The influence of cultural identity on choosing a faculty career for graduate students of color. *Journal of College Student Development.*

Hammond, P., & Davis, B. (2005). From idea to graduation: The evolution of the first PhD program in a HBCU. *ABNF Journal* 1*6*(6), 112–117.

Hamilton, B. A., & Scandura, T. A. (2003). E-mentoring: Implications for organizational learning and development in a wired world. *Organizational Dynamics, 31,* 388-402.

Handelsman, J., Ebert-May, D. Beichner, R., Bruns, P., Chang, A., DeHaan, R., Gentile, J., Lauffer, S., Stewart, J., Tilghman, S., & Wood, W. (2004). Scientific teaching. *Science, 304*, 521–522.

Hanson, S. L. (1996). *Lost talent,* Philadelphia, PA: Temple University.

Harding, S. (1998). Is science multicultural? Postcolonialisms, feminisms, and epistemologies. Bloomington, IN: Indiana University Press.

Haring, M. J. (1999). The case for a conceptual base for minority mentoring programs. *Peabody Journal of Education, 74*(2), 5–14.

Harmon, N. (2012). The role of minority-serving institutions in national college competition goals. Washington, DC: Institute of Higher Education Policy.

Harper, S. (2009). Institutional seriousness concerning black male student engagement: In S. R. Harper & S. Quaye (Eds.), *Student engagement in higher education: Theoretical perspectives and practical approaches for diverse populations.* New York: Routledge.

Harper, S. (2012). *Black male student success in higher education: A report from the national Black male college achievement study.* Center for the Study of Race and Equity in Education, University of Pennsylvania, Philadelphia.

Harper, S.R., & Newman, C.B. (Eds). (2010). Students of color in STEM (New Directions for Institutional Research, No. 148). San Francisco, CA: Jossey-Bass.

Harris, T. R., Bransford, J. D., & Brophy, S. P. (2002). Roles for learning sciences and learning technologies in biomedical engineering education: A review of recent advances. *Annual*, 732–739*. Review of Biomedical Engineering 4,* 29–48.

Hauer, K. E., Teherani, A., Dechet, A., & Aagarrd, E. M. (2005). Medical students' perception of mentoring: A focus group analysis. *Medical Teacher, 27*(8).

Hazari, Z., Sonnert, G., Sadler, P. M., & Shanahan, M. C. (2010). Connecting high school physics experiences, outcome expectations, physics career choice: A gender study. *Journal of Research in Science Teaching 47*(8), 978–1003.

Hazari, Z., Potvin, G., Lock, R. M., Lung, F., Sonnert, G. & Sadler, P. M. (2013). Factors that affect the physical science career interest of female students: Testing five common hypotheses. *Physical Review Special Topics – Physics Education Research*, *9*(2), 020115.

Heinrich, K. T. (1995). Doctoral advisement relationships between women: On friendship and betrayal. *The Journal of Higher Education, 66*, 447–469.

Hewlett, S. A., Luce, C. B., & Servon, L. J. (2008). *The Athena factor: Reversing the brain in scienc, engineering, and technology*: Watertown, MA: Harvard Business School.

Higgins, M. C., Chandler, D. E., & Kram, K. E. (2007). Developmental initiation and developmental networks. In B. R. Ragins & K. E. Kram (Eds.), *The handbook of mentoring at work: Theory, research, and practice* (pp. 349–372). Thousand Oaks, CA: Sage.

Hill-Butler, D. (2007, November). Africana mothering: Shifting roles and emerging contradictions. *The Journal of Pan African Studies, 2*(1), 1–3.

Hilton, T.L., Hsia, J., Solorzano, D.G., & Benton, N.L. (1989). Persistence in science of high-ability minority students. Princeton, NJ: Educational Testing Service.

Hogg, M.A., Terry, D.J., & White, K.M. (1995). A tale of two theories: A critical comparison of identity theory with social identity theory. *Social Psychology Quarterly, 58*(4), 255–269.

Holder, K. (2009). Gender gap: More female students than males attending universities. *UC Davis Magazine*.

Howard, J. (2014). *How does racial identity effect African American college students' ability to assimilate on predominantly White college campuses and its impact on retention: A mixed method study.* (Unpublished Doctoral dissertation).

How to get the mentoring you want: A guide for graduate students at a diverse university. (1999). The University of Michigan. Retrieved from http://www.rackhamumich.edu/StudentsInfo/Publications/StudentMentoring/contents.html

Hrabowski, F. A. III. (2012). Transforming the educational experience of young men of color. NOSCA: National Office for School Counselor Advocacy, 1, 28–31.

Hrabowski, F. A., & Maton, K. I. (1998). *Beating the odds: Raising academically successful African American males*. New York: Oxford University Press.

