1-1-2017

The Effects of Institutional Structure of Predominantly White Land-Grant Colleges and Universities in the Southeast on African American Graduation Rates in Engineering

Angela Clinkscales Verdell

The effects of institutional structure of predominantly white land-grant colleges and universities in the Southeast on African American graduation rates in engineering

By

Angela Clinkscales Verdell

A Dissertation
Submitted to the Faculty of
Mississippi State University
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy
in Public Policy and Public Administration
in the Department of Political Science and Public Administration

Mississippi State, Mississippi

December 2017

The effects of institutional structure of predominantly white land-grant colleges and universities in the Southeast on African American graduation rates in engineering

By

Angela Clinkscales Verdell

Approved:

____
Gerald A. Emison
(Major Professor)

____
P. Edward French
(Committee Member)

____
Christine L. Rush
(Committee Member)

____
Stephen D. Shaffer
(Committee Member)

____
Rick Travis
Dean
College of Arts & Sciences

Name: Angela Clinkscales Verdell

Date of Degree: December 8, 2017

Institution: Mississippi State University

Major Field: Public Policy and Public Administration

Major Professor: Gerald Andrews Emison

Title of Study: The effects of institutional structure of predominantly white land-grant colleges and universities in the Southeast on African American graduation rates in engineering

Pages in Study 137

Candidate for Degree of Doctor of Philosophy

The U.S. Department of Labor reports that only 5% of U.S. workers are employed in fields related to science and engineering, yet they are responsible for more than 50% of our sustained economic expansion (U.S Department of Labor, 2007). Furthermore, minorities makeup 0.0025 % (1/400) of that Science, Technology, Engineering, and Mathematics (STEM) workforce. Methods are currently underway to understand and address the attrition of minority students in the STEM workforce.

The problem of underrepresentation of minorities (URMs) in STEM careers continues to result in a "leaky pipeline" where URMs have cited institutional factors such "chilly campus" climates as barriers to persistence and success (Tinto, 1993 Astin, 1993, Seymour & Hewitt, 1997). Despite the "separate but equal" challenge surrounding the early establishment of US educational institutions, the US remains a model for accessible and affordable education. Social equity concerning URM student outcomes in STEM has become a prominent topic of discussion. Researchers and practitioners seek to understand why the growing disparity exists for minority students as this underserved population represents those that higher education has been least successful in educating (Bensimon, 2007). This daunting assertion of disparate educational attainment by race and ethnicity is alarming.

In this study the researcher used archived data and web content analysis to conduct a quantitative study to understand the effect of institutional constructs on the graduation rate of African American students pursing engineering degrees. The research model included hypotheses resulting from independent institutional variables of African American engineering students, institutional size and type, institutional endowment and social equity initiatives. The dependent variable of African American engineering student graduation rates was considered in relation to each independent variable. To answer research questions 1 and 2, descriptive statistics were used to analyze data that provided a comprehensive description of the institutions' resources and social equity initiatives. Spearman's Rho with ordinal variables and a small number of cases were computed to analyze the data.

This analysis revealed a positive correlation between the numbers of social equity initiatives and engineering graduation rates of African American students at PWI southeast land-grant colleges and universities located in the southeastern portion of the U.S. The outcomes of this study help to expand the literature on underrepresented minority (URM) STEM retention in higher education. Understanding the effects of institutional constructs on the success of African American engineering students allows for the implementation of effective intervention strategies that will help to increase the pipeline of well-prepared African American engineers for the global STEM workforce.

Keywords: Persistence, under-represented minority students, attrition, PWI

DEDICATION

To my mom, Jacqueline Smith, who is absolutely the best cheerleader that a child could ask for! You have always been a great example of what it means to work hard ("*better to do it right the first time", you would say*), respect others and to love God. This work is dedicated to your tireless love and concern that you have for us all!

To my grandmother, Earnestine Mitchell, who always believed in me and said, "*you can walk among kings and queens and everyday people alike*". For the times when you were not acknowledged for all that you knew and the contributions that you made, I dedicate this work to you.

Lastly, I dedicate this work to my biological children, Aaron Verdell and Jessica Verdell, my nephew, Jalen Parker (and my other nieces and nephew too), as well as ***ALL*** of my MSU (children)/students who have inspired me to do this work. Strive to always continue to "start strong and finish strong". Whatever you put your hands to do, do it with excellence as if unto God himself! This dissertation was more about those of you to come behind me than anything else!

> *"The good we secure for ourselves is precarious and uncertain until it is secured for all of us and incorporated into our common life." Jane Addams*

ACKNOWLEDGEMENTS

"Do not despise these small beginnings, for the LORD rejoices to see the work begin, to see the plumb line in Zerubbabel's hand." (Zechariah 4:10).

Because every good and perfect gift comes from God, I want to first and foremost thank Him for the ability to do this work and for seeing me through this process! I am thankful for my humble beginnings and the positive influence that you have allowed my life to have on the world! To God be the glory!

To my husband, Ron Verdell, thank you for your patience, understanding and encouragement throughout this process! To my sister, Nicole Clinkscales, thanks for being a girl's best friend and motivator!

To my MSU Engineering support system, THANK YOU! A special thanks to Dr. Vemitra White, who has cheered me along from day one of this program! Much love to Dr. Jamel Alexander and Dr. Debra Prince for helping me to make sense of many things! And thanks to Derius Galvez for his big heart and making sure that I stayed encouraged! To my pastor, Rev. J.L. Peoples, now that I've completed the "**P**ost **h**ole **D**igging" process, as you so eloquently put it, I'll now get to work!

A heartfelt thank you to my committee members for investing your time and energy in guiding me through this process. Dr. Emison, thank you for chairing this committee and steering me in the right direction! Many thanks for believing in me even when it seemed the odds were stacked against me! Dr. Shaffer, thank you for helping me to unravel my brain when it came to all things statistics! Your support and interest in the subject of this study was much appreciated! Dr. Rush and Dr. French thank you both for putting up with me throughout this program and for graciously serving on this committee.

Lastly, I would be foolish not to thank Quintara Miller and Kamicca Lott for your continued support! You both are always so encouraging and you don’t know how far that has taken me and others in the PPA program! Many blessings to you all! ACV

.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

As the U.S. faces a need to advance our economy and our society, we must ensure that as a country we are not mere consumers of technology innovations, but that we are the creators and sustainers of such advancements. Developing the solutions for some of the world toughest problems such as energy consumption, fuel and clean water will require inclusive participation across diverse groups to ensure that a range of insights, experiences, and perspectives are merged to result in the best solutions. The need to drive innovation has been stated by some as a national security issue of the U.S. as America should strive to become less complacent and dependent on technologies created by those around the world. Bowen and McPherson (2009) posit in their book, *Crossing the Finish Line: Completing at America's Public Universities* that the U.S. does not produce enough native-born candidates for advanced degrees for jobs in science and engineering. They expound that "foreign-born holders of doctorates constituted approximately half of all doctorate-holders among employed engineers, scientists, and mathematicians" (Bowen and McPherson, 2009).

The U.S. must identify ways to increase participation across a diverse spectrum of citizens to help meet the growing needs for knowledge-based economic demands of the 21st century. "Reaffirming and strengthening America's role as the world's engine of scientific discovery and technological innovation is essential to meeting the challenges of this century," stated former President Obama. (Obama, 2009). According to the U.S. Department of Labor, only 5% of U.S. workers are employed in fields related to science and engineering, yet they are responsible for more than 50% of our sustained economic expansion (U.S Department of Labor, 2007). Furthermore, minorities make-up 0.0025 % (1/400) of that STEM workforce. Figure 1 illustrates the U.S. workforce breakdown including STEM jobs.

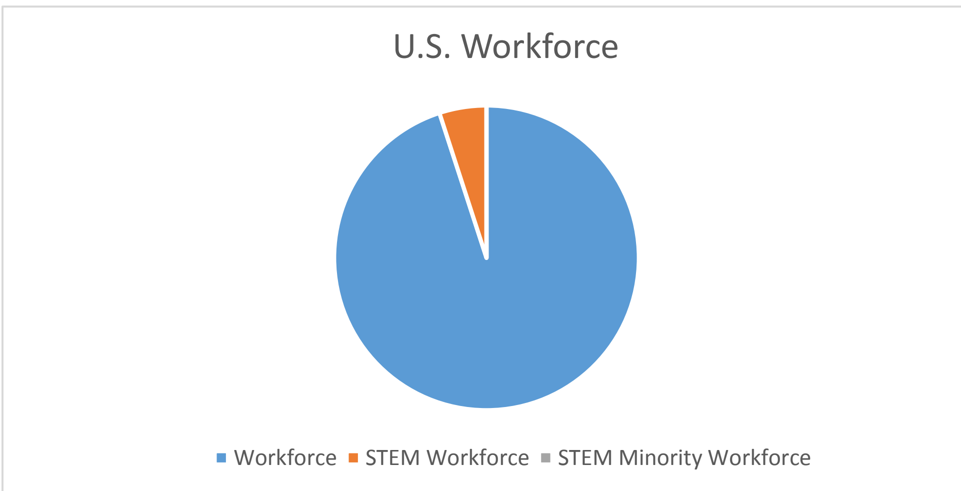

Figure 1. U.S. Workforce Breakdown (U.S. Department of Labor, 2007)

Methods are currently underway to explore these problems and to fix them. Secondary and post-secondary school systems are currently developing pathways for students to transition into the U.S. STEM workforce with many school districts ramping up instruction on coding and robotics. Despite the enhanced "hands-on" STEM curricula that secondary and post-secondary schools are implementing within and outside of classrooms, underrepresented minority students (URM) still face many challenges such as financial resources, access to exceptional teachers and volunteers, campus cultures and several other factors which prohibit URM student persistence and success (Tinto, Astin, Seymour & Hewitt).

The marginal success of minority groups in engineering at U.S. institutions of higher learning negatively impacts the U.S. labor market in fields related to science and engineering. With only 5% of U.S. workers employed in fields related to science and engineering, economic expansion in the U.S. is heavily dependent upon an increase of qualified STEM professionals. (U.S. Department of Labor, 2007). Demographic trends show increased diversity that will soon result in no majority racial or ethnic group in the United States – no one group that makes up more than fifty percent of the total population (Center for Public Education, 2012). A more heterogeneous population will require a focus on ensuring that the administration of public policy in U.S. institutions of higher learning will not merely ensure the access of underrepresented groups but focus to meet the need for increased success across all groups within the American public if the U.S. is to meet the technological innovation challenges of this century. Those who have historically been underrepresented in STEM disciplines will now play a more prevalent role in the racial demographics in the U.S.

U. S. policies governing state and federal provisions of higher education for underrepresented minority citizens have long created disenfranchisement of educational institutions and excluded some citizens (Slaton, 2010). "The demand for skilled workers in STEM fields will be difficult, if not impossible to meet, if the nation's future mathematicians, scientists, engineers, information technologists, computer programmers, and health care workers do not reflect the diversity of the population" (Crisp & Nora, 2012). Diversity in engineering remains an issue across all levels. As it is widely known, the participation of African Americans and minority groups in engineering disciplines pales in comparison to that of White students. Additionally, marginal numbers of African American engineering faculty makes it difficult for African American students to realize mentors and an almost non-existing number of African Americans in the ranks of college of engineering deans or university presidents further exacerbates the problem.

African Americans Engineering Degree Attainment

> "If you were to plant two seeds of equal strength in the ground and build a wall between them and block the sun, one will grow taller and produce multiple fruit while the other will be stunted. It does not mean that the taller of the two is better or that shorter is lesser. It means that one had access to the sun and the other did not" (Jackson, 2017).

African American representation in engineering degrees remains one of the most underrepresented minority groups. Of all engineering degrees awarded in the U.S. only 5% were achieved by African Americans with the same share of engineering careers realized (U.S. Department of Labor, 2007). Pre-college factors such as the lack of quality K-12 STEM program as well as exceptional teachers and volunteers hamper the access of many URM students in engineering. This paucity in representation is not reflective of the more than 12% of African American adults and 13% of African American undergraduate enrollment across U.S. colleges and universities.

Engineering Degrees Attained by Group, 2010			
	Bachelor's	**Master's**	**PhD's**
White	62,314	15,424	2,505
Asian	9,667	4,301	569
Latino	6,105	1,573	210
African American	4,688	1,385	163
American Indian/Alaska Native	525	114	10
Non-Resident Alien	4,951	16,549	4,314

Figure 2. Engineering and Engineering-Related Degree Attainment (NACME, 2012)

Source: U.S. Department of Education, National Center for Education Statistics, Integrated -Secondary System (IPEDS), Completions Component, 2009-2010 (persons of two or more races excluded)

Engineering degree attainment across levels and by race within the U.S. confirms the achievement gap across ethnic and racial lines. Using data captured in 2010 by the National Action Council for Minorities in Engineering (NACME) 135,846 engineering degrees were awarded in the United States across all levels. As illustrated in Figure 2, the breakdown of degrees from bachelors to PhDs shows the underrepresentation of African Americans when compared to all other races. Consequently, just as African American representation within engineering in the U.S. is reason for concern, Figure 2 also supports claims made by Bowen and McPherson (2009) of foreign-born holders of doctorates outpacing all Americans in advanced science, and engineering degrees earned. Further disaggregation of the data depicts the performance by gender across all levels of engineering degrees earned.

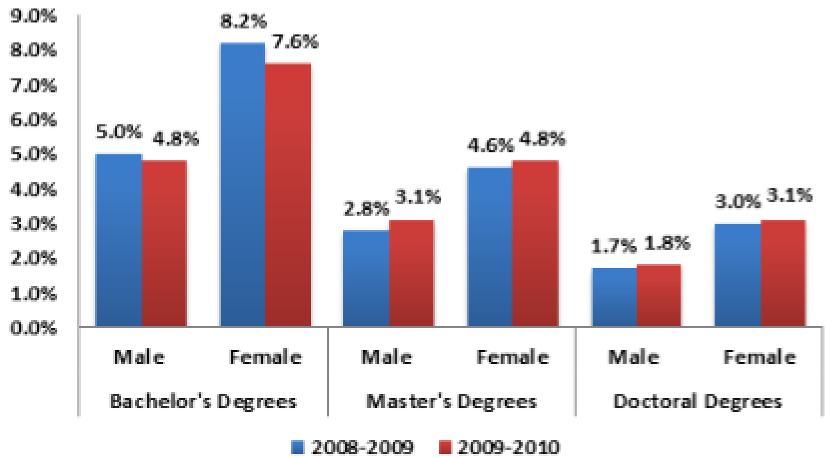

Figure 3. Percentage of African American Engineering Degree Attainment by Level and Gender, 2009 and 2010 (NACME, 2012)

Source: U.S. Department of Education, National Center for Education Statistics, Integrated -secondary System (IPEDS), Completions Component, 2009-2010 (persons of two or more races excluded)

The U. S. Department of Education shows that African American women are outpacing African American men in engineering degree attainment with 7.6 % and 4.8% respectively. This performance by African American women of nearly 44% higher in bachelor (2009-2010) attainment and as much as 52% (2008-2009) shows that African American women are achieving engineering degrees at a higher rate than African American males. Despite these accomplishments these percentages are still not representative of the overall U.S. African American citizenry. These realizations further the conversation on the continuing challenge realized by U.S. knowledge-based creators in need of engineering professionals. The need for more African American inclusion across all levels of engineering points to the issue of structural equity within institutions of higher learning. This lack of diversity is further evidenced by the low representation of African Americans in STEM positions within the U.S.

Diversity Trends

As the U.S. continues to grow more diverse, trends in immigration and birth rates indicate that soon there will be no majority racial or ethnic group in the United States – no one will account for 50% or more of the total population (Center for Public Education, 2012) With an increase in U.S. demographics, the educational achievement gap in STEM (Science, Technology, Engineering and Mathematics) disciplines in America continues to persist among underrepresented groups. As the U.S. competes to remain a world power in the area of technology and innovation, we struggle to do so with marginal participation from underrepresented minority groups. Within the collective fields of Science, Technology, Engineering and Mathematics (STEM), men are twice as likely to be employed in a STEM occupation as compared to women, with African Americans and Hispanic Americans being consistently underrepresented (Landivar, 2013). The U.S. Census Bureau reports that in 2011 minority groups such as Hispanics and African Americans made up 7% and 6% respectively of the STEM workforce. As a subset of STEM, it is clear to see that within engineering the percent of underrepresented minorities is dismal.

To address the needs of a growing heterogeneous population, American institutions strive to ensure that the perspectives and views of the public are valued and addressed. American society consists of many publics comprised of citizens who vary in race, ethnicity, social and economic standing, and religious backgrounds and affiliations. Colleges and universities play a major part in addressing social equality of underrepresented minority students enrolled within their institutions. The National Academy of Public Administration's (NAPA) Board of Directors recently adopted social equity as the fourth pillar of public administration, preceded by pillars of economy, efficiency, and effectiveness (Perry, 2005).

Equity Imperative

The overarching concept of social equity seeks to permeate every aspect of public service to enable uninhibited distribution of public resources. Social equity is defined by the National Academy of Public Administration (NAPA) as "the fairness, just and equitable management of all institutions serving the public directly or by contract, and the fair, just and equitable distribution of public services, and the implementation of public policy, and the commitment to promote fairness, justice, and equity in the formation of the public policy" (NAPA, Standing Panel on Social Equity, 2000). With broad access to colleges and universities, large numbers of "non-traditional" students – ethnically diverse, older and poor, with reduced academic experience and widely varying goals are being served by public universities (Scott, 2015). Broad access increases the need to ensure social equity within institutions of higher learning. The Education Policy Institute reports that people from all walks of American life understand the importance of education resulting in enrollment skyrocketing tenfold since the mid 1900's (Educational Policy Institute, 2003). Institutions of higher learning are increasingly faced with providing effective and efficient post-secondary education while also ensuring economical services that are fair, just, and equitable. This balancing act requires the need to disaggregate and understand the diverse world represented by higher education to provide new agenda for scholars and policy makers (Scott, 2015). Addressing the equity imperative, Scott contends that social equity of public service delivery can be achieved through the concept of diversity and diversity management in the administration of U.S colleges and universities.

To meet the needs of a diverse citizenry, a more in-depth analysis of college and university institutional structure is required. Such analysis will provide insight on factors that may be inherent to PWI college/university structure that may hinder the creation of pathways that allow for structural equity among URMs to succeed in engineering. With increased graduation rates of minorities in engineering, a more diverse pool of engineering professionals become available to fill the STEM pipeline that in turn will help to facilitate increased technological innovation that will enhance American economic and political stability.

Statement of the Problem

The underrepresentation of minorities in STEM education creates a disparity in URMs in STEM jobs. The U.S. Department of Labor reports that only 5% of U.S. workers are employed in fields related to science and engineering, yet they are responsible for more than 50% of our sustained economic expansion (U.S Department of Labor, 2007). Furthermore, minorities make-up 0.0025 % (1/400) of that Science, Technology, Engineering, and Mathematics (STEM) workforce. Methods are currently underway to examine and resolve the attrition of minority students in the STEM workforce. Secondary and post-secondary school systems are currently developing pathways for students to transition into the U.S. STEM workforce with many school districts ramping up instruction on coding and robotics. Although these things are being done, the problem of underrepresentation of minorities (URM) in STEM careers continue to result in a "leaky pipeline" where URM students have cited institutional factors such "chilly campus" climates as barriers to persistence and success (Tinto, 1993 Astin, 1993, Seymour & Hewitt, 1997). Despite the "separate but equal" fallacy surrounding the early establishment of US educational institutions, the US remains a model for accessible and affordable education. This claim is evidenced by the expansive system of American public colleges and universities supported by taxpayer dollars.

Colleges and universities are instrumental in addressing and enabling access to equitable outcomes for all students. Social equity concerning access to adequate institutional resources by URM and African American students in STEM has become a prominent topic of discussion. Researchers and practitioners alike seek to understand why the growing disparity exists for minority students as this underserved population represents those that higher education has been least successful in educating (Benisome, 2007). Such inequitable achievement has given rise to diminished participation by URMs with a resulting inequality in income, wealth, and access to opportunities which contribute to the widening gaps between races and ethnic groups in in America as compared to other nations.

This daunting assertion of disparate educational attainment by race and ethnicity is alarming. Because U.S. public institutions of higher learning fall within the boundaries of federal and state governance, the use of policy to drive equitable outcomes is important. Public entities thereby must judiciously interpret and administer laws and regulations as set forth by governing bodies while creating and implementing effective institutional policy. It is incumbent upon the leaders of U.S. colleges and universities to ensure that equity and fairness within public institutions of higher learning remain sacred tenants of the organization's realized mission, vision, and outcomes.

Purpose of the Study

There is a documented need for more African American students succeeding in engineering programs within U.S. institutions of higher learning. Therefore understanding the institutional factors that help or hinder achievement in engineering for these students is important in the creation of successful matriculation. Currently, policy tools such as federal and local funding, tuition, mission and vision directives, standards of accountability, and equity (Bensimon, 2007) are used as a method to influence retention and student success at PWIs. These tools are intended to help ensure that there is access to quality educational outcomes and equity for all students.

Predominantly white land-grant institutions have been termed the "people's university" due to their contribution of service toward economic growth within local communities. However, it has been found that the minority population in the U.S. is increasing and is making a large presence in PWIs. It is imperative that such universities provide equitable access to all students across the spectrum and provide them with transferrable skills that will lead to positive outcomes such as increased retention, graduation rates and STEM employment.

The role of social equity within public institutions of higher learning pertaining to disparities in outcomes of URMs across engineering is compelling and warrants further investigation. Admittedly, it is imperative to understand how the human element influences environments; and consequently how environments impact success across public entities such as institutions of higher learning.

The aim of this study is to examine the role of social equity initiatives for URM student persistence in engineering within PWIs located in the Southeastern region of the

United States. Furthermore, this study will provide a greater understanding on how institutional restructuring contributes to unbiased policies that could potentially improve URM engineering student success.

Research Questions

Prior research has found multiple factors such as academic and social integration are held as key factors related to student retention in STEM and more specifically engineering (Tinto, 1993). Scholars content that students experience both indirect and direct positive effects on education as a .result of racial and ethnic diversity (Chang, 1999). To this point, Munoz and Murphy (2014) encourage research that focuses on within-institution factors and characteristics affecting student matriculation. Hurtado, et al (1999) and others have attempted to categorize characteristics that significantly affect campus climate including institutional history, make-up of diversity, psychological variables, behavior and actions and leadership) and have demonstrated that ethnic minorities view higher education climates and contexts differently than their majority peers. Munoz and Murphy (2014).

The literature provides a basis for the research questions asked in this study concerning factors that influence African American engineering student success while matriculating at PWI land-grant institutions in the Southeast. The literature is consistent with other research regarding higher education success for underrepresented minority students such as Ward (2006) and Swail (2008). To fulfill the purpose of this research, the following two research questions were developed:

1. Does the intervention by predominantly white Southeast land-grant colleges and universities through social equity initiatives (SEI) enhance the graduation rates of African Americans in engineering?
2. Is there a difference in graduation rates of African American students in engineering among predominantly white Southeast land-grant colleges and universities that have social equity initiatives compared to those who do not?

Significance of the Study

The dominant paradigm that underrepresented minority students are less motivated and driven in institutions of higher learning is extensive across the literature (Bensimon, 2006) and is heavily referenced and regarded. However, work completed by researchers such as Tinto (1975, 1993), Astin (1993), Seymour and Hewitt (1997) and Bensimon (2006) suggest that there exist institutional factors that adversely affect the educational outcomes of minorities pursuing engineering degrees. As more African Americans enroll in tax supported predominantly white institutions, institutional culture and policies must be created and implemented to protect minority students from feelings of self-consciousness, not-belonging, isolation and marginalization when compared to the majority population and to aid in increased success in retention and graduation rates (Rodgers and Summers, 2008). It is imperative that practitioners, administrators, and policy makers take a holistic approach to understand URM student attributes and how race intersects with university structure and the influence it exerts on the persistence and success of African American students in engineering. As the U.S. demographics continue to shift to include larger numbers of minority students, the success or failure of these student groups will drive the overall success of institutions of higher learning and the global STEM workforce. This study will provide insight on factors that may go unnoticed that impact the educational equity of African American students pursuing engineering within public institutions of higher learning.

Delimitations

This study was limited to archived data recorded for African American students who attended PWIs in the Southeastern portion of the U.S. Data were limited to students who were enrolled at each university between the fall 2010 and fall 2016 and associated university characteristics of average institutional ACT score, institutional size, and institutional endowment over the same time period. Additionally, university website content analysis was conducted for each institution to provide quantitative analysis of the existence of social equity initiatives apparent within the institution. This analysis was intended to validate or to provide quantitative insight on content analysis resulting in the examination and understanding of what types of social equity initiatives existed across selected PWIs.

This study was limited by the fact that the literature consistently used the term URM as broad demographic category to include those of African American race. As generally prescribed by the literature, for this study in some instances URM was used as a surrogate for African American. Further, STEM was used as a substitute for engineering.

Definition of Terms

To assist with understanding this study, the following terms and definitions apply to this research.

1. Accreditation Board for Engineering and Technology (ABET) – The organization that assures programs meet standards to produce graduates ready to enter critical technical fields that are leading the way in innovation, emerging technologies and anticipating the welfare and safety needs of the public.
2. Institutional Agent – Instructors, administrators, counselors and staff, tutors, institutional researchers, etc.
3. Practitioners – College and university instructors, diversity officers, program coordinators.
4. National Science Foundation (NSF) – Independent federal agency created by Congress in 1950 to promote the progress of science to help advance the national issues of health, prosperity, and wealth, and the national defense.
5. Science, Technology, Engineering, and Mathematics (STEM) - defined by the National Science Foundation as those disciplines found within science, technology, engineering and mathematics domains.
6. Persistence – The measure of continuation from one academic term to another in a STEM discipline.
7. Social Equity- The fair, just and equitable management of all institutions serving the public directly or by contract, and a fair, just and equitable distribution of public services, and the implementation of public policy, and the commitment to

promote fairness, justice, and equity in the formation of public policy (NAPA, 2000).

8. Success – The measure of student graduation within a STEM discipline.

9. Predominantly White Institutions (PWI) - Colleges or universities where the majority of the population is primarily white.
10. Underrepresented minority student groups (URM) - Both male and females whose ethnicity is classified as Latino/Hispanic, African American/black, Asian American, or Native American.
11. Structural Equity- The fair, just and equitable alignment of internal structures and operations to ensure that education received by students supports student success goals (Aspen Institute, 2016).
12. Social Equity Initiatives- The institutionalized application of resources such as programs, services, mission and vision statements and policies directed at increasing the number of URMs in STEM disciplines.

CHAPTER II

REVIEW OF THE LITERATURE

The purpose of this study was to examine institutional factors related to the persistence of African American students majoring in engineering at PWI land-grant institutions located in the Southeastern region of the United States. This study will focus on STEM (Science, Technology, Engineering, and Mathematics) and SME (Science, Mathematics, and Engineering). Chapter II presents a literature review of issues and scholarly work that highlight models that describe some of the factors pertinent to student persistence and graduation. This section is organized into four sections. The first section of the literature review describes the need for an increase of underrepresented minorities pursuing STEM degrees and participating in the STEM workforce. The second section of literature review concentrates on theoretical perspectives on student success in colleges and universities. The third section of the literature review focuses on social equity and institutional and non-institutional factors that influence student persistence and success. The final section provides an in-depth discussion on institutional structure and functions that impact the persistence of African American students in engineering. Chapter II concludes with a brief summary of the literature as it pertains to African Americans in engineering disciplines and the STEM workforce.

Need for Increased and Diverse STEM Workforce

The U.S. Department of Commerce, Economics and Statistics Administration, states that STEM degree attainment is failing to keep pace with the demand for STEM workers. The agency states, "out of the 41.5 million workers with at least a bachelor's degree, 9.3 million or 22% have a STEM degree. Among workers with a bachelor's degree or higher, Hispanics and non-Hispanic Whites and members of all other groups are similarly represented in STEM majors while non-Hispanic Blacks have a lower likelihood, making up just 17% of all participants having a STEM degree" (U.S. Department of Commerce, Economics, and Statistics, September 2011).

The Minnesota Office of Higher Education using data provided by the U.S. Department of Commerce (2011) published economic data showing that "1 million additional STEM graduates will be needed over the next decade to fill the nation's economic demand." According to the publication, this need will continue to grow by 17% in the next 10 years, outpacing the overall job grown of 10% (Minnesota Office of Higher Education, 2016). As defined by the National Science Foundation, URM students of color (Black, Latina/o, Native American, Southeast Asian students) are the most underrepresented in STEM fields (Museus & Liverman, 2010). With the rapidly shifting demographic in the U.S. which is projected to result in an increase from 37% to 57% in underrepresented people of color by 2060, (U.S. Census Bureau, 2012) this phenomenon coupled with an existing disparity in participation of minority inclusion in STEM has prompted national discussion and research on the issue. The combination of high demand for STEM professionals and underrepresentation of students of color in these fields has been referred to by some as an unprecedented crisis and require attention and immediate action. Many have called on the attention of policy makers, educators, communities, and citizens to address this pressing issue.

The U.S. Department of Labor in 2007 warned that minorities make up 1/400 or 0.0025% of the STEM workforce. Social indicators such as educational attainment, socioeconomic status, and health conditions reveal a disparity between the lives of underrepresented racial minorities and White Americans (Bishaw & Semega, 2008). Having the ability to pursue STEM undergraduate and advanced degrees allows individuals from these marginalized groups to gain access to rewarding careers and will enhance their social and economic wellbeing (Carnevale, Smith & Melton, 2001; Gurin et al., 2002; Kuh & Love, 2000; Yosso et al. 2004) as well as their contribution to society in a meaningful way. Access to an educational system that promotes technical thinking and innovation is vital to the future competitiveness of America. Such access should be available to all students, without regard to race, ethnicity, or the socioeconomic status of members within a just society. Sandel purports that "A just society seeks not to promote any particular ends, but enables its citizens to pursue their own ends, consistent with a similar liberty for all" (Sandel, p. 82). American institutions must conform to what is "right" and afford the access of the good to all to achieve what is their desired end.

This crisis has prompted to action many academicians in higher education. Freeman Hrabowski, president of the University of Maryland-Baltimore County stated, "it is well documented that the United States needs a strong science and technology work force to maintain global leadership and competitiveness. The minds and talents of underrepresented minorities are a great, untapped resource that the nation can no longer afford to squander. Improving the STEM education of our diverse citizenry will strengthen the science and engineering work force and boost the U.S. economy" (National Academy of Sciences, 2010). Such inequities in achievement have given rise to the lack of participation by URMs and a realization in disparities in income, wealth, and access to opportunity that continue to widen more abruptly in the U.S. than in many other nations with gaps between races and ethnic groups escalating. According to Thomasian (2011) "a labor force without a rich supply of STEM-skilled individuals will face stagnant or even declining wealth by failing to compete in the global economy, where discovery, innovation, and rapid adaption are necessary elements for success" (p.9).

In 2008, the National Action Council for Minorities in Engineering (NACME) published the report, "Confronting the New American Dilemma: Underrepresented Minorities in Engineering: A Data Based Look at Diversity". The report provides data to show how the rate of growth for URMs is progressing yet is unsustainable to aid in America's quest for world class STEM excellence and leadership. The underrepresentation of minorities in STEM higher education creates a disparity in URMs in STEM jobs. Using intellectual talents, African Americans strive to contribute to society's realization of solutions to some of the world's most challenging problems. As minority populations continue to grow, increasing their participation in STEM disciplines is critical to the longevity and competiveness of the U.S.in the global economy.

Frameworks on Student Success in College

Within the social context of American society, white males have long dominated participation in STEM disciplines. Historically there has been much interest and debate around why this phenomenon is prevalent in American society. The National Academy of Sciences states, “with the participation of individuals of all racial/ethnic backgrounds and genders, the increasing demand for workers in these fields will not be met, potentially compromising the position of the United States as a global leader (Riegle-Crumb, 2010). Over the last three decades, many scholars have made an effort to demystify underrepresented minority (URM) student persistence in STEM. Much of this work has focused on the “dominant paradigm of student success” (Bensimon, pp. 443-447), where background characteristics of URMs and their university behavior have been used to explain the differences in student outcomes. Granted, Bensimon continues that the “dilemma of success” is not a problem that impacts all undergraduates equally (Bensimon, pp. 443-447).

Theoretical Perspectives on Student Success

Given the broad perspectives of factors affecting student success, notable research has benefited from a handful of sound theoretical approaches. Based on the existing retention literature, several approaches have been found to influence retention. These approaches have focused on the significance of sociological, organizational, psychological, culture and economic factors on the success of students in U.S. colleges and universities (Kuh et al. 2006). Research on student success, including student retention and student involvement has been viewed through the institutional departure theory, a model constructed by Vincent Tinto, Hurtado et al (1999) as well as conceptualization of institutional climate and critical race theory. The institutional departure theory states that individual students leave college because of the interactions in several systems within the college environment. He purports that minimal social and academic integration of students increases the likelihood of departure. (Tinto, 1993, p.

93). Figure 4 shows Tinto's model that is used to explain institutional departure. Institutional factors preventing social (acceptance) integration and academic achievement have been considered by scholars and are viewed as critical to student persistence (Braxton, 2000). Much investigation has been conducted on pre-entry and internal factors of student persistence including but not limited to high school rank, academic preparedness, motivation, and self-efficacy (Li et al., 2009). However, many scholars contend that disparities in African American student success in engineering disciplines are influenced by external factors such as low expectations of institutional agents, inadequate resources, poverty, inadequate parental support, and lack of positive mentors (Bonner, 2010b; Hrabowksi, 2003b; Hrabowski & Pearson, 1993).

Social Integration

Social equity, along with efficiency, economy and effectiveness are known as the four pillars of public administration. The work of public administration requires an interpretative approach that must be viewed critically to capture the role of administration within our society. In public administration, human decisions and interactions continue to drive and shape the environment of societies. Such decisions and interactions pose either positive or adverse effects on the success of individuals across public entities such as institutions of higher learning. Policy tools that are used to influence retention and student success include but are not limited to federal and local funding, tuition, mission and vision directives, standards of accountability, and equity (Benisome, 2007). These tools help to ensure that educational excellence and equity is a reality for all students.

Admittedly, it is imperative to understand how the human factor and policy tools influence environments and consequently how environments affects success across public entities such as institutions of higher learning. Concerns for cultural differences and exclusions in the university setting has been developed as the social integration research prompted by scholars (Medina, 2015). Defined as an interactionalist theory, Vincent Tinto's (1993) model along with Alexander Astin's theory of involvement (1984) are highly regarded in the area of student success.

Tinto's interactionalist theory (1975, 1987, 1993) postulates that student success is impacted by their ability to successfully *separate* from familiar groups which they have previously been a part of. Departing from groups such as family and school peers allows the student to experience a *transition* period "during which the person begins to interact in new ways with the members of the new group into which membership is sought" (Tinto, 1993, p.93). Tinto further states that adoption of normative values and beliefs of the new group, the institution of higher learning, must be realized for student persistence to occur. Tinto's model is rooted in Van Gennep's (1960) anthropological model of cultural rights and has been viewed as the dominant sociological perspective on student departure. Tinto describes student departure from college as a resultant of a student's inability to detach from family or community and to assume the values and the normative values and behavioral patterns of the environment of the institution of higher learning they are attending. (Kuh et al., 2006). Tinto suggests, "the most important condition for student success is involvement, or what is now commonly referred to as engagement" (Tinto, 2012, p.7).

Tinto's model further depicts underlying factors for attributing to why students change majors or depart from colleges and universities as being based on the students' academic and social integration. Kuh et al (2006) depicts academic integration as the satisfactory compliance with institutional norms such as passing grades and adhering to various university policies and accepting normative values such as valuing science over arts for science majors.

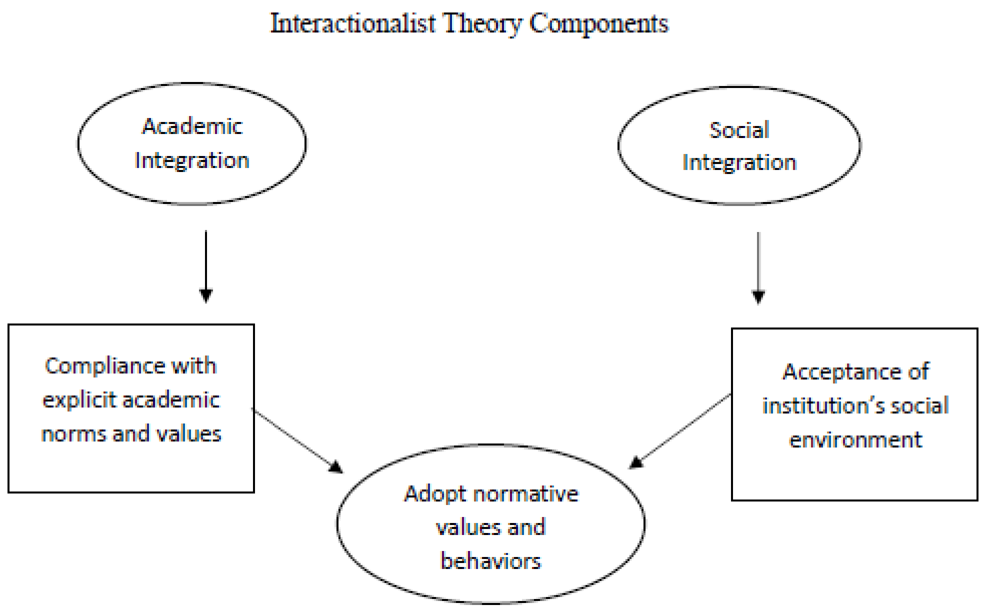

Figure 4. Depiction of Tinto's Interactionalist Theory of Student Departure (Tinto, 1993).

Conceptual depiction of Academic Integration and Social Integration of Tinto's Interactionalist Theory (Tinto, 1993).

Social integration is commonly represented by the extent to which students view institutional culture as well suited with his or her background and value preferences as demonstrated by their relations formed with peers and interaction with faculty and staff. Tinto purports that although academic and social integration are independent processes, there exists a complimentary relationship that promotes student adjustment to college life (Kuh et al., 2006).

In addition to Tinto, Alexander Astin has made significant contributions to the research of student persistence. Astin's Theory of Involvement model as shown in Figure 5 suggests that as students become engaged with on-campus clubs, groups, and dorm life, they continue to persist and attain their goals at statistically higher rates than students who are not engaged in campus- sponsored activities (Meyers et al., 2012). Astin's model of student involvement describes student development during the college experience.

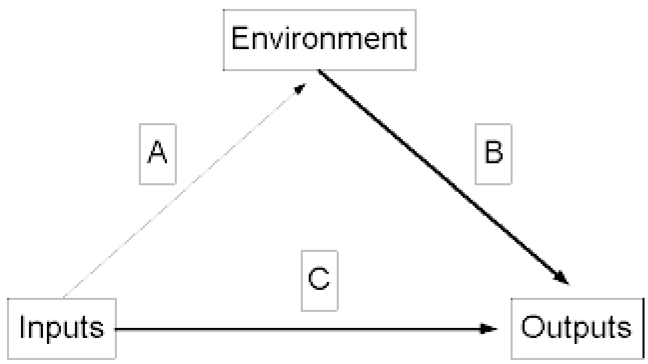

Figure 5. Depiction of Astin's Theory of Involvement (Astin, 1993).
Conceptual depiction of Astin's Theory of Involvement (IEO) Model (Astin, 1993).