Hrabowski, F. A., Maton, K. I., & Schmitt, C. L. (2000). African American college student excelling in the sciences: College and post college outcomes in the meyerhoff scholars program. *Journal of Research in Science Teaching*, *37*(7), 629-654.

Hurtado, S., Han, J. C., Sa'enz, V. B., Espinosa, L. L., Cabrera, N. L., & Cerna, O. S. (2007). Predicting transition and adjustment to college: Minority biomedical and behavioral science students' first year of college. *Research in Higher Education, 48*(7), 841–887.

Hurtado, S., Eagan, M. K., Cabrera, N. L., Lin, M. H., Park, J., &Lopez M. (2008). Training future scientists: Predicting first-year minority student participation in health science research. Research in Higher Education, *49*(2), 126–152.

Hyde, J. S., & Mertz J. E. (2009). Gender, culture, and mathematics performance. *Proceedings of the National Academy of Sciences of the United States of American, 106*(22), 8801–8807.

Ishiyama, J. (2007). Expectations and perceptions of undergraduate research mentoring: Comparing first generation, low-income White/Caucasian and African American students. *College Journal, 41*(3), 540–549.

Jackson, V. A., Palepu, A., Szalacha, L., & Caswell, C. (2010). *Why so few?* American Association of University Women. Retrieved from http://www.aauw.org/learn/research/upload/whysofew.pdf

Jackson, V. A., Palepu, A., Szalacha, L., Caswell, C., Carr, P. L., & Inui, T. (2003). Having the right chemistry. *A Qualitative Study of Mentoring in Academic Medicine, 78* (3), 328–334.

Jaeger, A., Haley, K., & Levin, J. (2010). *Not all going in the same direction: The effects of social identity on graduate student career choices.* Paper presented at the annual conference of the American Educational Research Association, Denver, CO.

James, S. (2007) Identity and science learning in african american students in informal science education context (Doctoral dissertation). ProQuest dissertation and Thesis. Publication number: AAI3300822.

Jett, C. (2013). HBCUs propel African American male mathematics majors. *Journal of African American Studies, 17*(2), 189–205.

Johnson, A., Brown, J., Carlone, H., & Cuervas, A. (2011). Authoring identity amidst the treacherous terrain of science: A multicultural examination of the journeys of three women of color in science. *Journal of Research in Science Teaching, 48*(4), 339–366.

Johnson, D.R. (2011). Examining sense of belonging and campus racial diversity experiences among women of color in STEM living learning programs. *Journal of Women and Minorities in Science and Engineering*, *17*(3), 209-223.

Johnson, D.R. (2012). Campus racial climate perceptions and overall sense of belonging among racially diverse women in STEM majors. *Journal of College Student Development*, *53*(2), 336-346.

Johnson, C. S. (1989). Mentoring programs. In M. L. Updraft & J Gardner (Eds.), *The freshman year experience: Helping students survive and succeed in college* (pp. 118–128). San Francisco: Jossey-Bass.

Jones, K. (2013). *The relationship between ideal mentoring and selected characteristics of African American social work doctoral students*. Doctoral Dissertation, Morgan State University. Baltimore, Maryland.

Jones, M., Barlow, A., & Villarejo, M. (2010). Importance of undergraduate research for minority persistence and achievement in biology. *The Journal of Higher Education, 81*(1), 82–115.

Kahveci, A., Southerland, S. A., & Gilmer, P. J. (2006). Retaining undergraduate women in science, mathematics, and engineering. *Journal of College Science Teaching, 36*(3), 34–38.

Kanter, R. M. (1977).*Men and women of the corporation.* New York: Basic Books.

Kimbrough, W., & Harper, S. (2006). African American men at historically Black colleges and universities: Different environments, similar challenges. In M. J. Cuyjet (Ed.), *African American men in college* (pp. 189–209). San Francisco: Jossey-Bass.

Kitchener, K. S. (1992). Psychologist as teacher and mentor: Affirming ethical values throughout the curriculum. *Professional Psychology: Research and Practice, 23,* 190–195.

Kram, K. E., & Isabella, L. A. (1985). Mentoring alternatives: The role of peer relationships in career development. *Academy of Management Journal, 28*(1), 110–132.

Knapp, L., Kelly-Reid, J., & Ginder, S. (2011, February 11). *Enrollment in Postsecondary Institutions, Fall 2009; Graduation Rates, 2003 & 2006 Cohorts; and Financial Statistics, Fiscal Year 2009: First look.* (NCES 2011-230). Retrieved from http://nces.ed.gov/pubsearch

Ko, L.T., Kachchaf, R. R., Hodari, A.K., & Ong, M. (2014). Agency of women of color in physics and astronomy: Strategies for persistence and success. *Journal of Women and Minorities in Science and Engineering, 20*(2), 171-195.