The model centers on three elements that influence a student's continued involvement: 1). student demographics and prior experiences; 2). environment including the experiences of student encounters during college; 3). student characteristics including knowledge, attitudes and beliefs post-college (Passarella & Terenzini, 2005).

This persistence framework describes student behaviors to include time and effort put into studies, interaction with faculty, and peer involvement (Bean, 1983). According to Bean academic and social integration leads to greater commitment to institution and graduation. Within the framework, institutional conditions are described as resources, educational policies, programs and practices, and structural features. Student behaviors and institutional conditions are described as intersecting at a point known as student engagement. When students are engaged, they are more likely to attend classes on regular basis, to participate in university life activities and to seek opportunities for improving their academic standing, such meeting with professors during office hours.

The National Postsecondary Education Cooperative along with Kuh et al, explain the collective certainty of scholars that institutional conditions are "able to impact student engagement behavior by fostering an environment that promotes student-faculty interaction, collaborative learning and institutional environments perceived by students as inclusive and affirming and where expectations for performance are clearly communicated and set at reasonably high levels" (as cited in Kuh et al., 2006) (Astin 1991; Chickering and Gamson 1987; Chickering and Reisser 1993; Kuh et al. 1991; Pascarella 2001; Pascarella and Terenzini 1991, 2005). Institutional conditions such as those described by Tinto and Astin continue to impede student progress. Such factors contribute to prevent social (acceptance) integration and academic achievement that is viewed as critical to student persistence (Braxton, 2000).

Factors Influencing Student Persistence

The literature on factors influencing persistence in STEM provide quantitative and qualitative approaches used when testing for correlation of factors affecting student departure. Marra et al. (2012) provided a mixed methodology approach in determining factors that strongly influence student decisions to depart engineering and to allow departure predictability based on factors assessed. The 113 undergraduate students studied by the researchers represented 19% of the 585 students contacted. An exit survey was used to allow students to self -report reasons for leaving engineering as well as the Student Leaving Engineering (SLE) instrument, which is used to collect data on various reasons why students leave engineering (Marra, Rodgers, Shen, and Bogue, 2007). With a concern for negative bias reporting for those not completing the surveys, t-tests between students who persisted and those who did not were conducted and no significant difference existed between the two groups. The procedure and implementation used provided systematic data analysis. The results from the study substantiated factors that the researchers categorized as "external (poor teaching and advising; curriculum) and "internal" (lack of belonging).

Marra et al (2012) identified internal and external factors that influence students' decision to persist or discontinue in engineering disciplines. This multi-year study focused on identifying factors that described the experiences of engineering students and how such factors affect decisions to stay or leave engineering. Using survey data from students, the researchers conducted exploratory factor analysis to better understand why students were abandoning engineering majors. They concluded that there exists both academic and non-academic factors that influence student persistence. Although non-academic attributes such as individual student background, demographical characteristics, and prior educational experiences along with external demands impact student success, the literature further cites that the experiences of students on college campuses have an effect on student outcomes. Seymour, Hewitt and Small purport that the persistence of STEM students has more do with the experiences of students and accessible resources within the institution rather than their cognitive ability (Seymour & Hewitt, 1997; Smallwood, 2004).

As Dean Emeritus of the College of Engineering, Computer Science and Technology at California State University, Los Angeles, Ray Landis has offered valuable insight as an enduring researcher and advocate of minority student success in engineering. He has provided landmark findings in engineering student retention and has authored numerous writings including his classical textbook, *Studying Engineering*, now in its fourth edition. In his 2005, Landis identified three stages that US engineering colleges are engaged in concerning minority-engineering students. Using data collected from approximately 300 US universities with accredited engineering programs, the National Association for of Minority Engineering Program determined that less than 1/3 of institutions had established formal minority engineering programs (MEPs) (Landis, 2005 as cited NAMEPA, 1990). Landis points to these data to support his position that although minority students are underperforming academically, this deficiency should not be the blame of the student. However, Landis exclaims that many institutions are aware of these deficiencies but choose not to establish minority engineering programs to address students' needs. This fixed mindset of colleges and universities results in passive reasons for inaction such as "poorly prepared", "lacking in ability," "unmotivated," "not willing to work," "inadequately financed." (Landis, 2005). Many faculty members have low expectations of minority students and therefore are less likely to try to understand the real reasons behind their poor academic and social integration and are less likely to support special efforts to help minority students graduate in engineering (Landis, 2005). Seymour and Hewitt (1994) conducted a study consisting of 335 undergraduate students across seven universities to better understand attrition rates among science, mathematics and engineering disciplines. Of the group, 90.2% of students leaving science, mathematics and engineering expressed that poor instruction in these courses resulted in their decision to leave accompanied by 73.7% of persisters sharing the same concern cites Clewell et al, of Seymour and Hewitt (1994) in their 2005 Louis Stokes Alliance for Minority Participation Program evaluation to the National Science Foundation (NSF) (2005). Furthermore, dissatisfaction with instruction was identified as the third most mentioned factor contributing to their decision to switch majors. Like Seymour and Hewitt (1994) Landis (2005) criticizes the use of "weeding out" tactics and condemns the use for being a deterrent for minority engineering students rather than one of "support and encouragement". Although much of the literature focuses on why minority students perform poorly in STEM disciplines, there are, however some high performing and exceptional minority students chose not to pursue these disciplines.

In a study conducted by Brown and Clewell (1998), approximately 140 African American and Latino non-science majors were interviewed to better understand their decision for not selecting SME fields. Based on the critical incident technique used to capture findings, the results revealed that SME teachers' arrogant attitudes, inability to be available or approachable, teaching practices and longer time to degree completed were noted by Brown and Clewell as prevailing factors in these high achieving students' decision to choose non-SME disciplines. These serve as examples of what Seymour and Hewitt (1994) defined as the "chilly climate" experienced by minority students pursing engineering disciplines at predominantly white institutions. Where climate refers to the attitude, perceptions and expectations associated with an institution (Rodgers & Summers, 2008).

Landis identifies three major problems and the factors contributing their longevity. He attributes the underrepresentation of minorities in engineering to poor access of these majors among minority students. Low completion rates of minority students in engineering indicates a retention problem Landis states. Academic performance problems are evidenced by the minority students who graduate with lower GPAs than those of non-minority engineering students (Landis, 2005). He states that US engineering colleges are operating within three stages regarding minority student matriculation: Inaction, Ineffective Action and Effective action. Each stage can be identified by characteristics and supporting rationale for the operation stage an institution is currently in. Figure 6 depicts characteristics associated with each operational stage of Landis' Retention by Design Problem and Solution model. Landis contends that institutions with low numbers of minority students have neglected to respond to the disparity of URMs in engineering resulting the absence of minority engineering programs to provide needed support services. Further, institutions with lesser faculty involvement with minority engineering students are operating within the "ineffective action" stage. At this stage Landis points out that faculty involvement results from administrative initiatives; however, in many cases the ethnic isolation experienced by minority students is often unnoticed and is ignored (Landis, 2005).

Operational Stage	Characteristic	Reason
• Inaction (Problem)	No minority engineering program	Few minority students; campus-wide minority support system; decision not to establish
• Ineffective Action (Problem)	Little to no faculty involvement with minority engineering students	Most created through administrative initiative; directors possess minimal engineering education background; student service oriented; ignores ethnic isolation of minority students
• Effective Action (Solution)	Optimal learning environment for minority engineering students equal to that for all students	Belief that students' academic performance is related to their educational environment; good educational environment produces good academic perform; poor academic environment produces poor academic performance

Figure 6. Retention by Design Problem and Solution stages (Landis, 2005).

Prominent barriers to minority student success is based on ethnic isolation, lack of peer support, lack of role models, and lack of faculty present within predominantly white institutions (Landis, 2005). To eliminate the barriers identified, Landis concludes that improved URM retention rates at predominantly white institutions can be achieved through a redesign of educational environments to create optimal learning environments that foster collaborative learning for minority students. Such inclusive environments will provide supportive academic communities by instituting 1) clustering of students in common sections of their key courses 2) a freshman orientation course 3) a student study center and 4) structured study groups. Training faculty on effective teaching, advising and mentoring is critical. Once these structures have been implemented, it is imperative that institutions track their impact on the performance and retention of minority engineering students explains Landis (Landis, 2005).

Institutional Theory

The organizational structure of colleges and universities differ according to institutional type, culture, and history. Institutions of higher learning organizational structure can be used as one of several models to determine organizational behavior and norms. However, both organizational structure and processes help to shape the behavior of colleges and universities according to some multi-dimensional models. J. Victor Baldrige's use of bureaucratic, collegial, and political dimensions illustrates how colleges and universities may operate within a bureaucratic hierarchical and decision-making structure and utilize a collegial process within the academic senate. (Baldrige, 1971). In his book, *Bureaucracy,* James Q. Wilson speaks to the many aspects of bureaucracy that impact decision making, attitudes and beliefs in organizations. Wilson addresses bureaucratic organizations and the struggle of compliance and conflicting constraints faced within these organizations. Although Wilson mainly focuses on governmental entities such as the military and other agencies such as the Federal Bureau of Investigations (FBI) and the Food and Drug Administration (FDA); however, bureaucratic culture commonly experienced within institutions of higher learning may experience similar constraints. Aside from the obvious governance and hierarchical structure of college and universities, there are other aspects of bureaucratic trends on many campuses. The increasing interdependence on external establishments such as corporate partnerships and governmental entities require the ability of post-secondary institutions to address conflicting goals and expectations despite moving further away from its core mission of providing students with a quality post-secondary education.

In the present day, economic environment many colleges and universities struggle to identify ways to provide quality ways to provide quality programs at a cost that allows the institution to remain viable while also pursuing improved national rankings. In some instances, colleges and universities find themselves increasing corporatization. This shift in organizational behavior by institutions of higher learning has resulted in the writings of noted authors such as Readings (1971) who purports that universities have shifted from the importance of the role of professors as being academician and teachers and that more focus is being placed on the corporatization of colleges. Reading expounds on how this shift is included by outside forces such as college rankings, corporate entities, etc. that has resulted in a bureaucratically organized “consumer-oriented corporation”, for which he believes is the demise of the sacredness of university structure of years gone by.

Although corporatization is intended to identify ways of becoming more efficient, in some case this may result in a diminished customer focus and customer service toward students while creating more reliance on top administration in decision making as compared to empowering mid-level decision making (Mills, 2012). Mills cites that upper administration benefit the most from corporatization efforts while the university takes on a more bureaucratic culture that is increasingly costly and difficult to reform institutional factors impacting student success.

As the U.S. continues to struggle with building a stronger, more diverse STEM workforce it must do so by increasing the participation of underrepresented groups who participate in both formal and informal educational opportunities. Institutional leaders of higher education must work to increase equity in outcomes for students pursing engineering majors. To help increase the supply of URMs within the engineering pipeline, university leadership will have to deconstruct its messaging from one of securing U.S. competitive advantage to one that expresses the need to build capacity of qualified and capable underrepresented students in STEM (Allen-Ramdial & Campbell, 2014). Formal STEM education offered by colleges and universities create unique situations, which students of color much contend.

Institutional conditions, policies and practices that contribute to the success of students have become a widely discussed topic in recent years. In 2016, the National Postsecondary Education Cooperative published *Spearheading a Dialog on Student Success* report that examined the relationship between institutional environments and student success. The report provided an insight into institutional environments and the relationship to student success broken down into four major categories 1) Structural and organizational characteristics 2) Programs and practices 3) Teaching and learning approaches 4) Student-centered campus cultures (Kuh et al., 2006). Although each of these four categories is important, it is worth noting a fifth category of institutional climate and institutional culture. BioScience reports that it can be challenging to move from aspirational intentions for an academic environment to fostering an actual environment that "materially and non-materially support all members of the communities equally" (Allen-Ramdial & Campbell, 2014, p. 614). The role of institutional climate and culture along with the aforementioned categories shapes the environment in which URM students must learn to thrive. Each of these categories include tangible and intangible elements that contribute to the overall institutional system and identity.

Theoretical perspectives on the impact of organizational structure of colleges and universities on student outcomes have contributed in the expansion of the student retention and student success literature (Berger & Milem, 2000). The examination of the relationship between student outcomes and organizational structure of colleges and universities has allowed multidimensional modeling to further explain organizational behavior across institutional types and in various institutional activities. This area of research is critical when considering what factors aid in the perpetuation of the "leaky pipeline" of African Americans pursuing engineering degrees at US colleges and universities.

Land-Grant Institution Evolution

Policies governing state and federal provisions of higher education for underrepresented minority citizens have long created disenfranchisement of educational institutions and excluded citizens (Slaton, 2010). Governing policies that have resulted in the exclusion of minorities in higher education include desegregation, urban renewal and affirmative action policies explains Slaton. The establishment of institutions of higher learning by America's founding fathers assisted in the preservation of democracy and economic prosperity. During the colonial era, the establishment of colleges and universities were intended for those in elite families and positions. Prior to the establishment of the state university system of higher education private institutions served as the only means to gain advanced education. Access to these institutions was reserved to those financially suited to afford to attend (APLU, 2012).

Making education accessible for all citizens had been disregarded in the overall model of the American education system. Education for the common man had not been included in the formation of American democracy. With a mission to provide a foundation for an accessible and practical education to the "industrial classes", the

Morrill Act of 1862 established land-grant institutions of higher learning in the United States (Morrill Act, 1862). Justin Morrill, author of the Morrill Act of 1862 and the Morrill Act of 1890, envisioned land-grant colleges as a means to champion the commitment to provide college access to underrepresented groups in terms of social class and race.

> "Having emancipated a whole race, shall it be said that there our duty ends, leaving the race as cucumbers of the ground, to live or to wilt and perish as the case may be? They are members of the American family, and their advancement concerns us all. While swiftly forgetting all they ever knew shall they have no opportunity to learn anything as freemen?" (1890universities.org)

The 19th century educational opportunities imagined by Morrill would include instruction in the areas of military tactics, agriculture and engineering; however, it would take the Morrill Act of 1890 to designate separate land-grant institutions for persons of color. Ultimately, the second Morrill Act established land-grant colleges in the former confederate states and included the stipulation that African Americans were to be included in the U.S. Land Grant University Higher Education System without discrimination (Morrill Act, 1890). Despite the resistance of southern border-states to admit blacks into their institutions, Negro Land-Grant Institutions were established as part of the second Morrill Act of 1890, resulting in land-grants with the designation of historically black colleges and universities (HBCUs) land-grant and predominantly white (PWI) land grant institutions.

The exclusion of African Americans in PWI land grant institutions furthered the racist ideology of "separate but equal accommodations" perpetuated across many American establishments. The landmark decision of the Plessy vs Ferguson Case (1896) expanded upon societal norms of marginalization by race. The Supreme Court's ruling that segregation in public accommodations did not violate the Fourteenth Amendment's equal protection of the law was therefore determined to be legally justified (Plessy v. Ferguson, 163, U.S. 537). It was not until 1954 with the Brown v. Board of Education of Topeka, 347 U.S. 483, decision that the "separate but equal" justification was overruled. Slaton (2010) contends that the present day lack of African Americans in engineering is the result of historical subjugation.

Today the U.S. has many forms of institutions of higher learning that represents the strides made in the institutional diversification. Colleges and university categorization include vocational, community, liberal arts, women's historically black serving, tribal, religious, research, professional, proprietary, doctoral and comprehensive (Baham, 2016). Each institutional type provides varied pathways to meet higher educational needs of a diverse American society. Black underrepresentation in engineering is a result of prolonged maintenance of racialized academic setting (Slaton, 2010). Further, the role of university faculty, staff, administrators, and boards of trustees

Institution of Higher Learning Mission and Vision Statements

The mission of land grant institutions as established in 1890 intended to provide quality teaching, service, and research to those less fortunate and most in need of educational interventions. This mission can be realized through the access and success of African American student pursuit of engineering degrees for predominately-white land grant institutions. Historically the Southeastern portion of the US has realized the highest representation of African Americans. Approximately 55% of all African Americans live in the South with 105 southern counties comprised of 50% or higher African American populations.

Institutional Diversity and Multiculturalism

With the changing demographics of America, it is becoming more evident than before that the U.S. is comprised of citizens with multifaceted backgrounds and cultures, aspirations, and societal norms. As cited by Yi (2008) scholarly studies have shown the importance of social context concerning diverse group interaction. For instance, with-in group heterogeneity and percentage of with differing social types will have an impact on group interaction. (South, Bonjean, Markham, & Corder, 1982). Chang et al (2006) adds that interaction among peers from diverse racial groups has been evidenced to contribute to the psychological development of college students (Rhee, 2008). As such, Hurtado et al (2012) surmised that the need to educate diverse students at broad access institutions is critical and that the success and efficacy as an institution is dependent upon the success of diverse students. However, such merging of students may result in group conflict. Rhee (2008) states, "race relations theorists argue that the increase in the proportion of the minority group may lead to conflict with the members of the majority when resources are scarce" (Blalock, 1967).

Bowen and McPherson (2009) point to the educational value of diverse (race/ethnicity, gender, SES, geography) student populations on college campuses and in classrooms. The use of equity assessments provides an opportunity for colleges and universities to assess and understand the level of success realized by URMs (Benisome, 2004). The concept of providing a public good through postsecondary education has expanded to include many "publics". Public institutions of higher learning must seek to ensure that the wellbeing of the public is achieved in a way that meets the needs of all citizens. Justice Sandra Day O'Conner in the Michigan affirmative action case asserted that the US must move beyond diversity as "the diffusion of knowledge and opportunity…must be accessible to all individuals regardless of race or ethnicity…Effective participation by members of all racial and ethnic groups in civic life or our Nation is essential if the dream of one Nation, indivisible, is to be realized" (Bowen and McPherson, 2006 as cited).

Access to an educational system that promotes critical thinking and innovation is vital to future competitiveness of America. Such access should be available to all students without regard to race, ethnicity, or the socioeconomic status of members within a just society. Echoing the sentiments of Justice O'Conner, Sandel purports "a just society seeks not to promote any particular ends, but enables its citizens to pursue their own ends, consistent with a similar liberty for all" (Sandel, 1984, p.82) The inclusion of diverse participations requires an unwavering commitment to social equity on the part of institutional agents of US colleges and universities. Early theorists Aristotle and Piaget suggest that racial and ethnic diversity within a student body leads to lively thinking and self-development as well contributes to one's sense of democracy through the ability to accept conflict and to assume viewpoints based on diverse inter-group relations (Rhee, 2008).

Institution of Higher Learning Climate

The adverse representation of African American and other ethnic groups in engineering majors continue to result in a "leaky pipeline" where URM students have cited institutional factors such "chilly campus" climates as barriers to persistence and success (Tinto, 1993 Astin, 1993, Seymour & Hewitt, 1997). STEM and engineering-specific literature proclaim that 1) lack of student interaction with faculty resulting in a "chilly climate" and 2) an agreement that the students' ability is not solely responsible for their decision to change majors from engineering (Flynn, 2016). Student retention can vary by campus and institutional type. Ohland, Sheppard, Lichtenstein, Eris, Chachra, and Layton (2008, p 259) identified that there "is significant institutional variation" and "assert a need to address persistence and engagement at the institutional level and throughout higher education" in engineering.

Elaine Seymour and Nancy Hewitt (1997), sociologists at the Bureau of Sociology Research at the University of Colorado at Boulder, conducted a multi-campus study on Science, Engineering and Math (SME) students who switched their majors to an area outside of SME. Their findings assert that institutional features rather than purely student characteristics contribute to the poor student success rate of SME postsecondary settings. The researchers purport that prior to the mid-1990s most research on STEM attrition centered on the idea that poor retention rates resulted from students being academically under-prepared for college. However, research has introduced the notion that engagement in college activities helps to strengthen students' commitment to both the institution and their persistence in engineering.

Underrepresented students' perception of university "climate" in engineering programs contribute to a sense of belongingness and may potentially result in increased student attrition (Washburn, et al., 2009). Studies on STEM student retention identify a students' subjective perception of faculty disconnection from students including faculty being unapproachable, indifferent to student success, and intimating. Students refer to this environment as the “chilly climate” (Seymour & Hewitt, 1997). Campus climate refers to the attitude, perceptions and expectations associated with an institution (Rodgers & Summers, 2008). In engineering education climate is referred to by Sadler et al (1996, p.1) as a culmination of many small inequities that as individual occurrences may seem insignificant but as a whole create a “chilly environment. This chilly climate serves as a barrier to students pursuing academic and social support because of being uncomfortable seeking out assistance. Perpetuated over time this isolation may result in students becoming more withdrawn from university placing themselves at an academic disadvantage.

The National Action Council for Minorities in Engineering and the National Association of Minority Engineering Program Administrators (YEAR) share that institutional factors that create barriers and fuel attrition add to existing factors such as student inadequate K-12 preparation and lack of adequate financial resources. Minority students attending predominantly white institutions are ethnically isolated in their academic environment, and it is taken for granted that they will readily adjust. The majority groups of students as well as faculty and the administration are not called upon to alter their attitudes or the institutional environment. The minority student is under pressure to adjust or else.” (NACME & NAMEPA, Ray Landis).

Attributes Influencing Student Success

Academic factors include teaching and advising whereas non-academic factors centered on concepts of student lack of belonging in engineering as contributors to student departure. Like Marra et al., Milton determined that engineering student retention is impacted by external factors such as an institution’s admission requirement and test scores such as the ACT. Findings suggest that many factors are at play in perpetuating disparity by race, ethnicity and gender in the makeup of engineering participants. Some have attributed this to the underrepresented group's lack of adequate secondary academic preparedness, and postulate such groups display a lack of motivation and marginalized attitudes with regards to STEM fields.

Li et al. (2009) described three broad categories: external, internal and demographic to capture factors that affect engineering persistence. Figure 7, Figure 8, and Figure 9 shows complete detailed characteristics that comprise each category. Influences by the community, college, and society are noted as characteristics of external factors.

Attributes	**College**	**Community**
Curriculum Requirements	✓	
Peer Influence	✓	✓
Adult Influence	✓	✓
Institutional Cultural Atmosphere	✓	
Faculty-Student Interaction	✓	

Figure 7. External Factors Impacting Student Persistence in Engineering (Li et al, 2009).

Development of a Classification System for Engineering Student Characteristics Affecting College Enrollment and Retention (Li et al., 2009).

Attributes	Cognitive	Affective
Academic Ability	✓	
Self- Efficacy	✓	✓
Learning Attribute	✓	
Attitude		✓
Self-Confidence		✓
Early Commitment		✓
Motivation (Affective)		

Figure 8. Internal Factors Influencing Student Persistence in Engineering (Li et al., 2009).

Development of a Classification System for Engineering Student Characteristics Affecting College Enrollment and Retention (Li et al., 2009).

Attributes
Age
Gender
Ethnicity
Socioeconomic Status
Home Background
School Type
Religion

Figure 9. Demographic Factors Impacting Student Persistence in Engineering

Development of a Classification System for Engineering Student Characteristics Affecting College Enrollment and Retention. Li et al. (2009).

Internal factors included cognitive influences such as academic ability, self-efficacy and learning attributes and affective influences consisting of student attitude toward learning, self-confidence, early commitment to STEM and motivation.

Demographic characteristics include attributes such as age, gender, ethnicity and socio-economic status as affecting student persistence along with community, college, school type, religion and student home background.

Institutional Policy

The role of policy within an institution is to provide governance and guidance to produce some desired effect. Policy creation can be developed to address issues regarding government, independent groups, private sector organizations and individuals. According to Schneider and Ingram's writings in *Policy Design for Democracy*, more emphasis should be placed on developing policy content or as it's referred to in the book, policy design, as opposed to focusing on processes whereby policy is created (Schneider and Ingram, 1997). Good policy design will include elements such as rules, rationale and delivery structures with regards to social constructions and target groups.

Of particular interest Schneider and Ingram (Ingram et al., 2007, pp.98, 101), noted "the allocation of benefits and burdens to target groups in public policy depends upon their extent of political power and their positive or negative social construction on the deserving or undeserving axis". Because policy designs are such that a faction of society is considered deserving of benefit while others are not, suggests that not all governing policies are created equally nor are they equitable in their allocation of benefit to groups considered to be outside of societal norm.

Postsecondary institutional policies established regarding admissions, spending priorities, hiring practices and student life, might include provisions for meeting the need of the majority while often times overlooking or diminishing those of lesser "political power". Such underserved groups stand to experience policy design focused to address the needs and desires of the majority group. It is not fair to suggest that all postsecondary institutions employ negligible policy creation; however, it is necessary for the occurrence to be considered when seeking to understand the role of policies within institutions of higher learning and the impact it has on URM pursuit and persistence of STEM.

The educational achievement gap in STEM disciplines in America continues to persist among underserved groups. As the U.S. continues to compete to remain a world power in the area of technology and innovation, we continue to struggle to do so with marginal participation from underrepresented groups across America. As America moves forward economically, so should be the expectation from the viewpoint of social justice. Factors that impede realization of the good life should be identified, examined and corrected such that all members of society have the opportunity to reach their fullest utility and to be free to determine what that utility is.

Historically America has contributed to the creation of a divided society of those deserving of benefit and those who do not. This model has perpetuated years of inequality and unjust policies that has stifled the growth, harmony and pleasured experience of what it means to live in a true democracy. Policy makers within postsecondary institutions should seek to design policies that promote equality in hiring practices that will result in a faculty and staff more reflective of race, ethnicity and gender of URM students and should strive to foster an environment more inclusive of cultural norms of underrepresented students. Federal and state policy makers should address the socioeconomic and early academic preparedness disparities of URMs that may impede pursuit of STEM. The implementation of these recommendations in no way suggest an immediate rise in URM STEM matriculation in postsecondary institutions will occur; however, if we as a nation continue to do nothing to address this issue, we may find ourselves in a self-imposed economic and social upheaval.

The role of policy within an institution is to provide governance and guidance to produce some desired effect. Policy creation can be developed to address issues regarding government, independent groups, private sector organizations and individuals. According to Schneider and Ingram's writings in *Policy Design for Democracy*, more emphasis should be placed on developing policy content or as it referred to in the book, policy design, as opposed to focusing on processes on processes whereby policy is created (Schneider and Ingram, 1997).

Postsecondary institutional policies established regarding admissions, spending priorities, hiring practices, and student life may include provisions for meeting the need of the majority while often times diminishing those of lessor "political power". Such underserved groups stand to experience policy designs focused on addressing the needs and desires of the majority group. It is unsubstantiated that all postsecondary institutions employ negligible policy creation; however, it is necessary for the occurrence to be considered when seeking the understand the role of policies within institutions of higher learning and the impact it has on African American pursuit and persistence in engineering.

Diversity and Multiculturalism

The role of U.S. colleges and universities has become increasingly integral to institutions of higher learning perpetuating many societal norms. With ever changing demands in STEM fields, institutions of higher learning must work to provide diverse human capital to meet the needs of new knowledge based markets. The upward shift of demographical make-up of underrepresented groups in the U.S. demands highly educated workforce. Because of this, the need to educate diverse students is more evident today than ever in history.

Summary

The role of U.S. colleges and universities has become an integral part of societal norms and has shaped the global knowledge economy. The U.S. Department of Labor accounts that only 5% of U.S. workers are employed in fields related to science and engineering, yet they are responsible for more than 50% of our sustained economic expansion (U.S Department of Labor, 2007). With minorities comprising 1/400 of the STEM workforce, this paucity in minority representation has led to much research to investigate this phenomenon. Historically the dominant paradigm that underrepresented minority students are less motivated and driven in institutions of higher learning is extensive across the literature (Benisome, 2006) and is heavily referenced and regarded. However, further studies have introduced theories discussing the impact of external factors on the success of minority students pursing STEM degrees.

The literature on student departure is exhaustive and contains several models and theoretical frameworks to consider. When exploring the gap in STEM achievement by African Americans, organizational attributes such structure and the conceptualization of institutional climate have shown to impact African American student academic integration, social integration, involvement, engagement (Astin, 1993; Pascarella and Terenzini, 1991; Berger and Braxton, 2000; Hurtado et al, 1997), and the STEM persistence.

CHAPTER III

THEORETICAL FRAMEWORKS

Educational research of student success in college universities encompasses many disciplines and research methodologies to address various research questions. Psychology, sociology, anthropology and philosophy are among disciplines widely referenced for educational research which have contributed to the development of critical theoretical frameworks in this field of study. Creswell states that a paradigm is a theory or approach used to address or solve a problem. According to Creswell, this basic set of beliefs is used to guide research action (Creswell, 2013). He contends that multiple paradigms or theories can be used to address a single research question. Despite many years of institutional interventions, there remains a high level of attrition among African Americas in STEM disciplines across U.S. colleges and universities. The literature on student persistence abounds with research using several well-established models such as Tinto's model (1993) on institutional departure and the Critical Race Theory.

Institutional Departure Theory

Tinto's model has been upheld as a widely referenced theoretical framework in understanding the factors influencing student retention in higher education. Tinto's model is applicable to this research as it incorporates the Interactionalist Theory, which states that student departure is impacted by students' ability to achieve successful academic and social integration within an institution of higher learning. The model further describes the importance of student interaction with faculty, peers, and university resources as being critical to increased student retention. Tinto states that the adoption of normative values and beliefs such as interacting with professors, striving for good grades, and engaging in campus culture of the institution of higher learning must be realized for student persistence to occur.

Despite being highly regarded in the field of student retention, Tinto's departure model lacked the inclusion of institutional climate and diversity when considering factors that influence social integration within colleges and universities. Having been criticized for omitting these components within the model, Tinto's model has been altered to better analyze occurrences surrounding URM student retention. Accordingly, Braxton & Sullivan (2000) recommended a revision of Tinto's model that integrated economic and organizational perspectives on student departure. The inclusion of the effects of organizational elements such as institutional climate as well as socio-economic factors, are helpful in better understanding the predicament of African American students pursuing engineering degrees at predominantly white institutions.

Critical Race Theory

The use of the Critical Race Theory (CRT) as a framework for this research provides a basis for understanding how race impedes social equity within colleges and universities. The theory has been used to analyze the role that race and racism play in contributing to the inequalities between dominant and marginalized racial groups. As cited by Solórzano & Yosso (2002), Matsuda describes the origins of this theory as stemming from work initially developed by legal scholars Derrick Bell, Alan Freeman, and Richard Delgado and was used to study the U.S. legal system to account for and eliminate the role of racism in American law (Solórzano & Yosso, 2002). Used to examine the role that race plays in educational experiences; Ladson-Billings and Tate (1995) first introduced critical race theory for educational research. Bell (1992) states that "as one of its five tenets of CRT, that racism is a permanent component of American life". As such, the prevalence of racism as suggested by CRT requires a "realist view" of accepting the role that racism plays in shaping American society. The critical race theory seeks to discover how race, privilege, and exclusion of minority groups is often overlooked when seeking to understand social disparities within the U.S. (Parker & Villalpando, 2007). Hiraldo positions CRT as a framework contributing to diversity research efforts within those predominantly White institutions concerned with examining campus climate efforts rather than simply aiming to increase the absolute numbers of diverse of students. Supporters of the critical race theory model view racism as a social construct that leads students to feel culturally alienated, physically isolated and without a voice while matriculating at institutions of higher learning. Within the educational settings, these experiences are common and are often intensified for African America students attending predominantly white, elite, independent schools (Datnow & Cooper, 1998, 2000). In accordance with previous research by Crenshaw, Gotanda, Peller, & Thomas (1995); Matsuda, Lawrence, Delgado, & Crenshaw (1993) as well as Tierney (1993), the use of the critical race theory framework for this research will help to identify and analyze structural and cultural characteristics of education that uphold dominant and subordinate racial positions demonstrated within the setting of a predominately white land-grant institution (Solórzano, et al, 2009).

Institutional Theory

The idea of institutional theory has become a common and powerful illustrative tool for studying organizational issues, including those of higher education (Cai and Mehari, 2015). Institutional theory presents a viewpoint toward addressing the institutional impact on African American student success in engineering at predominately-white institutions. Scott (2004) suggests that processes, norms, rules and routines serve as guiding principles for social behavior. Cai and Mehari (2015) describe institutional theory as a tool to explain the actions of both individuals and collective actors. They depict the interdependency of actor's actions on institutions and consequently, the impact of human agency on institutional change. Institutional theory is a concept originated in Selznick's 1957 book, "*Leadership in Administration*" where he purports that institutions are social organisms that are impacted by its institutional environment. (Selznick, 1957).

Contributing to the idea of institutional theory, Max Weber defined the "iron cage" as the rationalist order in which humanity was imprisoned. (Weber, 1952). Impassioned by this idea, he wrote that bureaucracy efficiency and power was a means of controlling men and women, and once established, the force of which is irrevocable (Weber, 1968). DiMaggio and Powell revisited Max Weber's "iron cage" concept to explain how the role of bureaucratization and rationalization have contributed to the creation of the increasing homogeneity of organizations despite attempts of rational actors to change them. (DiMaggio and Powell, 1983). They describe three isomorphic processes, coercive, mimetic and normative, as the basis for homogeneity. The use of this theory for the research provides insight on how some behaviors, norms and culture contribute to the misunderstanding of African Americans student outcomes within engineering at U.S. colleges and universities.

Institutional Departure

Research on underrepresented minority student success, including student retention and student involvement; have been viewed through the construct of institutional departure theory. Defined as an interactionalist theory, Vincent Tinto's (1993) model along with Alexander Astin's Theory of Involvement were regarded in relation to student success in this study. Tinto provides a theoretical base model of why students change majors or depart from institutions of higher learning. The model describes academic integration as the satisfactory compliance with institutional norms and social integration being commonly represented by the extent to which students view institutional culture as well suited with his or her preferences (Kuh, et al, 2006). Both Tinto and Astin's theories are pertinent to this study as they examine underrepresented minority student success and student engagement in relation to institutional factors at PWIs.

Both Tinto's and Astin's models have been analyzed as effective models in reference to different research methods that foster retention and are widely accepted across all disciplines. Research indicates that both student engagement and involvement on an institutional level can improve retention in STEM. As cited in Myers et al. (2012), "Astin's Theory of Involvement (I-E-O) suggests that as students become engaged with on campus clubs, groups, and dorm life they continue to persist and attain their goals at statistically higher rates than students who are not engaged in campus-sponsored activities"(p.1).

Astin's model of student involvement describes how students develop during the college experience. The model centers on three broad elements of student demographics and prior experiences; environment including the experiences of student encounters during college ; student characteristics including knowledge, attitudes and beliefs post-college as contributing to student success (Passarella & Terenzini, 2005).

Braxton et al. (2000) affirmed that the previous models of student departure (Bean 1980; Tinto 1993) have ascended to "near paradigmatic status" in the field of higher education. Nearly every study on retention and student departure references one of these "classic models" (Hurtado, et al, 2012). Despite the prominence of such models, there are some in the field who purport the weakness of these theories and believe that deeper understanding can be gained by injecting the role of ethnicity, which may influence the social integration process as experienced by students on campuses (Murguia et al. 1991). As explained by Hurtado et al, this acknowledgment of the weaknesses of Tinto's models resulted in a new theoretical integration model. This model incorporates diverse student experiences in understanding underlying causes of student departure to better consider the experiences through the use of this modified version of Tinto's model (Hurtado and Carter 1997, Museus et al. 2008; Nora and Cabrera 1996; Tierney 1992).

Diversity Climate

Diversity climate is an important concept in considering institutional factors impacting URM student outcomes. Scholars seeking to understand its impact on outcomes on human cognition and behavior (Munoz and Murphy, 2014) have long researched the construct of "climate". Campus climate has been studied by researchers seeking to understand the influence it has on educational outcomes for underserved and

URM students. Some researchers declare that minority students enter college with significantly diminished perceptions of their own capabilities and with varying levels of confidence regarding their higher education success (Nunez 2009). Solorzano and Villalpando (1998) and Gyuyll et al (2010) purport that this heightened sense of academic "self-consciousness" or "stigma" reflects the diminutive social status generally held by minorities in American society (Munoz and Murphy, 2014).

CHAPTER IV

RESEARCH METHODS

The purpose of this study is to understand the effects of institutional structure of predominately-white institutions (PWIs) related to African American student success in engineering. This chapter presents methods that were used to fulfil the research purpose. The first section includes the general model, hypotheses, and related literature for the research. Research questions and discussion are included in section two. The third section consists of information on data collection and procedure followed by data analysis. The final section includes discussion of expected findings.

The following hypotheses are constructed based on the literature regarding diversity climate, institutional theory, and institutional departure. Astin's (1993) input-environment-outcomes (I-E-O model) provides insights on how inputs of student and institutional characteristics impact postsecondary students' outcomes of retention, persistence and graduation rates. Historical accounts of outcomes among college students have been attributed to individual student characteristics such as academic preparedness, family socio-economic standing, enrollment status, and interruption in college studies (Adelman 1999; 2003; Baily et al., in press; Cabrera et al., in press as cited Bailey et al., 2005). Conversely, these models neglect to consider the role of institutional characteristics and "average student characteristics" and the influence it has on student outcomes. This oversight has led to studies that include the institution as the unit of analysis (Astin, Tsui, & Avalos, 1996; Mortenson, 1997, Porter, 2000, Ryan, 2004; Scott, Baily, & Kienzl, in press; as cited by Bailey et al., 2005). Focusing on within-institution factors rather than solely focusing on factors that are external to institutions of higher learning provides a starting point on how best to codify the characteristics that significantly affect campus climate (Munoz and Murphy, 2014; Hurtado, et al., 1999). Campus characteristics that may significantly impact campus climate include but are not limited to the history of the institution, compositional diversity, psychological variables, behavior and actions, and leadership have demonstrated that ethnic minorities view higher education climates and contexts differently than their majority peers (Hurtado, et al., 1999). Racial and ethnic diversity have both direct and indirect positive effects on the education outcomes and experiences of students (Chang, 1999). The effects on student outcomes are derived from the influence of several factors.

Titus (2004) conducted research that included both institutional and individual characteristics in understanding student persistence in four-year colleges. Using data captured from two nationally representative databases, (IPES 1995 and BPS: 96/98) Titus was able to merge individual student data with institutional data to provide a more informed outlook on student persistence. He determined that "persistence is higher at more selective, residential, and larger institutions" (Titus, 2004; as cited in Bailey et al., 2005). Subsequently he purported that higher expenditures per full-time equivalent students is related to greater student persistence; however, he further proclaimed that colleges with higher administrative costs experienced decreased persistence.

Operational Model

The operational model provided in Figure 1 provides a high-level methodological approach to addressing the research questions proposed by this study. The model illustrates the conceived relationship between variables and provided seven hypotheses for consideration.