Koberg, C. S., Boss, R. W., & Goodman, E. (1998), Factors and outcomes associated with mentoring among health-care professional. *Journal of Vocational Behavior, 58,* 58–72.

Kuh, G., & Love, P. (2000). A cultural perspective on student departure. In John M. Braxton (Ed.), *Reworking the Student Departure Puzzle*. Nashville: Vanderbilt University Press.

Kumashiro, K. (2000). Toward a theory of anti-oppressive education. *Review of Educational Research, 70*(1), 25–53.

Ladson-Billings, G. (1995). Toward a theory of culturally relevant pedagogy. *American Educational Research Journal, 32*(3), 465–491.

Ladson-Billings, G., &Tate, W. F. (1995). Toward a critical race theory of education. *Teachers College Record, 97*(1), 47–68.

Lave, J., & Wenger, E. (1991). Situated learning: Legitimate peripheral participation. New York, NY: Cambridge Press.

Lee, J. T. (1998). Which kids can 'become' scientists? Effects of gender, self-concepts, and perceptions of scientists. *Social Psychology Quarterly*, *61*(3), 199–219.

Lee, J. T. (2002). More than ability: Gender and personal relationships influence science and technology involvement. *Sociology of Education, 75*(4), 349–373.

Lee O. (2005). Science education with English language learners: Synthesis and research agenda. *Review of Educational Research*, *75*(4), 491–530.

Leebaert, D. (2002). *The fifty-year wound: How America's cold war victory shapes our world*. New York: Little, Brown, and Company.

Leedy, P. D., & Ormond, J. E. (2005). *Practical research: Planning and design* (8th ed.). Upper Saddle River, NJ: Pearson Prentice Hall.

Lemke, J. L. (2001). Articulating communities: Sociocultural perspectives on science education. *Journal of Research in Science Teaching, 38*(3), 296–316.

Lent, R. W., Brown, S. D., & Hackett, G. (1994). Toward a unifying social cognitive theory of career and academic interest, choice, and performance. *Journal of Vocational Behavior, 45,* 79–122.

Lent, R. W., Brown, S. D., & Hackett, G. (2000b). Contextual supports and barriers to career choice: A social cognitive analysis. *Journal of Counseling Psychology, 47,* 36–49.

Lent, R. W., Brown, S. D., Sheu, H., Schmidt, J., Brenner B. R., Gloster, C. S., & Lyons, H. (2005). Social cognitive predictors of academic interests and goals in engineering: Utility for women and students at historically Black universities. *Journal of Counseling Psychology, 52,* 84–92.

Lent, R. W., Lopez, A. M., Lopez, F. G., & Sheu, H. B. (2000a). Career development from a social cognitive perspective. In D. Brown & L. Brooks (Eds.), *Career choice and development* (pp. 373–421). San Francisco: Jossey-Bass.

Lent, R. W., Lopez, A. M., Lopez, F. G., & Sheu, H-B. (2008). Social cognitive career theory and the prediction of interests and choice goals in the computing disciplines. *Journal of Vocational Behavior, 73,* 52–62.

Levinson, D. J., Darrow, C. N., Klein, E. B., Levinson, M. H., & McKee, B. (1978). *The seasons of a man's life* .New York: Knopf.

Li, X. (2007). Characteristics of minority-serving institutions and minority undergraduates enrolled in these institutions. Washington, DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education.

Lichtwarck-Aschoff, A., van Geert, P., Bosma, H., & Kunnen, S. (2008).Time and identity: A framework for research and theory formation. *Developmental Review, 28*, 370–400.

Linnenbrink, E., & Pintrich, P. (2002). Motivation as an enabler for academic success. *School Psychology Review, 31,* 313–327.

Litzler, E., Samuelson, C., & Lorah J. (2014). Breaking it down: Engineering student STEM confidence at the intersection of race/ethnicity and gender. Research in Higher Education, *55*, 810–832.

Locks, A. M., Hurtado, S., Bowman, N. A., & Osequera, L. (2008). Extending notions of campus climate and diversity to students' transition to college. *Review of Higher Education*, *31*(3), 257-285.

Loevinger, J. E. (1957). Objective tests as instruments of psychological theory. *Psychological Reports, 3,* 635–694.

London, B., Rosenthal, L., Levy, S. R., & Lobel, M. (2014). The influences of perceived identity compatibility and social support on women in nontraditional fields during the college transition. *Basic and Applied Social Psychology*, *33*(4), 37-41.