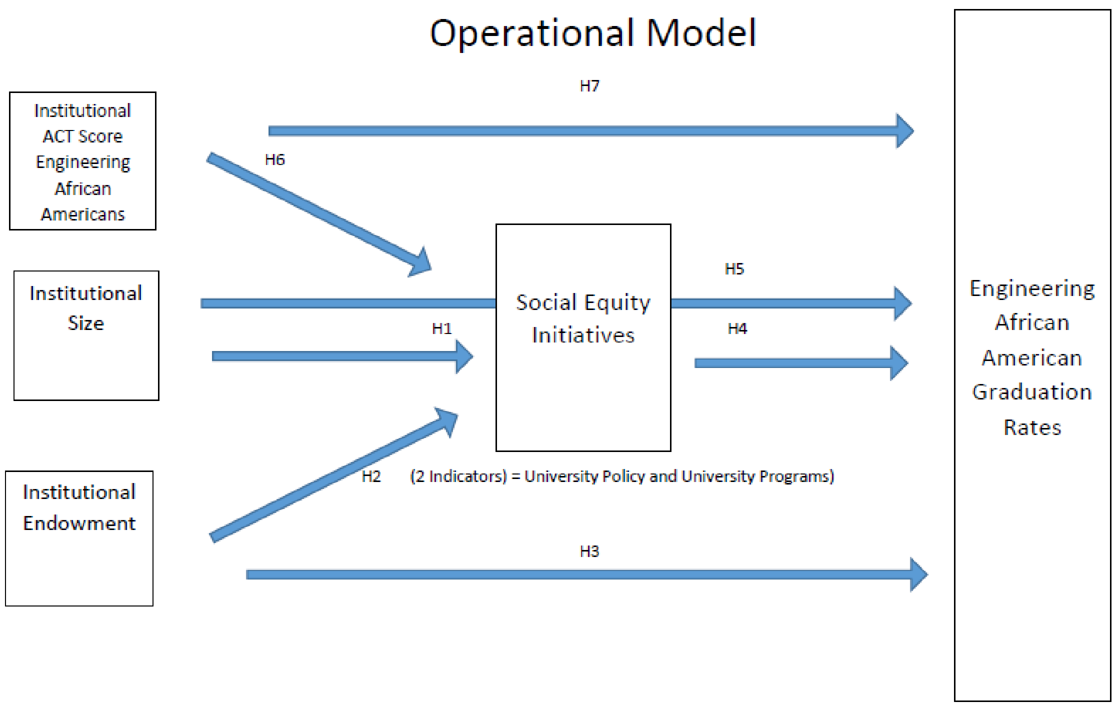

Figure 10. Operational Research Model

The literature provides a basis for these research hypotheses and insight into factors that contribute to African American student success in engineering at PWI land-grant institutions. The literature is consistent with other research regarding higher education success for underrepresented minority students.

Research Hypotheses

Hypothesis 1: There is a positive relationship between institutional sizes to the number of social equity programs for African Americans in engineering at Southeastern land-grant PWIs.

Hypothesis 2: There is a positive relationship between institutional endowments to the number of social equity programs at Southeastern land-grant PWIs.

Hypothesis 3: Institutional endowment will have a positive relationship to the graduation rate of African American students at Southeastern land-grant PWIs.

Hypothesis 4: There is a positive relationship between the number of social equity programs and graduation rates of African Americans in engineering at Southeastern land-grant PWIs.

Hypothesis 5: There is a positive relationship between institutional size and the graduation rate of African Americans in engineering at Southeastern land-grant PWIs.

Hypothesis 6: ACT scores for African American engineering students will have an inverse relationship to the number of social equity programs offered at Southeastern Land-grant PWIs.

Hypothesis 7: There is no relationship between ACT scores for African American engineering students and student success.

The following section provides literature to support each hypotheses.

Hypothesis 1: There is a positive relationship between institutional size to the number of social equity programs for African Americans in engineering at Southeastern land-grant PWIs.

Research conducted by Hu and Kuh (2003) revealed that students attending Doctoral/Research-Extensive universities are more likely to interact with peers from different backgrounds when compared to students attending other types of 4-year institutions. Kuh, et al. (2006), contend that one reason for this phenomenon is the result of "concerted efforts to provide diversity- related programming" (Kuh and Umbach, 2005; Pike and Kuh 2006). The National Postsecondary Education Cooperative (NPSC) defines the percentage of students within a university setting differing in racial and ethnic backgrounds as structural diversity. Structural diversity of institutions of higher learning has a positive effect on student outcomes (American Council on Education (ACE) and American Association of University Professors (AAUP) 2000; Hurtado et al. 1998, as cited from Kuh et al, 2006). As structural diversity increases, there exists greater levels of positive interaction among students across many aspects of diversity, including race (Hurtado et al., 2003; Pascarella, 2001). Gurin (1999) attributes this phenomenon to the increase in the probability that students will interact with students from different backgrounds that do not necessarily mirror their own. Kuh, et al., (2006) contend that students who have more frequent experiences with diversity experience 1) More personal and educational growth, 2) More involvement in active and collaborative learning, 3) Higher levels of satisfaction with their college experience. Consequently Pike, et al, (cited from Kuh, et al., 2006) stated that although Doctoral/Research universities have increased levels of students from different backgrounds interacting, this however does not significantly impact the level of informal interaction diversity.

Hypothesis 2: There is a positive correlation between institutional endowments to the number of social equity programs at Southeastern land-grant PWIs.

Minority students have reported the experience of a "chilly" climate, isolation, and cultural insensitivity as additional obstacles to college matriculation (Swail et, al., 2003), resulting in interventions such as social equity programs and policies being recommended by researchers in the field. The need for established programs and policies aimed to improve both academic and social integration of African American students attending PWIs has been the recommendation for a number of research efforts in recent years; however, this poses a financial obligation to colleges and universities. As previously stated in this chapter, the National Association of College and University Business Officers (NACUBO) has reported that institutions with endowments exceeding $100 million increased spending rates while those with small endowments lowered their spending rates (www.collegeboard.org, assessed August 31, 2017). The College Board further shared that although the Great Recession has concluded, associated increases in tuition and fees continue to outpace inflation.

As a strategic institutional priority to address African American student retention, the University of Illinois at Chicago formed a Task Force (2016) on the Progression and Success of African American students to address the retention of and success of this undergraduate group. Using focus groups consisting of 60 African American students, the Task Force was able to capture student feedback based on their experiences. To address negative feelings expressed by African American students concerning campus climate among the recommendations were the need for the allocation of additional university funds for educational, cultural and community-building events and projects. Such programs would emphasize connecting African American students and faculty and help to increase the visibility of African Americans on campus (https://strategicpriorities.uic.edu/.../2016/.../Final-African-American-Student-Success-.) Additionally, the group recommended the incorporation of programs such as hosting an annual Martin Luther King (MLK) Day as a visible university commitment to diversity and social justice, allowing for non-campus Black and minority communities to participate. Also, establishing special scholarships for low-income African Americans students with a goal of raising at least $1 million over three years.

Hypothesis 3: Institutional endowment will have a positive relationship to the success of African American students at Southeastern land-grant PWIs.

Although there has been an increase in minority college enrollment, African Americans continue to enroll in lower number (Aud, Fox KewalRamani, 2010) with students from this demographic more likely to experience higher levels of attrition and not earn college degrees (Berkner, He, & Cataldi, 2002; Porcheas et al., 2010). The lack of academic and social integration by African American students on PWI campuses is the most significant predictor of persistence until graduation contends Strayhorn (2008) and a sense of belonging being a major factor in minority retention (Hausmann, Schofield, & Woods, 2007).

College affordability is a notable factor in considering social equity implications of parity in degree obtainment for African Americans pursuing engineering degrees. When compared to other racial and ethnic groups, African American students received the highest percentage of financial aid with 92% of all fulltime African American students receiving financial aid in 2007-2008 (Aud et, al., 2010). The cost of attending college has resulted in barriers for students pursing postsecondary degrees. According to the College Board, colleges and universities receive revenue from a variety of sources in addition to tuition and fees. These include but are not limited to state and local appropriations, research grants, endowments and other enterprises. Despite having multiple sources of income, trends in college pricing continue to rise. Between 2003-2004 and 2013-2014, educational expenses for fulltime students attending public four-year institutions increased by 16% in inflation-adjusted dollars compared to public two year institutions reporting an increase of 4% in associated expenditures (www.collegeboard.org, assessed August 31, 2017).

The National Association of College and University Business Officers (NACUBO) reported for 2009-2010 that institutions with endowments exceeding $100 million increased spending rates while those with small endowments lowered their spending rates. However, since 2012 spending levels across universities with varying levels of endowments have become more homogenous (www.collegeboard.org, assessed August 31, 2017). Pascarella and Terenzini (2005) determined that private colleges were slightly advantaged over public four-year institutions regarding persistence when not controlling for student background and characteristics. A study conducted by Bowen, Chingos, McPherson (2009) showed that while six-year graduation rates of private and flagship public institutions were comparable, four-year graduation rates were 20% and 14% lower at public schools than at Ivy League and liberal arts colleges. (Bettencourt, et al., 2013). Bowen et al. (2009) purport that the difference may be attributed to generous financial aid packages:

> "Private colleges tend to have more generous financial aid packages. Because private colleges tend to have large endowments they are able to provide generous aid packages to low-income students, alleviating financial pressure, which allows them to complete in a more timely fashion" (Bowen et al., 2009).

Bettencourt et, al. (2013) state that research outcomes surrounding gaps between persistence of those attending private versus public institutions of higher learning are laden by the difficulty of disaggregating institutional effects from factors influencing student success prior to their postsecondary matriculation. Many factors impact how students engage, interact, and integrate into college environments (Bean, 1980; Tinto, 1987; 1993).

Hypothesis 4: There is a positive relationship between the number of social equity programs and graduation rates of African Americans in engineering at Southeastern land-grant PWIs.

Providing layers of support to African American engineering students in engineering has been identified as an approach to addressing increased retention and graduation rates. HBCUs traditionally have excelled at providing supportive learning environments where students have access to faculty and staff, peer mentors and advisors that help to guide them, buffer the challenges of college life and foster a climate of achievement (Fleming, 1988). As defined by Slanton-Salazar (1997), social capital is the access to resources and information for social progression and accomplishment of goals.

Pierre Bourdieu's (1977, 1986, and 1987) research is grounded in theories of social reproduction and symbolic power, where norms and access to institutional power are central to his premise on social capital. Dika and Singh (2002) insights on Bourdieu's position explain his outlook:

> "He defined social capital as the aggregate of actual or potential resources linked to possession of a durable network of essentially institutionalized relationships of mutual acquaintance and recognition. This group membership provides members with the backing of collectively owned capital….social capital is made up of social obligations or connections and it is convertible, in *certain conditions*, into economic capital." (p. 33)

Harper (2008), states Bourdieu's concept of social capital are based on three significant concepts: (a) capital is cumulative and can potentially produce social benefits and profits, (b) relationships can afford previously excluded individuals access to information and resources enjoyed by the domain group in power, and (c) the quality and quantity of such relationships can determine the convertibility of capital (Dika & Singh, 2002; Portes, 1998). Furthering the significance of social capital, Stanton-Salazar (1197) contended that "capital can be converted into socially valued resources and opportunities (e.g. emotional support, legitimized institutional roles and identities, privileged information, access to opportunities for mobility)" (p.8).

Hypothesis 5: There is a positive relationship between institutional size and the graduation rate of African Americans in engineering at Southeastern land-grant PWIs.

The National Postsecondary Education Cooperative (NPSC) maintains that structural characteristics of an institution include features of size, residential character, student –faculty ratio, endowment and structural diversity (Kuh, et al., 2006). However, when controlling for student characteristics, features such as institutional size result in "trivial and inconclusive student success outcomes" (Pascarella and Terenzini, 2005, p. 596). Labov (2004); Johnson (2007); Gasiewski et al. (2012) stressed the challenge experienced by underrepresented minority students in STEM with regard to large classroom setting. Contrary to the position of Pascarella and Terenzini, Labov (2004); Johnson (2007); Gasiewski et al. (2012) argue that large lecture-style classrooms diminish students' ability to engage and interact with professors. The inability to have access to professors in the classroom has a negative effect on student academic and social integration. Positive social and academic integration is an important aspect of URM students in perceiving themselves able to be successful. Kuh, et al., (2006) further explain that neither "urbanicity nor size (i.e. full-time equivalent enrollment) was related to informal interactional diversity".

Persistence of racial and ethnic minority students and majority students is positively related to a diverse campus (Hurtado, et al., 1998). Nettles (1991) found that African American students enrolled in institutions with small percentages of African American students were more likely to complete degree requirements at a slower pace than those African Americans enrolled at institutions with a greater density of African American students (Kuh, et, al., 2006). The density of the composition of racial and ethnic student make-up is important as students are more likely to participate in activities that are diversity-related on campuses with a larger density of students of color, regardless of institution type (Kuh, et al., 2006).

As the widely recognized forerunner in describing institutional diversity in U.S. higher education for more than four decades, the Carnegie Classification of Institutions of

Higher Learning provides a framework for institutional categorization based on size, among other factors. Table 1 provides the breakdown of Carnegie's large four-year institutions. According Carnegie, the student population size of an institution matters. The size of colleges and universities matters as it "relates to institutional structure, complexity, culture, finances, and other factors". The Carnegie framework describes institutional size by residential or non-residential status, which is viewed as an indicator of campus environment, which students choose to attend, and the programs and services provided by the institution (www.carnegieclassifications.iu.edu.)

Table 1

Carnegie Classifications of Institutions of Higher Learning, 2013-2014).

Institution Type	Duration Type	Large Size	Enrollment Status	Residential Characteristic
4 -Year Large Primarily Non-residential	4 year	Minimum of 10,000 students	50% or fewer full- time students	Fewer than 25% students live on campus
4 -Year Large Primarily Residential	4 year	Minimum of 10,000 students	Minimum of 50% full- time students	25-49% students live on campus
4-Year Large Highly Residential	4 year	Minimum of 10,000 students	Minimum of 80% full- time students	Minimum 50% students live on campus

Hypothesis 6: ACT score for African American engineering students will have an inverse relationship to the number of social equity programs offered at Southeastern Land-grant PWIs.

The ACT has historically been used as an incoming metric for college admission. When used as a "stand-alone" predictive tool, the ACT at best provides a snapshot of "what students have learned and what they are ready to learn next" at a particular point in time (ACT, 2015). The ACT Research and Policy organization (2013) describe ACT college readiness assessment scores as the minimum scores required that will result in the greatest likelihood that students will have success in college courses such English Composition, Social Sciences courses, College Algebra or Biology (www.act.org, 2013). Although the use of this unidimensional approach to admission and course planning is a limiting perspective of who the student is and what their capabilities are (Swail, et al., 2003), ACT scores continue to be widely used to determine student remediation needs and student course placement in U.S. colleges and universities (www.act.org, 2013).

In response to the lagging ACT scores of student subgroups including First Generation College, low socioeconomic backgrounds, underprepared, and minority status, many universities have created programs to address these student needs. For some institutions, ACT scores are used to assess student preparedness for admission into specific majors and programs of study such as engineering.   A retention assessment conducted at Mississippi State University from 2001-2005 concluded that 8% of pre-engineering students enrolled into engineering following one year of pre-engineering status while 12% of students received full engineering student status after two years of enrollment (Reese, & Green, 2008). This study also revealed that minority students were disproportionately represented in the pool of pre-engineering students (Reese & Green, 2008).

The findings from the study prompted the development of the Pre-Engineering class to support engineering student retention. The class spoke to the needs of incoming students with ACT scores less than the minimum score required to be admitted into the engineering program. The one-hour course instructed on topics of study skills, time management, community skills, learning styles, and engineering majors. In addition to the class, the Pre-Engineering Program provided students with special academic advisors through the Academic Advising Center, and a prescribed list of initial set of courses. Engineering student retention is a work administered across U.S. colleges and universities and is aided by efforts and contributions of state and national organizations.

Hypothesis 7: There is no relationship between ACT scores for African American engineering students and student success.

Despite the ACT being historically used as an incoming metric for college admission, recent studies have shown that standardized tests such as the ACT alone are not the best indicator of student success. Although used as a predictive tool, the ACT was not intended for this sole purpose but rather should best be used as a snapshot of "what students have learned and what they are ready to learn next" at a particular point in time (ACT, 2015). Some U.S. institutions of higher learning are making standardized tests optional for university admissions. Among them is Bates College, where former Vice President William C. Hiss posed the national policy issue of whether standardized tests essentially reduced student diversity by restricting access to higher education for students who might otherwise be successful if admitted. Based on the twenty-year study conducted, Hiss reports a minimal rate of one-tenth of one percent difference in graduation rates between students who submitted standardized test scores and students who did not. His findings include similar results in GPA attainment with a difference of five hundredths between ACT submitters and non-submitters. Furthermore, the study illustrates a fifty percent increase in admission applications after making standardized test scores optional and states that use of standardized test scores was not essential in predicting student performance.

Prediction of academic outcomes for URM (underrepresented minority) STEM students has been a growing concern among policy makers, industry leaders and those in academia. Although the interest in predictor-outcome relationships is widely touted, research on the topic is limited. Chavous et al., (2004) explored the relationship among gender, institution, and stereotypes when predicting academic competences. Researchers Brower and Ketterhagen (2004) explored the ways enrollment at HBCUs and PWIs are impacted by different experiential characteristics (Reeder, Schmitt, 2013). These studies provide insight on the role of colleges and universities in shaping students' psychological constructs (e.g., expectations, self-concept and academically relevant outcomes) (Reeder and Schmitt, 2013). Research from Cokley, 2000; Chavous et al., 2004; Greer & Chawalisz, 2007 indicates that African American students at PWIs perceive higher levels of minority –related stress and unfair treatment (Reeder & Schmitt, 2013). The findings of previous research support the belief that because African Americans at PWIs experience high levels of minority-related stress, their efforts to overcome this deficit of being in a minority group diminishes their ability to focus on academic performance. Reeder Schmitt further express that "African Americans at PWIs must put forth greater effort than their HBCU counterparts. Such an explanation is congruent with research indicating that PWI students do indeed invest greater effort and time in academic endeavors" (Reeder, Schmitt, 2013).

The American Society of Engineering Education (ASEE) is a nonprofit organization of more than 10,000 engineering faculty members in the U.S. and Canada. ASEE seeks to "advance innovation, excellence, and access at all levels of education for the engineering profession" (ASEE, 2017). Through research and publication efforts, ASSE is viewed as an pre-eminent authority on the education of engineering professionals.

ASEE recognizes the need for increased diversity across engineering and engineering technology programs in colleges and universities. As part of an encompassing ASSE study of student retention, ASEE (2012) has shown a combination of individual and institutional factors that contribute to the difference in outcomes of student retention across programs, majors and types of students. Findings shared by ASEE show that there "some variability in retention can be explained by the level of student preparedness for engineering programs… other studies have shown that a primary reason for the attrition of students from engineering is their perception of a learning environment that fails to motivate them and is unwelcoming; it's neither the students' capabilities nor their potential for performing well as engineers that determines their persistence" (ASEE, p. 3).

To combat declining retention of ASEE supports the inclusion of individuals from all segments of society. With a focus on diversity across engineering education and the engineering profession, ASEE promotes the inclusion of those who have been historically underrepresented within engineering. As an intervention to improve retention, over sixty best practices and strategies incorporated across U.S. engineering schools were identified by ASEE. These published approaches addressed issues, but were not limited to at-risk students, first year students, academic preparation and performance concerns where specific interventions such as summer bridge programs were used to minimize academic and social gaps realized by underrepresented minority engineering students; many of whom with marginal ACT scores (Verdell, et, al., 2016).

Expectations and Research Questions

This research examined whether assumptions that were made based on the literature regarding URM student success at PWIs will hold to be correct. Institutional theory and diversity climate literature concern student success as it relates to institutional impact of predominately-white institutions. Along with Tinto's departure theory, the aforementioned theories have been used to formulate the research hypotheses and research questions. Guiding the research design and hypotheses is the overarching question of what institutional structures, in the form of SEIs, can explain the success of URM engineering students at predominately-white land-grant institutions in the southeastern United States? Although not designed to holistically answer this question, this research seeks to provide insight on how institutional policies and programs addressing social equity affect the success of underrepresented minority students pursing engineering degrees at PWI land-grant institutions. In this section below, the expectations for this study aimed to answer the research questions based on the theories outlined in chapters three and four.