Lott, J. Jr. (2005). *Civic orientation predictors of Black students: An exploratory study.* Doctoral dissertation, Louisiana State University.

Luecke, R. (2004). *Coaching and mentoring: How to develop top talent and achieve stronger performance.* Boston: Harvard Business School Press.

Luna, G., & Cullen, D. L. (1995). Empowering the faculty: Mentoring redirected and renewed *ASHE-ERIC Higher Education Report Series 953*(24), Washington DC: George Washington University, Graduate School of Education and Human Development.

Mangold, W. D., Bean, L. G., Adams, D. J., Schwab, W. A., & Lynch, S. M. (2003). Who goes, who stays: An assessment of the effect of a freshman mentoring and unit registration program on college persistence. *Journal of College Student Retention, 4*(2), 95–122.

Marshal, L.L. (1994). Physical and psychological abuse. In W.R. Cupach & B.H. Spitzerg (Eds.), *The dark side of interpersonal communication*. 281-311. Hillside, NJ: Lawrence Erlbaum.

Mason, M. A., & Goulden, M. (2006). *UC Doctoral Student Career Life Survey.* Berkley, CA: University of California.

Massey, W.E. (1992). A success story amid decades of disappointment. *Science, 258*, 1177-1179.

Maton, K., Hrabowski, F.A., & Schmitt C. (2000). African American college students excelling in the science: College and post-college outcomes in the Meyerhoff scholars program. *Journal of Research in Science and Teaching*, *37*(7), 629–654.

Maxwell, M. (Ed.). (1994). *When tutor meets student* (2nd ed.). Ann Arbor, MI: University of Michigan Press.

McCauley, C. D., & Van Velsor, E. (Eds.). (2004). *The center for creative leadership handbook development* (2nd ed.). San Francisco, CA: Jossey-Bass.

McGee, R. Jr., Saran, S., & Krulwich, T. A. (2012). Diversity in the biomedical research workforces: Developing talent. *Mount Sinai Journal of Medicine, 79,* 397–411.

McHenry, W. (1997). Mentoring as a tool for increasing minority student participation in science, mathematics, engineering, and technology undergraduate and graduate programs. *Diversity in Higher Education, 1*, 115–140.

Merolla, D. M., & Serpe, R. T. (2013). STEM enrichment programs and graduate school matriculation: the role of science identity salience. *Social Psychology Education*, *16*(4), 575–597.

Merolla, D. M., Serpe, R. T., Stryker, S., & Schulz, P. W. (2012). Structural precursors to identity processes: The role of proximate social structures. *Social Psychology Quarterly, 75*(2), 149–172.

Merriam, S. (1983). Mentors and protégés: A critical review of the literature. *Adult Education Quarterly, 33*(3), 161–173.

Mervis, J. (2005). Do minority-training programs work? *Science*, *22*.Retrieved from http://sciencecareers.sciencemag.org/career_ magazine/previous _issues/articles/2006_01_20/no DOI: 17282342761167908125.

Miller, A. (2002). *Mentoring students and young people: A handbook of effective practice.* London: Kogan Page.

Muller, C. B. (1997). *Mentoring along the career track in the twenty-first century: Mentoring and mentors for students.* A Report Prepared for Dartmouth College.

Murray, M. M. (2001). *Beyond the myths and magic of mentoring: How to facilitate an effective mentoring process.* San Francisco, CA: Jossey-Bass.

Museus, S., & Quaye, S. J. (2009). Toward an intercultural perspective of racial and ethnic minority college student persistence. *Review of Higher Education, 33*(1), 67–94.

Museus, S., Palmer, R., Davis, R., & Maramba D. (Eds.). (2011). *Racial and ethnic minority students' success in STEM education: ASHE higher education report*. Hoboken, NJ: Jossey-Bass.

Myers, D. W., & Humphreys, N. J. (1985). The caveats in mentorship. Business Horizons. 28:9-14.

National Academy of Sciences. (1997). *Advisor, teacher, role model, friend*: *On being a mentor to students in science and engineering.* Washington, DC: National Academy Press.

National Academies of Sciences, Engineering, and Medicine. (2010). *Expanding underrepresented minority program participation: America's science and technology talent at the crossroads.* National Academies Press. Retrieved from http://www.nap.edu/

National Center for Educational Statistics (NCES). (2010, Spring). Integrated postsecondary education data system (IPEDS). *Graduation Survey 2001–2009.*

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

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

National Research Council. (2011b). *Successful STEM education: A workshop summary*. Washington, DC: National Academies Press.

National Science Foundation. (2006). Women, minorities, and persons with disabilities in science and engineering 2004. NSF. (22 April 2014). Retrieved from www.nsf.gov/publications/pub_summ.jsp?ods _key=nsf04317).