1. Does the intervention by predominantly white Southeast land-grant colleges and universities through social equity initiatives (SEI) enhance the graduation rate of African American in engineering?
    A. Expectation 1: I expect that there will be a positive correlation between the number of social equity initiatives and the graduation rates of African Americans at predominantly white land-grant institutions.

B. Expectation 2: I expect that predominantly white land-grants with more African American student enrollment will have more social equity initiatives geared toward African American student persistence and success.

C. Expectation 3: I expect to find that predominantly white land-grant institutions with university policy (mission/vision statement) to promote and support diversity and inclusion will have positive impact on URM student success.

2. Is there a difference in graduation rates of African American students in engineering among predominantly white Southeast land-grant colleges and universities that have social equity initiatives (SEI) compared to those who do not?

   A. Expectation 1: I expect that predominantly white Southeast land-grant colleges and universities with social equity initiatives will have a higher graduation rate of African American students in engineering than predominantly white Southeast land-grants that do not have social equity initiatives.

   B. Expectation 2: More specifically, universities with social equity initiatives geared toward African American persistence in engineering will have higher graduation rates in comparison to those that do not.

Data Collection & Procedure

To examine hypotheses the data from the Integrated Postsecondary Education Data System (IPEDS) and the American Society of Engineering Education (ASEE) were used. IPEDS collects data from survey components and houses data for nearly 6,700 institutions that provide postsecondary education within the United States were used. The database provides institutional level data on students, enrollment, student charges, institutional finance, faculty and staff. Used at the federal and state level for policy analysis, IPEDS is a well-established and reliable source for data concerning U.S. institutions of higher learning. ASEE compiles profile self- reported data on engineering and engineering technology colleges and can be accessed by using the ASEE online data mining tool. Institutional endowment figures will be gathered from the 2016 U.S. News and World Report for Higher Learning.

Additional institutional level data on social equity initiatives (SEIs) was captured through web content analysis from each institution included in this study. Content analysis is a research technique used to make replicable and valid inference by interpreting and coding textual material. This process allowed for systematic evaluation of electronic text that was coded and converted into quantitative data.

Using general categories of "best practices" for student retention published by the American Society of Engineering Education (ASEE) 2012 and my literature review as a guiding principal, Tables 5 lists 32 key word phrases that were used to determine the existence, types, and quantity of SEI programs and policies geared toward student diversity and inclusion efforts. Additionally the key word search was used to determine the types and quantity of SEIs specific to African American (URM) student success in engineering. The list of key words used for web searches is provided in Tables 5.

The key word search consisted of promising practices and strategies for retaining students in engineering. These practices identified by the American Association of Engineering Education (ASEE) were quoted by engineering schools as being a part of their holistic approach to improving retention. These colleges of engineering stressed the importance of combining multiple strategies as opposed to simply focusing on one approach.

Frequently mentioned types of support reported by participating institutions including what have been termed for this study SEIs, being: 1) tutoring, 2) mentoring, 3) learning centers, 4) programs specifically developed for at-risk students, 5) programs developed specifically for first-year students and 6) academic advising are all recommended programs (ASEE) 2012.

The major categories for the key word search of SEIs include 1) student learning through tutoring 2) student programs 3) student academic enrichment programs 4) student research 5) institutional/departmental policy changes. Each of these major categories were used in relation to diversity and inclusion for determining the key words that were searched.

Table 2

Web Search Key Words (1-10)

Social Equity Initiative (SEI)	College of Engineering Level	SEIs Y/N	Name of SEIs	University Level	SEIs Y/N	Name of SEIs
Engineering Diversity/Inclusion Student Organization						
Diversity/Inclusion Student Organization						
Nationally Funded URM Programs						
URM Engineering Scholarships						
Engineering Office of Diversity						
Office of Diversity						
Diversity/Inclusion Mission and Vision Statement						
Diversity/Inclusion Mission and Vision Statement						
Engineering Diversity/Inclusion Retention Program						
Diversity/Inclusion Retention Program						

Table 3

Web Search Key Words Continued (11-16)

Engineering Diversity/Inclusion Retention Policy						
Diversity & Inclusion Retention Policy						
Engineering Student Diversity & Inclusion Policy						
Student Diversity & Inclusion Policy						
Engineering Diversity & Inclusion Mentoring						
Diversity & Inclusion Mentoring						

Table 4

Web Search Key Words (17-27)

Social Equity Initiative (SEI)	College of Engineering Level	SEIs Y/N	Name of SEIs	University Level	SEIs Y/N	Name of SEIs
Engineering Diversity/Inclusion Tutoring						
Diversity/Inclusion Tutoring						
Engineering Diversity/Inclusion Learning Community						
Diversity & Inclusion Learning Community						
Engineering Diversity/Inclusion Peer Mentoring						
Diversity/Inclusion Peer Mentoring						
Engineering At-Risk Programs						
At Risk Programs						
Engineering Summer Academic Enrichment						
Engineering STEM Summer Bridge Program						
Engineering Minority Research/Symposiums						

Table 5

Web Search Key Words Continued (28-32)

Minority Research & Symposium						
Engineering Learning Center & Skills Building						
Learning Center						
Engineering Measure of Student Learning Outcomes						
Diversity Sensitivity Training						

Method of Analysis

This quantitative study provides descriptive statistics for all of the final variables (means, variances, frequency distribution) in the model. Hypotheses were tested using bivariate statistics, specifically Spearman's Rho for ordinal variables with a small total population size. Spearman's Rho was selected to help measure the statistical dependence between the rankings of two variables. Spearman's Rho assessed how well the relation between the independent and dependent variables were described using a monotonic function.

Measurements

This study examined the relationship of institutional variables on social equity programs and policies implemented by predominantly white land-grant institutions located in the southeastern portion of the U.S. Further, the study examined the relationship of social equity programs and policies to the success of African American engineering students enrolled at predominantly white land-grant institutions located in the southeast. This research provides insight into institutional structure and associated behaviors that result in relationships between social equity initiatives and graduation rates of African Americans in engineering at PWI land-grant institutions located in the southeast.

Participants

Table 6

Selected Southeastern PWI Land-grant Institutions

Institution Name
Auburn University
University of Arkansas
University of Florida
University Georgia
University of Kentucky
Louisiana State University
Mississippi State University
Clemson University
University of Tennessee
University of Missouri
North Carolina State University

Participants for this study were not randomly selected for this study. Using a quasi-experimental procedure, each university included in this study was selected based on their identification as a predominantly white land-grant institution in the southeastern region of the U.S. (Creswell, 2014). All data that were utilized in this study are archived data for each predominantly white southeastern and-grant institution used in this study. Institutional data were retrieved for academic year of 2016. Table 6 provides a listing of each institution included in this study. All 11 universities have the designation as a predominantly white land-grant institution that is located in the southeastern portion of the U.S.

Of the 12 predominantly white land-grant institutions located in the southeast, 11 institutions were selected to be included in this study. Texas A&M University is located in the southeastern portion of the U.S as defined by the South Eastern Conference (SEC) and is a predominantly white land-grant institutions. However, Texas A&M University is located outside of the traditional geographic South of the U.S. and is commonly referred to as “border-state”.

Descriptive statistics for each of the selected institutions were captured and compiled in data charts as seen in Table 7. Inputs for each institution included undergraduate enrollment, institutional size and the level of annual institutional endowment. All inputs were captured for academic year 2016. Combined institutional descriptive data for Table 7 were used to list data for institutional SEIs and engineering SEIs geared toward URMs and African Americans. This data will be provided in later tables.

Table 7

Combined Institutional Descriptive Data 2016.

Institution	College of Engineering SEIs	University SEIs	ACT Score for Engineering Acceptance	Mean ACT Score Engineering African American	Institutional Size	Institutional Endowment	African American Engineering Graduation
Auburn University							
University of Arkansas							
Clemson University							
University of Florida							
University of Georgia							
University of Kentucky							
Louisiana State University							
University of Missouri							
Mississippi State University							
North Carolina State University							
University of Tennessee							

Instrumentation

All of the data that were utilized in this study are archived data, therefore no instruments were used to collect data. To answer the two research questions of this study, data representing the variables of interest for the dependent variables were retrieved from IPEDS data records and the ASEE data-mining tool. Institutional endowment data was captured from the 2016 U.S. News and World Report for Higher Education. As described in the Data Collection and Procedure section of this chapter, data for institutional social equity initiatives for each institution were captured using web content analysis. Digital content for each university was extracted by searching for key words to identify programs and policies addressing the persistence and graduation of African Americans and URMs in engineering.

Dependent Variable

African American Engineering Graduation Rate

This variable reflects the graduation rate of African American engineering students enrolled at predominantly white land-grant institutions located in the southeast. Success for graduation rate was defined as the number of African American students who graduated in engineering for 2016. The raw number of African American graduates in engineering were used to further highlight the parity in graduation numbers compared to other groups.

Independent Variable

Mean Institutional ACT Score

The average ACT score for African American engineering students measures student content knowledge in mathematics, English, reading, and science with four sub-scores. In each content area a sub-score is assigned and reported as scaled scores ranging from 1-36. In addition to sub-scores, the ACT score is captured as an overall composite score ranging from 1-36.

Institutional Size

Table 8

4-Year Residential Undergraduate Full Time Enrollment Scale.

Institution Type	(A) UG FTE	(B) UG FTE	(C) UG FTE	(D) UG FTE
4-year residential	18,000-20,000	21,000 – 23,000	24,000 – 26,000	27,000+

This variable provided a classification for each selected institution based on institution type, duration type, and enrollment status of students, residential characteristics and a minimum enrollment of 10,000 students. The Carnegie Classifications of Institutions of Higher Learning framework (2013-2014) was used to determine institutional size. Institutions were categorized according to 4-year large primarily non-residential; 4-year large primarily resident; 4 year large highly residential. An enrollment range was determined based on the residential type and the number of full-time enrolled (FTE) undergraduate students. Table 8 provides the breakdown for 4-year residential universities with full-time undergraduate enrollment ranging from 18,000 students to campuses exceeding 27,000 students. To code the data a classification scale for full-time enrolled students included A = 18,000 – 20,000; B = 21,000 – 23,000; C = 24,000 – 26,000 and D = 27,000 or more where a minimum of 50% of students reside on-campus. However, the analysis used the actual university enrollment numbers.

Institutional Endowment

The current study measured the variable annual institutional-level endowments for each selected institution for the year 2016. A range of high, medium, or low can be used to designate a value to each institution, though I used the actual values for each institution.

Social Equity Initiatives

This factor was assessed by conducting web content analysis using a method of key word search to identify the quantity and type of SEIs available at each institution. As discussed earlier in this chapter, Table 2 and Table 3 contain key words that will be used to conduct the web content search for each institution. Text findings were coded to determine a value of 1 = social equity initiative or 0 = no social equity initiative. The resulting variable is a scale that counts the number of social equity initiatives that each university has.

Revised Model

The use of ACT scores for admission across a growing number of colleges is shifting, as institutions such as George Washington University have implemented a test-optional policy for applicants. In addition to test-optional policies concerning ACT scores, some Colleges of Engineering no longer stipulate a required minimum ACT score, but rather rely on the ACT scores of admitted students to determine the percentile range of ACT scores accepted. This resulted in the lack of data to determine a true minimum ACT score required for admissions into engineering. Percentile ranges for the 25^{th} and 75^{th} percentile was captured to show the range of ACT scores used for admission into engineering programs.

The underrepresentation of African Americans in engineering has resulted in a small population of student enrollment. The small size of this population makes it plausible to use aggregated standardized tests scores such as the ACT, to individually identify students within a university College of Engineering. To ensure data security and to protect the confidentiality of students, ACT scores for African Americans in engineering is not included as published data at the university level. Data tools such IPEDS, ASEE data mining tool, and the Multiple-Institution Database for Investigating Engineering Longitudinal Development (MIDFIELD) operate under similar confidentiality constraints. Institutional ACT scores for African American students in engineering were not available for this study.

The original operational model was revised to address the lack of ACT data for 2016 for African American engineering students across each PWI. The revised model has eliminated Hypothesis 6 and Hypothesis 7. The elimination of these hypotheses did not obstruct the data needed to answer each of the two research questions. Figure 11 provides the revised operational model. Table 9 below provide information on ACT data available for selected institutions.

Figure 11. Revised Operational Model

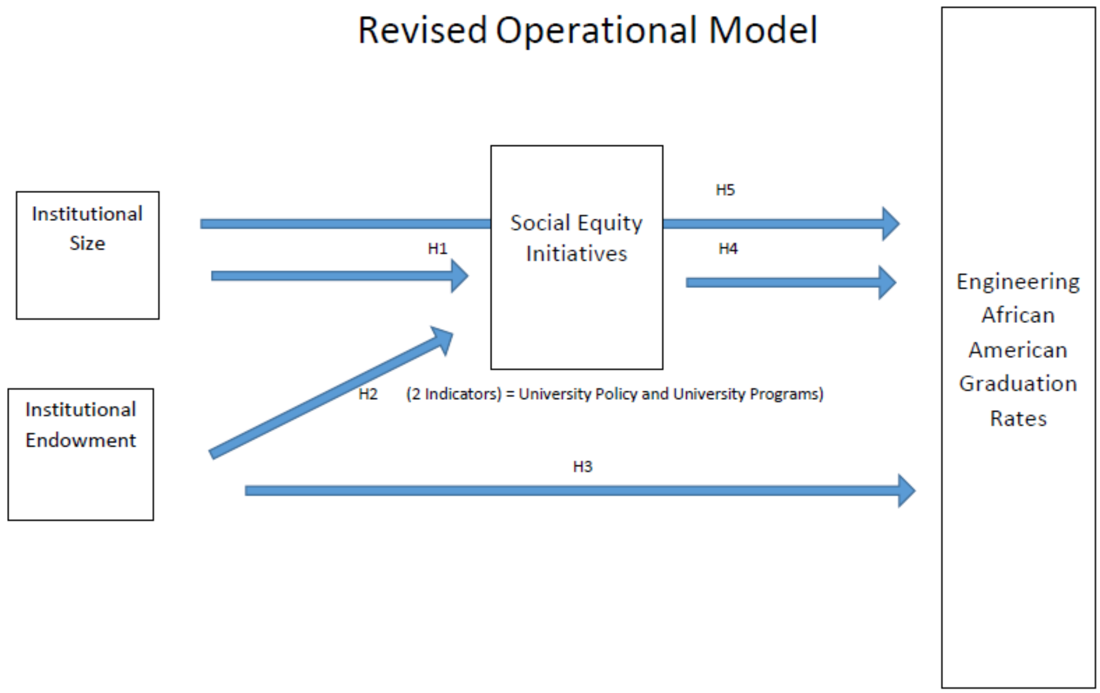

Table 9 *Institutional ACT Data for 2016.*

Institution	ACT Score Engineering Acceptance	ACT of Engineering 25th &75th percentile	ACT of Engineering African American
Auburn University	22	26-31	NA
Univ. of Arkansas	20	24-30	NA
Clemson University	NA	27-32	NA
University of Florida	NA	27-31	NA
University of Georgia	NA	25-30	NA
Univ. of Kentucky	23	25-31	NA
Louisiana State Univ.	22	24-29	NA
Univ. of Missouri	24	25-30	NA
Mississippi State Univ.	23	24-30	NA
North Carolina State Univ.	NA	26-31	NA
Univ. of Tennessee	25	27-32	NA

Expected Outcome and Limitation

Before testing the model, it was expected that the results from the study would be consistent with the theoretical frameworks on student success in college, specifically institutional departure theory, institutional climate and critical race theory. Further, it was anticipated that there would be a positive relationship between the number of social equity initiatives and graduation rates of African Americans in engineering at PWI Southeastern land-grant institutions. It was anticipated that a positive relationship between institutional size to the number of social equity initiatives. Likewise, it was anticipated that institutional endowment would have a positive correlation to the success of African Americans students at Southeastern PWI land-grants. Based on theoretical foundations and literature, it was expected that predominantly white land-grants with more African American student enrollment would have more social equity initiatives geared toward African American student persistence and success. One limitation includes the fact that the literature consistently used the term URM as broad demographic category to include those of African American race. As generally prescribed by the literature, for this study in some instances URM was used as a surrogate for African American. Further, STEM was used as a surrogate for engineering.

CHAPTER V

FINDINGS

Chapter V presents the findings of the analysis. The chapter is organized in respect to the two original research questions stated at the onset as found below and the five hypotheses. The Statistical Package for the Social Science (SPSS) was used to calculate the data. The software computed basic descriptive statistics.

A response to each research question and hypothesis is presented with evidentiary support from the descriptive statistics results.

The following are the research questions for the study.

1. Does the intervention by predominantly white Southeast land-grant colleges and universities through social equity initiatives SEIs enhance the graduation rates of African Americans in engineering?
2. Is there a difference in the graduation rates of African American students in engineering among predominantly white Southeast land-grant colleges and universities that have social equity initiatives SEIs compared to those who do not?

The results of this study provide insight into the relationship between the five institutional factors identified and African American engineering student graduation rates at PWI land-grant institutions in the Southeast.

Data Sources

As previously reported in Chapter IV of this study, the data that were used in this study were gathered from archived data recorded for eleven selected predominantly white Colleges of Engineering within land-grant institutions located in the Southeastern region of the United States and web content data extracted from each institution's website. In this study, success was defined as the graduation of African Americans in engineering. African American graduation rate was viewed as a dependent variable. In examining STEM retention, the literature defined success in terms of both persistence and graduation. The use of graduation rate as the measure of success rather than persistence serves to emphasize the importance of the need for more prepared African Americans in the STEM global workforce.

Use of Independent and Dependent Variables

African American engineering graduation rate was the only dependent variable in Hypothesis 3, Hypothesis 4 and Hypothesis 5. The independent variables for these hypotheses included institutional size, institutional endowment, and social equity initiatives, which examined the impact of graduation rates of African American engineering students. Hypothesis 1 and Hypothesis 2 both included the dependent variable social equity initiatives with the other two variables being independent variables.

Descriptive Statistics

The following tables include basic descriptive statistics for each variable. The selected universities for this study consisted of 11 predominantly white land-grant institutions located in the Southeast region of the U.S. that operated a College of Engineering during the academic year of 2016. Table 13 includes undergraduate enrollment, institutional size, and annual endowment for each selected institution. Each PWI used for this study met the Carnegie classification of a large 4-year large institution; however, 27% of the institutions were identified as “primarily non-residential”. The remaining 73% of the institutions resulted in an institutional size of “primarily residential”.

Results of Data Analysis

This section of Chapter V presents the results of data analysis that was used to answer the two research questions that guided this study. For each research question, the question is stated followed by the method of data analysis that was used to answer the questions. Following the research question and the method of analysis is the results recorded. Each hypothesis will be stated followed by the method of data analysis that was used to accept or reject each hypothesis.

Research Question 1

Research Question 1 was designed to determine whether predominantly white land-grant institutions located in the Southeast enhance the graduation rates of African Americans in engineering. To answer Research Question 1, descriptive statistics were computed for pertinent data that would provide an accurate description of each institution included in the study. Does the intervention by predominantly white Southeast land-grant colleges and universities through social equity initiatives (SEIs). The answer to Research Question 1 is organized into the following three sections: (a) measures of institutional enrollment data, (b) social equity initiatives descriptive data for each institution (c) African American engineering student enrollment descriptive data and.