Nettles, M.T. (Ed.) (1988). *Toward black undergraduate student equality in American higher education.* New York: Greenwood Press.

Neumark, D., & Gardecki, R. (1998). Women helping women? Role model and mentoring effects on female Ph.D. in economics. *The Journal of Human Resources*, *33*(1), 220–246.

Noe, R. A. (1988). An investigation of the determinants of successful assigned mentoring relationships. *Personnel Psychology, 41*, 457–479.

Oder, N. (2009). Cornell library expands HBCU collections project. *Library Journal 134*(14), 16.

Olitsky S. (2006). Facilitating identity formation, group membership, and learning in science classrooms: What can be learned from out-of-field teaching in an urban school? Science Education, *91*, 201–221.

Ong, M. (2005). Body projects of young women of color in physics: Intersections of gender, race and science. *Social Problems, 52*(4), 593–617.

Osborne, J.W. (1997). Race and academic disidentification. *Journal of Educational Psychology, 89*(4), 728–735.

Osborne, J.W. (1999). Unraveling underachievement among African American boys from an identification with academics perspective. Journal of Negro Education, *68*(4), 555.

Outcalt C.L., &Skewes-Cox T.E. (2002). Involvement and satisfaction: The human environment at HBCUs. *Review of Higher Education, 25*(3), 331–347.

Oyserman, D., Harrison, K., & Bybee, D. (2001). Can racial identity be promotive of academic efficacy? *The International Journal of Behavioral Development, 24*(4), 379–385.

Pagan, R., & Edwards-Wilson, R. (2003). A mentoring program for remedial students. *Journal of College Student Retention, 4*(3), 207–225.

Palinscar, A. S. (1989). Social constructivist perspectives on teaching and learning. *Annual Review of Psychology, 49,* 345–375.

Palmer, R., Davis, R., & Maramba, D. (2011). The impact of family support for African American males at a historically black university: Affirming the revision of Tinto's theory. *Journal of College Student Development, 52,* 577–597.

Palmer, R., & Gasman, M. B. (2008). It takes a village to raise a child: The role of social capital in promoting academic success for African American men at a Black college. *Journal of College Student Development, 49*(1), 52–70.

Paloli, L., Knight, S. Dennis, K., & Frankel, R. (2002). Helping medical school faculty realize their dreams: An innovative, collaborative mentoring program. *Academic Medicine, 77*(5), 377–384.

Paulsen, M., &St. John, E. P. (2002). Social class and college costs: Examining the financial nexus between college choice and persistence. *Journal of Higher Education, 73*(2), 189–236.

Perna, L., Lundy, V. W., Drezner, N., Gasman, M.B., Yoon, S., Bose, E., & Gary, S. (2009). The contribution of HBCUs to the preparation of African American women for STEM careers: A case study. *Research in Higher Education, 50*(1), 1–23.

Petchauer, E. (2009). Framing and reviewing hip-hop educational research. *Review of Educational Research, 79*(2), 946–978.

Philip, K., & Hendry, L. B. (2000). Making sense of mentoring of mentoring making sense? Reflections on the mentoring process by adult mentors with young people. *Journal of Community and Applied Social Psychology, 10*, 211–223.

Pickens, J., & McNaughton, S. (1988). Peer tutoring of comprehension strategies. *Educational Psychology*, 8, 67-80.

Posselt, J. R., Jaquette, O., Bielby, R., & Bastedo, M. (2012). Access without equity: Longitudinal analyses of institutional stratification by race and ethnicity, 1972–2004. *American Educational Research Journal, 49*(6), 1074–1111.

Prescod, D. (2016). Addressing the STEM crisis through career development. Penn State College of Education, 07-09 news.

Provasnik, S., &Shafer, L. L. (2004). Historically Black colleges and universities, 1976 to 2001. Washington, DC: U.S. Department of Education, National Center for Education Statistics.

Ragins, B. R., & Kram, K. E. (2007). The roots and meaning of mentoring. In B. R. Ragins & K. E. Kram (Eds.). *The handbook of mentoring at work: Theory, research, and practice* (pp.3–15). Thousand Oaks, CA: Sage.

Ramirez, J. (2012). The intentional mentor: Effective mentorship of undergraduate science students. *Journal of Undergraduate Neuroscience Education, 11*(1), A55–A63.

Redmond, S. (1990). Mentoring and cultural diversity in academic settings. *American Behavioral Scientist, 34*, 188 -200.

Ricard, R. B., & Brown, M. C. (2008). *Ebony towers in higher education: The evolution, mission, and presidency of historically Black colleges and universities*. Sterling: Stylus.

Roberts, A. (2000). Mentoring revisited: A phenomenological reading of the literature. *Mentoring and Tutoring, 8*(2), 145–170.