Research Question 2

Research Question 2 was designed to determine whether there was a difference in the graduation rates of African American students in engineering among predominantly white Southeast land-grant colleges and universities that have social equity initiatives (SEIs) compared to those who do not. To answer Research Question 2, descriptive statistics were computed for pertinent data that would provide an accurate description of each institution included in the study. The answer to Research Question 1 is organized into the following three sections: (a) measures of institutional enrollment data, (b) social equity initiatives descriptive data for each institution (c) African American engineering student enrollment descriptive data and.

Measures of Institutional Enrollment

To provide a profile description of each institution selected for the study, institutional undergraduate enrollment, endowment, the number of social equity initiatives, African American engineering enrollment, African American engineering graduation and the percentage of African American engineering graduation at each institution was determined. The average enrollment across all PWIs was 24,482 full time enrolled (FTE) students (Table 10). The lowest enrollment was 18,090 FTE at Mississippi State University and the highest was 36,794 FTE at the University of Florida. For African American enrollment of engineering students, the lowest number of FTE students was 115 students at the University of Tennessee and the highest enrollment of African Americans enrolled was 430 FTE students at Mississippi State University (Table 13). Summary Descriptive Institutional Profile Data for 2016.

Table 10 *Summary Descriptive Institutional Profile Data for 2016*

Institutions	Average Enrollment	Average Endowment
N = 11	24,482	$801,000,000

Measure of Social Equity Initiatives (SEIs)

The lowest number of social equity initiatives was 4 at the University of Georgia and the highest social equity initiatives (SEIs) at the college level was 16 at Mississippi State University. Table 11 displays the results of the descriptive analysis that were used to examine the variable of social equity initiatives.

Table 11 *Social Equity Descriptive Statistics*

Social Equity Initiatives Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Social Equity	11	4.00	16.00	8.0000	4.17133
N	11				

Social Equity Initiatives (SEIs) were identified for each institution. A total N = 11 with 32 SEIs evaluated for each institution. The descriptive data resulted in M= 8 with a SD = 4.17. The maximum number of SEIs at an institution resulted in 16 with the lowest occurrence being 4. A range of 12 was used to capture the high and low number of SEIs (Table 12). Four institutions had 5 SEIs, resulting in a frequency distribution percent of 36.4%. The remaining seven institutions each had a different number of social equity initiatives (see Table 14).

Table 12 *Social Equity Descriptive Statistics*

Social Equity Initiatives Descriptive Statistics		
N	Valid	11
	Missing	0
Mean		8.0000
Skewness		1.031
Std. Error of Skewness		.661
Range		12.00
Minimum		4.00
Maximum		16.00

Although data were captured on the social equity initiatives at both the College of Engineering and the institution level, only data representing the college level have been included in this study. College level data provides a most relevant frame of reference regarding factors affecting graduation rates of African American students in engineering. University level social equity initiative are less directly relevant, and allow for future research recommendations

The 32-college level SEIs examined resulted in output of descriptive statistics including the mean, standard deviation and minimum and maximum values for each SEI. Of the 32 SEIs examined, 1) Engineering Diversity and Inclusion Mission and Vision Statement 2) Engineering Diversity and Inclusion Retention Program, 3) Student Diversity Inclusion Policy and 4) Diversity and Inclusion Learning Community resulted in no institution having programs or initiatives for these SEIs (Table 15).

Table 13 *Institutional Profile Data for 2016.*

Institution	Undergraduate Enrollment	Endowment	Social Equity Initiatives SEIs	African American Engineering Enrollment	African American Engineering Graduation	Percentage of AA Engineering Institution Graduation
Mississippi State University	18,090	$445 million	16	430	50	11.3%
Clemson University	18,395	$621 million	14	369	37	6.6%
University of Tennessee	22,139	$654 million	7	115	19	3.5%
University of Arkansas	22,548	$899 million	5	135	14	4.1%
Auburn University	22,658	$658 million	12	315	35	6.3%
University of Kentucky	22,865	$1.2 billion	5	117	10	3.4%
North Carolina State University	23,847	$999 million	10	220	47	3.3%
University of Missouri	25,898	$870 million	5	139	21	4.7%
Louisiana State University	26,123	$469 million	6	452	52	7.4%
University of Georgia	27,740	$1.0 billion	4	133	5	7.3%
University of Florida	36,794	$1.5 billion	6	230	40	3.3%

Table 14 *Social Equity Descriptive Statistics*

	Social Equity Initiatives N = 11				
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4.00	1	9.1	9.1	9.1
	5.00	4	36.4	36.4	45.5
	6.00	1	9.1	9.1	54.5
	7.00	1	9.1	9.1	63.6
	9.00	1	9.1	9.1	72.7
	12.00	1	9.1	9.1	81.8
	14.00	1	9.1	9.1	90.9
	16.00	1	9.1	9.1	100.0
	Total	11	100.0	100.0	

Table 15 *Descriptive Statistics for College of Engineering SEIs (1-32).*

Social Equity Initiative	N	Minimum	Maximum	Mean	Std. Deviation
Engineering Diversity & Inclusion Student Orgs	11	0	1	.64	.505
Diversity & Inclusion Student Org	11	0	1	.18	.405
Nationally Funded URM Program	11	0	1	.45	.522
URM Engineering Scholarships	11	0	1	.45	.522
Engineering Office of Diversity	11	0	1	.36	.505
Office of Diversity	11	0	1	.09	.302
	11	0	0	.00	.000
Social Equity Initiative	N	Minimum	Maximum	Mean	Std. Deviation
Engineering Diversity & Retention Program	11	0	1	.09	.302
Diversity & Inclusion Retention Program	11	0	1	.09	.302
Engineering Diversity &Inclusion Retention Policy	11	0	0	.00	.000
Diversity & Inclusion Retention Policy	11	0	1	.09	.302
Engineering Student Diversity & Inclusion Policy	11	0	1	.09	.302

Student Diversity & Inclusion Policy	11	0	0	.00	.000
Engineering Diversity & Inclusion Mentoring	11	0	1	.55	.522
Diversity & Inclusion Mentoring	11	0	1	.18	.405
Engineering Diversity & Inclusion Tutoring	11	0	1	.27	.467
Diversity & Inclusion Tutoring	11	0	1	.09	.302
ENGR Diversity & Inclusion Learning Comm.	11	0	1	.18	.405
Diversity & Inclusion Learning Community	11	0	0	.00	.000
Engineering Diversity & Inclusion Peer Mentoring	11	0	1	.27	.467
Diversity & Inclusion Peer Mentoring	11	0	1	.18	.405
Engineering At-Risk Program	11	0	1	.18	.405
At-Risk Program	11	0	1	.18	.405
Engineering Summer Academic Enrichment	11	0	1	.73	.467
Engineering STEM Summer Bridge	11	0	1	.73	.467
	11	0	1	.36	.505
Social Equity Initiative	N	Minimum	Maximum	Mean	Std. Deviation
Engineering Learning Center & Skills	11	0	1	.36	.505
Learning Center	11	0	1	.18	.405
Engineering Measure of Student Learning Outcomes	11	0	1	.09	.302
Diversity Sensitivity Training	11	0	0	.00	.000

Measure of Institutional Size

For this study, all institutions were categorized according the number of full time undergraduate students. As noted in Table 16, the results included a frequency of 36% having between 21,000 and 23,000 full time enrolled students, followed by 27% ranging between 24,000 and 26,000 full time enrolled students. Those institutions with enrollment between 18,000 and 20,000 students as well as those with full time enrollment at and above 27,000 students resulted in 18% of the distribution respectively. Enrollment data has been included as actual full time enrolled undergraduate students. Institutional size was determined using Table 8. 4-Year Residential Undergraduate Full Time Enrollment Scale in Chapter 3. The average overall enrollment population across all institutions resulted in M = 24,482 students where the average endowments were M = $801million (Table 10).

Table 16 *Institutional Size Frequency Distribution 2016.*

Enrollment 18-20k (2 = 18%)	Mississippi State University **(18,090)** Clemson University **(18,395)**
Enrollment 21-23K (4 = 36%)	University of Tennessee **(22,139)** University of Arkansas **(22,549)** University of Kentucky **(22,865)** Auburn University **(22,658)**
Enrollment 24-26K (3 = 27%)	North Carolina State University **(23,847)** University of Missouri **(25,898)** Louisiana State University **(26,123)**
Enrollment 27,000 and above (2 = 18%)	University of Georgia **(27,740)** University of Florida **(36,794)**

Measure of African American Engineering Graduation Rate

The dependent variable of African American graduation rates in engineering resulted in the lowest percentage of graduates only 3.3% of graduates for both North Carolina State University and the University of Florida were African American. The highest graduation rate of African American engineering students was realized by Mississippi State University at 11.3% actual numbers of African American engineering student enrollment and graduation data were also captured for 2016. A total N = 11. The average number of African American gradates resulted in M= 30 with a SD = .661 (Table 17). These actual numbers were not my dependent variable.

Table 17 *African American Engineering Student Graduation Descriptive Statistics*

African American Engineering Graduation Statistics		
N	Valid	11
	Missing	0
Mean		30.00
Skewness		-.122
Std. Error of Skewness		.661
Range		47
Minimum		5
Maximum		52

The maximum graduation rate equaled to 52 students with the lowest graduation rate equaled to five students. For all included institutions, the frequency for the graduation rate resulted in an equal distribution of percent for each institution. Minimum graduation rates for African American engineering students resulted in a value of five where the maximum value resulted in 52 African American students graduating in engineering. These raw numbers of African American engineering graduates were my dependent variable.

Table 18 *African American Engineering Student Graduation Rate Frequency*

African American Engineering Student Graduation Rate					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	5	1	9.1	9.1	9.1
	10	1	9.1	9.1	18.2
	14	1	9.1	9.1	27.3
	19	1	9.1	9.1	36.4
	21	1	9.1	9.1	45.5
	35	1	9.1	9.1	54.5
	37	1	9.1	9.1	63.6
	40	1	9.1	9.1	72.7
	47	1	9.1	9.1	81.8
	50	1	9.1	9.1	90.9
	52	1	9.1	9.1	100.0
	Total	11	100.0	100.0	

(N=11) (M=30) (SD=.661).

Measure of Institutional Endowment

Examination of institutional endowment revealed an average institutional endowment for the total population was $801 million rounded to the nearest million. The lowest endowment of $445 million was achieved by Mississippi State University and the University of Florida achieved the highest endowment of $1.5 billion (Table 13). The average endowment rounded to the nearest million was $801,000,000 for the selected PWIs (Table 10).

Endowments of the included institutions resulted in nine of eleven, or 82% of institutions, exceeding endowments of $500,000,000. Three of the eleven institutions had endowments equal to or above $1 billion.

Findings from Hypotheses

This section includes correlation tables for each of the five hypotheses included in the study. The Statistical Package for Social Sciences (SPSS) was used to examine the relationship between all variables used in this study.

Table 19 *Hypotheses Accepted or Rejected*

Hypothesis	Accepted or Rejected
H1: There is a positive relationship between institutional sizes to the number of social equity programs for African Americans in engineering at Southeastern land-grant PWIs.	Rejected
H2: There is a positive relationship between institutional endowments to the number of social equity programs at Southeastern land-grant PWIs.	Rejected
H3: Institutional endowment will have a positive relationship to the graduation rate of African American students at Southeastern land-grant PWIs.	Rejected
H4: There is a positive relationship between the number of social equity programs and graduation rates of African Americans in engineering at Southeastern land-grant PWIs.	Accepted
H5: There is a positive relationship between institutional size and the graduation rate of African Americans in engineering at Southeastern land-grant PWIs.	Rejected

Findings from Hypotheses

The following section will detail the findings for Hypotheses 1-5 in detail.

Independent Variable: Institutional Size

Hypothesis 1: There is a positive relationship between institutional sizes to the number of social equity programs for African Americans in engineering at Southeastern land-grant PWIs.

Table 20 *Institutional Size and Social Equity Initiatives (SEIs)*

Institution	Institutional Size	Social Equity Initiatives (SEIs)
Mississippi State University	18,090	16
Clemson University	18,390	14
University of Tennessee	22,139	7
University of Arkansas	22,548	5
Auburn University	22,658	12
University of Kentucky	22,865	5
North Carolina State University	23,847	9
University of Missouri	25,898	5
Louisiana State University	26,123	6
University of Georgia	27,740	4
University of Florida	36,794	5

Table 21 *Institutional Size and SEI Correlation Descriptive Statistics*

Institutional Size and SEI Correlation				
			Enrollment	Social Equity
Spearman's rho	Enrollment	Correlation Coefficient	1.000	-.721*
		Sig. (2-tailed)	.	.012
		N	11	11
	Social Equity	Correlation Coefficient	-.721*	1.000
		Sig. (2-tailed)	.012	
		N	11	11

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

The independent variable, Institutional Size and the dependent variable, Social Equity Initiatives (SEIs) were used to examine Hypothesis 1. A bivariate correlation analysis was used to measure the relationship between the two variables. Spearman's Rho for ordinal data with a small number of N = 11 and a two-tailed test of significance was computed to analyze the data. Spearman's correlation coefficient of r = -.721 indicates there is a strong negative relationship between institutional size and social equity initiatives. This relationship is statistically significant (p=.012) for the selected institutions at a 0.05 significance level of error.

The hypothesis was rejected. Hu and Kuh (2003) revealed that students attending Doctoral/Research-Extensive universities are more likely to interact with peers from different backgrounds compared to students attending other types of 4-year institutions. Kuh, et al (2006) contend that one reason for this phenomenon is the result of "concerted efforts to provide diversity related-programming" (Kuh and Umbach, 2005; Pike and

Kuh, 2006 as cited in Kuh, et al., 2006). Although the PWI institutions selected for this study were categorized as large 4-year institutions with social equity initiatives, the results from this study do not support the claims of outcomes of Hu and Kuh (2003).

Independent Variable: Institutional Endowment

Hypothesis 2: There is a positive relationship between institutional endowments to the number of social equity programs at Southeastern land-grant PWIs.

Table 22 *Institutional Endowment and Social Equity Initiatives (SEIs)*

Institution	Institutional Endowment	Social Equity Initiatives (SEIs)
Mississippi State University	$445 million	16
Louisiana State University	$469 million	14
Clemson University	$621million	7
University of Tennessee	$654 million	5
Auburn University	$658 million	12
University of Missouri	$870 billion	5
University of Arkansas	$899 million	9
North Carolina State University	$999 million	5
University of Georgia	$1.0 billion	6
University of Kentucky	$1.2 billion	4
University of Florida	$1.5 billion	5

The independent variable, Institutional Endowment and the dependent variable, Social Equity Initiatives (SEIs) were used to examine Hypothesis 2. A bivariate correlation analysis was used to measure the relationship between the two variables. Spearman's Rho for ordinal data small number of N = 11 and a two-tailed test of significance was computed to analyze the data. Spearman's correlation coefficient of r = -.721 indicates a strong and negative relationship between institutional endowment and social equity initiatives. This relationship is statistically significant (p=.011) for the selected institutions at a 0.05 significance level of error.

Table 23 *Institutional Endowment and Social Equity Initiatives (SEIs) Descriptive Statistics*

Endowment and Social Equity Initiatives (SEIs)				
			Endowment	Social Equity
Spearman's rho	Endowment	Correlation Coefficient	1.000	-.726*
		Sig. (2-tailed)	.	.011
		N	11	11
	Social Equity	Correlation Coefficient	-.726*	1.000
		Sig. (2-tailed)	.011	
		N	11	11

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

This hypothesis was rejected. Minority students reported the experience of "chilly" climate, isolation, and cultural insensitivity as additional obstacles to college matriculation (Swail et al, 2003), resulting in interventions such as social equity programs and policies aimed to improve both academic and social integration of African American students attending PWIs.

The literature supports that institutions are establishing special scholarships for low-income African American students and have identified the need to incorporate programs that aim to close the equity gap in African American study achievement. However, the results of this study do not support the hypothesis that a positive relationship exists between institutional endowments and the number of social equity programs at land-grant PWI in the Southeast.

Independent Variable: Institutional Endowment

Hypothesis 3: Institutional endowment will have a positive relationship to the graduation rate African American students at Southeastern land-grant PWIs.

Table 24 *Endowment and African American Engineering Graduation Rate*

Institution	Institutional Endowment	African American Engineering Graduation Rate
Mississippi State University	$445 million	50
Louisiana State University	$469 million	37
Clemson University	$621million	19
University of Tennessee	$654 million	14
Auburn University	$658 million	35
University of Missouri	$870 billion	10
University of Arkansas	$899 million	47
North Carolina State University	$999 million	21
University of Georgia	$1.0 billion	52
University of Kentucky	$1.2 billion	5
University of Florida	$1.5 billion	5

Table 25 *Endowment and African American Engineering Graduation Rate*

Descriptive Statistics

Endowment and African American Engineering Graduation Rate Correlation				
			Endowment	African American Engineering Graduation
Spearman's rho	Endowment	Correlation Coefficient	1.000	-.518
		Sig. (2-tailed)	.	.102
		N	11	11
	AA ENGR Grad	Correlation Coefficient	-.518	1.000
		Sig. (2-tailed)	.102	
		N	11	11

The independent variable, Institutional Endowment and the dependent variable, African American Engineering Graduation were used to examine Hypothesis 3. A bivariate correlation analysis was used to measure the relationship between the two variables. Spearman's Rho for ordinal data and small number of N = 11 and a two-tailed test of significance was computed to analyze the data. Spearman's correlation coefficient of r = -.518 indicates there is a strong negative relationship between institutional endowment and African American graduation rates. This relationship is not statistically significant (p=.102) for the selected institutions at a 0.05 significance level of error.

This hypothesis was rejected. Minority college enrollment continues to increase; however, African Americans continue to enroll in a lower number than Whites (Aud, Fox KewalRamani, 2010). The National Association of College and University Business Officers (NACUBO) reported for 2009-2010 that institutions with endowments exceeding $100 million resulting in increased spending rates when compared to spending rates of those with small endowments. However, the outcome of this research does not provide support for institutions choosing to invest endowment funds on the implementation of social equity initiatives at PWI land-grant institutions, or with using endowment money to increase African American graduation rates.

Independent Variable: Social Equity Initiatives

Hypothesis 4: There is a positive relationship between the number of social equity programs and graduation rates of African Americans in engineering at Southeastern land-grant PWIs.

Table 26 *Social Equity Initiatives (SEIs) and African American Engineering Graduation Rate*

Institution	Social Equity Initiatives (SEIs)	African American Engineering Graduation Rate
University of Georgia	4	5
University of Arkansas	5	14
University of Florida	5	40
University of Kentucky	5	10
University of Missouri	5	21
Louisiana State University	6	52
University of Tennessee	7	19
North Carolina State University	9	47
Auburn University	12	35
Clemson University	14	37
Mississippi State University	16	50

Table 27 *SEI and African American Engineering Student Graduation Rate Descriptive Statistics*

SEIs and African American Engineering Graduation Rate				
			African American Engineering Graduation	Social Equity
Spearman's rho	AA ENGR Grad	Correlation Coefficient	1.000	.633*
		Sig. (2-tailed)	.	.037
		N	11	11
	Social Equity	Correlation Coefficient	.633*	1.000
		Sig. (2-tailed)	.037	
		N	11	11

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

The independent variable, Social Equity Initiatives (SEIs) and the dependent variable, African American Engineering Graduation were used to examine Hypothesis 4. The bivariate correlation was used to measure the relationship between the two variables. Spearman's Rho for ordinal data and small number of $N = 11$ and a two-tailed test of significance was computed to analyze the data. Spearman's correlation coefficient of $r = +.633$ indicates there is a strong positive relationship between institutional size and social equity initiatives. This relationship is statistically significant ($p=.037$) for the selected institutions at a 0.05 significance level of error.