Rodger, S., & Tremblay, P. F. (2003). The effects of a peer mentoring program on academic success among first year university students. *The Canadian Journal of Higher Education, 33*(3), 1–18.

Rodriguez, Y. E. (1995). Mentoring to diversity: A multicultural approach. *New Directions for Adult and Continuing Education, 66,* 69–77.

Rose, G. L. (2003). Enhancement of mentor selection using the Ideal Mentor Scale .*Research in Higher Education, 44*(4)*,* 473–494.

Ross-Thomas, E., & Bryant, C. E. (1994). Mentoring in higher education: A descriptive case study. *Education, 115*(1), 70–76.

Rucker, M., & Gendrin, D. (2003). The impact of ethnic identification on student learning in the HBCU classroom. *Journal of Instructional Psychology, 30*(3), 207–215.

Russell, S.H., Hancock, M. P., & McCullough J. (2007). Benefits of undergraduate research experiences. *Science, 316*, 548–549. [PubMed]

Salinitri, G. (2005). The effects of formal mentoring on the retention rates for first-year, low-achieving students. *Canadian Journal of Education, 28*(4), 853–873.

Sanders, J. M., & Wong, H. Y. (1985). Graduate training and initial job placement. *Sociological Inquiry, 55,* 154–169.

Sands, R. G., Parson, A. L., & Duane, J. (1991). Faculty mentoring in a public university. *Journal of Higher Education, 62*(2), 174–193.

Scandura, T. A. (1992). Mentoring and career mobility: An empirical investigation. *Journal of Organizational Behavior, 13,* 169–174.

Schiebinger, L. (1989). *The mind has no sex?* Cambridge, MA: Harvard University Press.

Schultz, P. W., Hernandez, P. R., Woodcock, A., Estrada, M., Chance, R., Aguilar, M., et al. (2011). Patching the pipeline: Reducing educational disparities in the sciences through minority training programs. *Journal of Educational Policy Analysis, 33*(1), 95–114.

Schunk, D., Pintrich, P., & Meece, J. (2008). *Motivation in education: Theory research, and applications* (3rd ed.).Upper Saddle River, NJ: Pearson Education.

Seymour, E., & Hewitt, N.M. (1997). Talking about leaving: Why undergraduates leave the sciences. Boulder, CO: Westview Press.

Sirin S. (2005). Socio-economic status and academic achievement: A meta-analytic review of research. *Review of Educational Research, 75*(3), 417–453.

Slaughter-Defoe, D. T., Garret, A.M., & Harrison-Hale, A.O. (2006). Affirming future generations of ethnic minority scientists. *Monographs of the Societyfor Research in Child Development, 71*, 188–192.

Smith, B. L., MacGregor, J., Matthews, R. S., & Gabelnick, F. (2004). *Learning communities: Reforming undergraduate education.* San Francisco:Wiley and Sons.

Smith, J., Lewis, K., Hawthorne, L., & Hodges, S. (2013). When trying hard isn't natural: Women's belonging with and motivation for male-dominated STEM fields as a function of effort expenditure concerns*. Personality and Social Psychology Bulletin*, *39*(2), 131-143.

Snipes, J., Fancsali, C., &Stoker, G. (2012). Student academic mindset interventions: A review of the current landscape. Washington, DC: IMPAQ International.

Sorrentino, D. M. (2007). The SEEK mentoring program: An application of the goal-setting theory. *Journal of College Student Retention, 8*(2), 241–250.

Spurgeon, S., & Myers, J. (2010). African American males: Relationships among racial identity, college type, and wellness. *Journal of Black Studies 40*(4), 527–543

Steel, C. (1997). A threat in the air: How stereotypes shape intellectual identity and performance. *American Psychologist, 65*(5), 797–811.

Stewart, P. (2011). HBCU merger proposals persist despite fervent opposition. *Diverse: Issues in Higher Education* (March). Retrieved from http://diverseeducation.com/article/14884/

Strauss, S.E., Johnson, M.O., Marquez, C., & Mitchell, D.F. (2013). Characteristics of successful and failed mentoring relationship: A qualitative study across two academic health centers. *Academic Medicine*, *88*(1), 82-89. Doi: 10.1097/ACM.0b013e31827647a0.

Strodtbeck, F. L., Ronchi, D., & Hansell, S. (1976). Tutoring and psychological growth. In V. L. Allen (Ed.), *Children as teachers: Theory and research on tutoring* (pp. 199–218). New York: Academic Press.

Sydnor, K., Dobson, A., Smith H., & Edwards, L. (2010). Expanding research opportunities: Making the argument for the fit between HBCUs and community-based participatory research. *Journal of Negro Education 79,* 79–86.

Syed, M., Azmitia, M., & Cooper, C. R. (2011). Identity and academic success among underrepresented ethnic minorities: An interdisciplinary review and integration. *Journal of Social Issues, 6*(3), 442–468.

Tafjel, H. (1978). The achievement of group differentiation. In H. Tafjel (Ed.), *Differentiation between social groups: Studies in the social psychology intergroup relations* (pp. 77–98). London, UK: Academic Press.

Tajfel, H. (1982). Social psychology of intergroup relations. *Annual Review of Psychology*, *33*, 1–39.

Tafjel, H., & Turner, J. C. (1985). The social identity theory of intergroup behavior. In S. Worchel & W. G. Austin (Eds.), *Psychology of intergroup relations* (pp. 7–20).

Tenner, E. (2004). The pitfalls of academic mentorships. *Chronicle of Higher Education, 50*(49), 7.

Terenzini, P., & Wright, T. (1987). Influences on students' academic growth during four years of college. *Research in Higher Education*, 26, 161–179.

The Mentoring Partnership. (1995). Pittsburg, Pennsylvania. Mentoringpittsburg.org.

Thomas, G. D. & Hollenshead, C. (2001). Resisting from the margins: The coping strategies of black women and other women of color faculty members at a research university. *The Journal of Negro Education*, *70*(3), 166–175.

Thompson, P. F. (2008). On firm foundations: African American black college graduates and their doctoral student development in the ivy league. In M. B. Gasman & C. L. Tudico (Eds.), *In historically black colleges and universities: Triumphs, troubles, and taboos.* New York: Palgrave McMillian.

Tillman, L. C. (2001). Mentoring African American faculty in predominantly white institutions. *Research in Higher Education, 42*(3), 295–325.

Tinto, V. (1993). *Leaving college: Rethinking the causes and cures of student attrition*. Chicago: The University of Chicago Press.

Tinto, V. (2012). *Completing college: Rethinking institutional actions*. Chicago: University of Chicago Press.

Touchton, J. G. (2003, February 25). Women's ways of mentoring. NASPA Net Results. Retrieved March 4, 2005, from http://www.naspa.org/netresults/PrinterFriendly. cfm?ID=965.

Treisman, U. (1992). Studying students studying calculus: A look at the lives of minority mathematics students in college. *The College Mathematics Journal, 23*, 362-372.

Tsui, L. (2007). Effective strategies to increase diversity in STEM fields: A review of the research literature. *Journal of Negro Education*, *76*(4), 555–581. Retrieved from http://www.jstor.org/stable/400372.

Turner, J.C., Hogg, M.A., Oakes, P.J., Reicher, S.D., & Wetherell, M. S. (1987).*Rediscovering the social group: A self-categorization theory.* Oxford: Basil Blackwell.

United Negro College Fund. (2008). Fact sheet. Retrieved from http://give.uncf.org/site/DocServer/AEOS_about_uncf_factsheet.pdf?docID=541.

U. S. Commission on Civil Rights. (2010). Briefing report: The educational effectiveness of historically Black colleges and universities. Retrieved from www.uscr.gov

U.S. Department of Education, National Center for Education Statistics. (2002). Hispanic serving institutions: Statistical trends from 1990 to 1999. Washington, DC: Author.

van Emmerik, I. J. H. (2004a). For better and for worse: Adverse working conditions and the beneficial effects of mentoring. *Career Development International, 9,* 358–374.

van Eps, M., Cooke, M., Creedy, D., & Walker, R. (2006). Students' evaluation of a year-long mentorship program: A quality improvement initiative. *Nurse Education Today*, *26*, 519–524.

Vartanian, T., Karen, D., Buck, P., &Cadge, W. (2007). Early factors leading to college graduation for Asians and non-Asians in the United States. *The Sociological Quarterly*, *48*(2), 165–197.

Virginia Consortium Program in Clinical Psychology Catalog. (2011). Last modified May 26. Retrieved from http://sci.odu.edu/vcpcp/45714% 20VA % 20CONSORTIUM-lores.pdf

Villalpando, O., & Delgado, B. D. (2002). A critical race theory analysis of barriers that impede the success of faculty of color. In W. A. Smith, P. G. Albach, & K. Lomotey (Eds.), *The racial crisis in American higher education: Continuing challenges for the twenty-first century* (Revised ed.; pp. 242–269). New York: State University of New York Press.

Wakefield, W. D., & Hudley, C. (2007). Ethnic and racial identity and adolescent and well-being. *Theory into Practice, 46*(2), 147–154.

Walker, T., Howard, D., Washington, C., & Godley, P. (2007). Development of a health sciences library at a Historically Black College and University (HBCU): Laying the foundation for increased minority health and health disparities research. *Journal of the Medical Library Association 95*(4), 439–441.

Wallace, D., Abel, R., & Ropers-Huilman, B. (2000). Clearing a path for success: Deconstructing borders through undergraduate mentoring. *The Review of Higher Education, 24,* 87–102.

Walters, N. B. (1997). *Retaining aspiring scholars: Recruitment and retention of students of color in graduate and professional science degree programs.*

Paper presented at the annual meeting of the Association for the Study of Higher Education. Albuquerque, NM. (ERIC Document Reproduction Service N. ED415816).

Walther, J. B. (1996). Computer-mediated communication: Impersonal, interpersonal, and hyper personal interaction. *Communication Research, 23,* 3–43.

Wanberg, C. R., Welsh, E. T., & Hezlett, S. A. (2003). Mentoring research: A review and dynamic process model. *Research in Personnel and Human Resource Management, 22,* 39–124.

Waters, L., McCabe, M., Kiellerup, D., & Kiellerup, S., (2002). The role of formal mentoring on business success and self-esteem in participants of a new business start-up program. *Journal of Vocational Behavior, 76,* 292–305.

Watkins, A. F. (2005). Cultivating the education of African American college students: A learning styles approach. In L. B. Gallien & M. Sims-Peterson (Eds.), *Instructing and mentoring the African American college student: Strategies for success in higher education.* Boston: Pearson Education.

Wenger, E. (1998). *Communities of practice: Learning, meaning and identity.* Cambridge: Cambridge University Press.

Wenglinsky, H. (1996). The educational justification of Historically Black Colleges and Universities: A policy response to the US Supreme Court. *Educational Evaluation and Policy Analysis 18*(1), 91–103.

Williams, L. (2017). Five qualities that make a good mentor. Nursing Times.

Wineke, W.R., & Certain, P. (1990). The freshman year in science and engineering: Old problems, new perspectives for research universities. University Park, PA: Alliance for Undergraduate Education.

Wilson, A., Sanner, S., & McAllister, L. (2010). An evaluation study of a mentoring program to increase the diversity of the nursing workforce. *Journal of Cultural Diversity,* 17, 144–150.

Wilson, P. P., Valentine, D., & Pereira, A. (2002). Perceptions on new social faculty about mentoring experiences. *Journal of Social Work Education, 38*(2), 317–333.

Wilson, T.D., &Linville, P.W. (1985). Improving the performance of college freshmen with attributional techniques. Journal of Personality and Social Psychology, *49*, 287–293.

Wilson, Z.S., Holmes, L., deGravelles, K., Sylvain, M.R., Batiste, L., Johnson, M., McGuire, S.Y., Su, S.P., Warner, I.M. (2012). Hierarchical Mentoring: A transformative strategy for improving diversity and retention in undergraduate STEM disciplines. *Journal of Science Education Technology*, *21*, 148-156. Doi: 10.1007/s10956-011-9292-5.

Witham, K., & Mara Bensimon, E. (2012). Cultivating the education of African American college students: A learning styles approach. In S. D. Museus & U. M. Jayakumar (Eds.), *Creating campus cultures: Fostering success among racially diverse student populations.* New York: Routledge.

Wright, B. L. (2009). Racial ethnic identity, academic achievement, and African American males: A review of literature. *Journal of Negro Education, 78*(2), 123–134.

Yeager, L. (2000). *Mentoring: Perceived benefits and challenges for a university setting*. Doctoral Dissertation. Spalding University, Louisville, KY.

Zahra, H., Sadler, P., & Gerhard, S. (2013). The science identity of college students: Exploring the intersection of gender, race, and ethnicity. *Journal of College Science Teaching, 42*(5), 82–91.

Zalaquett, C. P., & Lopez, A. D. (2006). Learning from the stories of successful undergraduate Latina/Latino students: The importance of mentoring. *Mentoring and Tutoring, 14*(3), 337–353.

Zamani, E.M. (2003). African American women in higher education. New Directions for Student Services, 104, 5–18.

Zellers, D. F., Howard, V. M., & Barcic, M. A. (2005). *New professional development paradigms in practice: A benchmarking study on faculty mentoring programs in higher education*. Unpublished manuscript, University of Pittsburgh.

Zellers, D. F., Howard, V. M., & Barcic, M. A. (2008). Faculty mentoring programs: Re-envisioning rather than reinventing the wheel. *Review of Educational Research*, *78*(3), 552–588.

Zimmerman, B. B., & Danette, P. (2007). Technical communication teachers as mentors in the classroom: Extending an invitation to students. *Technical Communications Quarterly, 16*(2), 175–200.