This hypothesis was accepted. Providing layers of support to African American engineering students in engineering is supported by the literature as an approach to addressing increased retention and graduation rates. Further the literature claims that Historically Black Colleges and Universities (HBCUs) traditionally have excelled at providing supportive learning environments where students have access to faculty and staff, peer mentors and advisors that help to guide them, buffer challenges of college life and foster a climate of achievement (Fleming, 1988).

Independent Variable: Institutional Endowment

Hypothesis 5: There is a positive relationship between institutional size and the graduation rate of African Americans in engineering at Southeastern land-grant PWIs.

Table 28 *Institutional Size and Social Equity Initiatives (SEIs)*

Institution	Institutional Size	African American Engineering Graduation Rate
Mississippi State University	18,090	50
Clemson University	18,390	37
University of Tennessee	22,139	19
University of Arkansas	22,548	14
Auburn University	22,658	35
University of Kentucky	22,865	10
North Carolina State University	23,847	47
University of Missouri	25,898	21
Louisiana State University	26,123	52
University of Georgia	27,740	5
University of Florida	36,794	5

The independent variable, Institutional Size and the dependent variable, African American Engineering Graduation were used to examine Hypothesis 5. A bivariate correlation analysis was used to measure the relationship between the two variables. Spearman's Rho for ordinal data and small number of N = 11 and a two-tailed test of significance was computed to analyze the data. Spearman's correlation coefficient of r = -.055 indicates there is a weak negative relationship between institutional size and social equity initiatives. This relationship is not statistically significant (p=.873) for the selected institutions at a 0.05 significance level of error.

Table 29 *Institutional Size and African American Graduation Descriptive Statistics*

Institutional Size and African American Graduation Rate				
			Enrollment	African American Engineering Graduation
Spearman's rho	Enrollment	Correlation Coefficient	1.000	-.055
		Sig. (2-tailed)	.	.873
		N	11	11
	AA ENGR Grad	Correlation Coefficient	-.055	1.000
		Sig. (2-tailed)	.873	
		N	11	11

This hypothesis was rejected. Hurtado, et al (1998) contend that persistence of racial and ethnic minority students and majority students is positively related to a diverse campus. Nettles (1991) found that African Americans enrolled in institutions with small percentages of African American students were more likely to complete degree requirements at a slower pace. However, the literature supports that density of the composition of racial and ethnic student make-up is important as students are more likely to participate in activities that are diversity-related on campuses with a larger density of students of color regardless of institution type (Kuh, et al, 2006).

One hypothesis in this study was accepted. The findings from the study are important from a scholarly perspective because they provide empirical evidence of the social equity initiatives (SEIs) that lead to increased graduation rates of African Americans in engineering at predominantly white land-grant institutions in the Southeast.

Research Question Response

Based on the bivariate correlation and the value of r = .633, the outcome indicates that there is a strong positive relationship between social equity initiatives (SEIs) and the graduation rate of African Americans in engineering at PWI land-grant institutions. Consequently, the answer to Research Question 1 is that social equity initiatives at PWI land grants positively influence the graduation rate of African American students in engineering.

All selected PWI land-grants resulted in the use of at least 3 social equity initiatives (SEIs). Research Question 2 addresses the absence of social equity initiatives at PWI land grant institutions. The outcome from this study is therefore inconclusive on whether there is a difference in the graduation rates of African American students in engineering among predominantly white Southeast land-grant colleges and universities that have social equity initiatives (SEIs) compared to those who do not. All of the universities I studied used the some SEIs.

Relevance of the Findings

H1: Hypothesis 1 addressed Research Question 1 by seeking to understand if a positive relationship existed between institutional size and SEIs. By establishing this relationship, it could be better understood the factors that determine the use of SEIs at PWIs to enhance graduation rates in engineering for African American students. Based on the outcome of Hypothesis 1, it is concluded from these findings that institutional size does not influence an institution's decision on whether or not to implement SEIs. This outcome would further indicate that institutional SEIs are independent of institutional size. Although the literature states that doctoral/research-extensive institutions are more likely to have greater interaction among peers from different backgrounds and that such institutions are more likely to employ efforts to provide diversity related-programming, this does not translate into the enactment of types of social equity initiatives included in this study for PWIs considered. Hypothesis 1 was rejected and did not support the research questions established for this study.

H2: To answer Research Question 1, Hypothesis 2 inquired of the relationship between institutional endowments and SEIs. It is important to understand how SEIs are influenced at PWIs. Hypothesis 2 addressed Research Question 1 by seeking to understand whether institutional endowments positively correlated to SEIs. By establishing this relationship it would indicate that institutional endowments influence the occurrence of social equity initiatives at Southeastern PWIs. Although the literature states the support of special scholarships for low-income African American students, it was determined the endowment funds were being widely used to support other types of

SEIs that were included in this study. The outcome of this hypothesis indicates that endowments do not influence SEIs. Although it may be assumed that higher levels of institutional endowments would result in more funds to support SEIs; however, this was not indicated by the results of Hypothesis 2. Further, this research illustrated that institutions with smaller levels of endowment have greater numbers of SEIs and higher graduation rates than institutions with larger endowments. This hypothesis was rejected and did not support the research questions established for this study

H3: In seeking to understand the role of SEIs in engineering graduation rates of African Americans, Hypothesis 3 indicates that institutional endowments do not affect the graduation rates of African Americans engineering students at PWIs. This outcome would suggest that some Southeastern land-grant PWIs choose not to invest endowment funds on the implementation of social equity initiatives (SEIs) and subsequently such institutions choose not to use endowment funds to increase African American graduation rates in engineering.

H4: Hypothesis 4 was accepted and provides support to answer Research Question 1. The literature states that by providing layers of support to African American engineering students through the use of SEIs, helps to address both academic and social engagement of these students. Social equity programs and initiatives result in students experiencing improved "fit" and "sense of belonging", increased involvement, higher rates of retention and graduation. Traditionally, Historically Black Colleges and Universities (HBCUs) have excelled at providing supportive learning environments where students have access to faculty and staff, peer mentors and advisors that help to guide them, buffer challenges of college life and foster a climate of achievement (Fleming, 1988). The use of SEIs at land-grant PWIs helps to foster environments for African American engineering students similar to those found at HBCUs.

H5: This hypothesis was rejected and did not support Research Question 1. Hurtado, et al (1998) contend that persistence of racial and ethnic minority students and majority students is positively related to a diverse campus. The PWIs in this study included varying levels of racial diversity concerning African Americans in engineering. Although the most successful PWI in this study resulted in a graduation rate of 11.3% for African Americans in engineering, the raw data indicates this percentage to be equal to 50 students. The rate of graduation for African Americans in engineering remains bleak in comparison to the graduation rates of Whites. Although this hypothesis did not strengthen the response to Research Question 1, it does highlight the fact that there remains the need to address the "leaky pipeline" of Africans pursuing engineering at PWI land-grants in the Southeast.

H6: This hypothesis was removed from the revised mode and was not tested as ACT data for African Americans in engineering were not available for this study.

H7: This hypothesis was removed from the revised mode and was not tested as ACT data for African Americans in engineering were not available for this study.

CHAPTER VI

CONCLUSION, THEORETICAL IMPLICAITONS, PRACTICAL IMPLICATIONS, LIMITATIONS, FUTURE RESEARCH

As the U.S. faces a need to advance our economy and our society, we must ensure that as a country we are not merely consumers of technological innovations, but that we are creators and sustainers of such advancements. The need to drive innovation has been stated by some as a national security issue for the U.S. as America strives to become less complacent and independent on technologies created by those around the world. The U.S. must identify ways to increase the participation across a diverse spectrum of citizens to help meet the growing needs for knowledge-based economic demands of the 21st century.

The marginal success of minority groups in engineering at U.S. institutions of higher learning negatively impacts the U.S. labor market in fields related to science and engineering. With STEM related jobs accounting for more than 50% of sustained economic growth in the U.S. but having only 5% of the population in these jobs, and African Americans representing only 5% of that figure, this results in a conundrum and a sense of urgency for U.S. colleges and universities. As the racial demographics of the U.S. shifts to a more heterogeneous population, those who have been historically underrepresented in STEM disciplines will now need to play a more prevalent role in the in the U.S. STEM labor market. With African American representation in engineering degrees remaining one of the most underrepresented minority groups, engineering degree attainment across all levels and by race will be key in America remaining economically vital and technologically competitive.

To address the need of a growing heterogeneous population, American institutions strive to ensure that the perspectives and views of the public are valued and addressed. American society consists of many publics comprised of citizens who vary in race, ethnicity, social and economic standing, and religious backgrounds and affiliations. College and universities play a major role in addressing social equity of underrepresented minority student enrolled in their institutions. To meet the needs of a diverse citizenry, a more in-depth analysis of college and university institutional structure is required.

This study has provided analysis and insight on institutional factors within predominantly white land-grant institutions that aid in the creation of pathways that allow for structural equity among URMs to succeed in engineering. Social equity initiatives (SEIs) found within the 11 PWI land-grant institutions within the Southeastern region have illuminated programs and policies that are positively related to the graduation of African Americans in engineering. Social equity initiatives matter. These programs and polices help to provide the support systems that are needed to allow African American students who are pursing engineering to establish a greater sense of belonging and improved academic achievement which enables them to persist to graduation.

Theoretical Implications

This research contributes to the theoretical and empirical contributions to the literature on URM STEM student retention. The use of institutional theory for this study addressed the institutional impact on African American student success in engineering at predominantly white land-grant institutions in the Southeast. The results of this study strengthen tenets of institutional theory by supporting Selznick's notion that institutions are social organisms that are impacted by their environment (Selznick, 1957). As identified by this study, the correlation of social equity initiatives (SEIs) to graduation rates of African American engineering students further illustrate how incorporating inclusive norms, rules and routines can serve as a guiding principle for creating improved student success outcomes for underserved populations. Cai and Mehari (2015) describe institutional theory as a tool to explain the actions of both individuals and collective actors. This interdependency of actor's actions on institutions and consequently, the impact of human agency on institutions, is upheld by the outcomes of this study. This research enhances theoretical development as it allows for a broadened application of institutional theory within the realm of URM student retention in STEM disciplines.

Practical Implication

An important problem faced by American engineering colleges is addressing and solving the problem of broadening participation for underrepresented groups. The U.S. Department of Labor reports that 5% of the U.S. workers are employed in fields related to science and engineering, yet these professions account for more than 50% of the sustained economic growth in the U.S. (U.S. Department of Labor, 2007). Further, minorities make-up 0.0025% of the STEM workforce with African Americans accounting for only 5% of this figure. This research provides insight into programs and policies that can be used in institutions of higher learning to improve the success rate of African Americans pursuing engineering degrees.

SEIs identified in this study, along with current policy tools such as federal and local funding, tuition, mission and vision directives, standards of accountability, and equity should be used to influence the success of URMs at PWI land-grant institutions. (Bensimon, 2007). The research results presented here should bolster support institutional and governmental policy makers to identify policies and practices that are more equitable to assist in creating a more diverse and skilled engineering workforce.

Limitation and Future Research Recommendations

The population for this study was small. The study focused on the graduation rate of African American engineering students at predominantly white (PWIs) land-grant institutions in the southeast. Because the study was not inclusive of PWI land-grants outside of the southeast, the study is limited in its ability to generalize the outcomes regarding the use of social equity initiatives (SEIs) of this study for African American engineering students outside of the Southeastern region. Future research should focus on the SEIs aimed at addressing the graduation rate of African American engineering students within PWI land-grants outside of the Southeastern region.

Another limitation includes the assessment of social equity initiatives (SEIs) via web content analysis. Because institutions may use different program and policy titles from those used in this study for SEIs, this methodology of data capture may result in flawed data compilation. Future research of web content analysis for SEIs should include the examination specifically of each institution's College of Engineering website as opposed to key work searches. This method may more accurately account for social equity initiatives that exist within an institution.

National standardized testing organizations such as ACT and policy makers should consider allowing the publication of disaggregated test scores for African Americans in STEM disciplines. Access to this data will allow for more informed and accurate research concerning factors which impact the success of underrepresented groups in engineering disciplines in institutions of higher learning. Such data will better highlight the equity gap concerning minority STEM student achievement and allow for interventions to prevent the "leaky pipeline" of URMs in engineering.

This study was impacted by the limited comparative data analysis for ACT scores for admission into colleges of engineering. With varied admission policies regarding standardized test score usages and levels, some institutions do not readily publish data on specific ACT admission requirements for engineering programs. A limitation in the findings concerning this issue occurred during this study. A growing number of colleges and universities are no longer requiring applicants to provide standardized test scores as part of the admission process to attract more students of color (George Washington University, 2009). Further research should be conducted on the success of African American students attending test-optional institutions to assess the relationship between SEIs and African American graduation rates.

Summary

Engineering is a rigorous discipline and requires the ability to think critically, and to establish a sound foundation and application of mathematics and the sciences to persist to graduation. However, in some cases this is not enough. For many well-prepared African American engineering students there are external factors influencing their success. The literature, along with this study, concludes that factors within the institutional structure of colleges and universities contribute to the success or failure of this demographic of students.

The key findings from this study include the establishment that a strong positive relationship between social equity initiatives (SEIs) and the graduation rate of African Americans in engineering at southeastern PWI land-grant institutions exist. As policy makers and administration of Colleges of Engineering seek to improve the graduation rates of underrepresented minority students to create a pipeline of quality minority engineers, a holistic approach concerning retention and inclusion should include social equity initiatives as identified by this study.

Further, the over generalization of the underrepresented minority student (URM) category consistently used as a broad characterization of STEM URMs to include Africans Americans in engineering, impedes the ability to effectively research factors specifically affecting African Americans in engineering.

Moreover, the use of the concept of social equity within institutions of higher learning establishes the view that all public institutions, including public institutions of higher learning, are responsible and accountable for ensuring the fairness, just and equitable distribution and management of public goods and public services. Broad access to predominantly white land-grant institutions in the Southeast subsequently require the need to ensure social equity within these institutions of higher learning. For the purpose of this study, public goods and public services include equitable access to resources on U.S. college and university campuses for "non-traditional" students –ethnically diverse, older and poor, with reduced academic experience and widely varying goals.

REFERENCES

Adelman, C. (1999). Answers in the tool box. Academic intensity, attendance patterns, and bachelor degree attainment (Report No. PLLI-1999-8021). Washington, D C: National Institute on Postsecondary Education, Libraries, and Lifelong Learning: Retrieved: ERIC Document Reproduction Service No. ED431363.

Allen-Ramdial, S., A. & Campbell, A., G. (2014). Reimaging the pipeline: Advancing STEM diversity, persistence, and success. *BioScience Journal*. Retrieved: http://bioscience.oxfordjournals.org.

American Association of Engineering Education (2012). Going the distance: Best practices and strategies for retaining engineering, engineering technology and computing students. Retrieved: http://www.asee.org/retention.../best-practices.../ASEE-Student-Retention-Project.pdf.

American Association of University Professors (AAUP). (2000). Retrieved: https://www.aaup.org.

American Council on Education (ACE). Retrieved: https://www. acenet.edu. .

Aristotle (2009). *The Nicomachean Ethics*. Translated by W.D. Ross, revised with an introduction and notes by L. Brown. Oxford: Oxford University Press.

Aspen Institute, College Excellence Program (2016). Structural equity: Big picture thinking and partnerships that improve community college student outcomes Retrieved: https://assets.aspeninstitute.org/content/uploads/2016/06/structural-equity.pdf.

Association of Public and Land Gran Universities. (2012). Retrieved: http://www.aplu.org/

Astin, A. W. (1993). What matters in college? *Four critical years revisited*. San Francisco: Jossey-Bass.

Aud, S., Fox, M., & KewalRamani, A. (2010). Status and trends in the education of racial and ethnic groups (NCES 2010-015). Washington, DC: Government Printing Office.

Bahm, T. (2016). *Holding performance measures accountable for social equity: A polycentric approach to evaluating American higher education* (Doctoral dissertation). Retrieved from Mississippi State University Author. etd-10072016-13483.

Bailey, T., & Alfonso, M. (2005). Paths to persistence: An analysis of research on program effectiveness at community colleges. New Agenda Series. Indianapolis: Lumina Foundation for Education.

Bailey, T., Alfonso, M., Scott, M., & Leinbach, T. (in press). Educational outcomes of occupational postsecondary students. New York: Columbia University, Teachers College, Community College Research Center.

Bailey, T., Badway, N., & Gumport, P., J., (2001). Rethinking the role and function of developmental education in community college. New Directions for Community College s, 145, 11-30. doi: 10.1002/cc.352.

Baldrige, J., V. (1971). *Power and Conflict in the University: Research in the Sociology of Complex Organizations.* New York: J. Wiley.

Bean, J.P., and Eaton, S. B. (2000). A psychological model of college student retention. In J.M. Braxton (Ed.) Reworking the student departure puzzle (pp48-61). Nashville, TN: Vanderbilt University Press.

Bean, J. P. (1983). The application of a model of turnover in work organizations to the student attrition process. *Review of Higher Education*, 6, 129–148.

Bell, D. (1992). Faces at the bottom of the well: The permanence of racism. New York: Basic Books.

Bell, D. (1995). Who's afraid of critical race theory? *University of Illinois Law Review*, 1995, 893-910.

Bensimon, E. M. (2007). Presidential address: The underestimated significance of practitioner knowledge in the scholarship on student success. *The Review of Higher Education*, 30(4), 441-469.

Berger, J., & Milem, J. (2000). Organizational behavior in higher education and student outcomes. In J.C. Smart (Ed.). Higher education: Handbook of theory and research (Vol. 15, pp. 268-338). New York: Agathon.

Berkner, L., He, S., & Catladi, E., F. (2002). Descriptive summary of 1995-96 beginning postsecondary students: Six year later (NCES 2003-151). Washington, DC: National Center for Education Statistics.

Betancourt, A., Burrus, J., Elliott, D., Brenneman, R., M., Carney, L., Moor, G., Jackson, T., Robbins, S., Kyllonen, P., Roberts, R., D. (2013). Putting and keeping students on track: Toward a comprehensive model of college persistence and goal attainment. Retrieved: www.ets.org.

Blalock, J. M. (1967). Toward a theory of minority-group relations. New York: Wiley.

Braxton, J., Bray, N., & Berger, J. (2000). Faculty teaching skills and their influence in the college student departure process. Journal of College Student Development, 41, 215-227.

Bonner, F., II (2010). Academically gifted African American males. Black Issues in Higher Education, 18(6), 80.

Bowen, William G., Chingos. Matthew M., McPherson, Michael S. (2009). Crossing the finish line: Completing college at America's public universities. Princeton, NJ: Princeton University Press.

Braxton, J. M. (1999). Theory and elaboration and research development: Toward a fuller understanding of college student retention. Journal of College Student Retention: Research, Theory, and Practice, 1, 93-97.

Braxton, J., Milem, J., & Sullivan, A. (2000). The influence of active learning on the college student departure process. *The Journal of Higher Education*, 71, 569-590.

Brown, S. V., & Clewell, B. C. (1998). Project talent flow: The non-STEM field choices of Black and Latino undergraduates with the aptitude for science, engineering, and mathematics careers (Alfred P. Sloan Foundation Grant No. 95-12-15). Washington, DC: The Urban Institute.

Cai, Y., Mehari, Y. (2015) The use of institutional theory in higher education theory. *Theory and Method in Higher Education Research*, Vol 1. Emerald Group Publishing Limited, pp. 1-25.

Cabrera, A., F., Nora, A,. Terenzini, P., T., Pascarella & Hagedorn, L., S. (1999). Campus racial climate and the adjustment of students to college. *The Journal of Higher Education. Vol 70, Iss. 2, 1999.*

Carnevale, A., Smith, N., Melton, M. (2001). Georgetown University Center on Education and the Workforce. Retrieved: http://files.eric.ed.gov/fulltext/ED525307.pdf

Center for Public Education (2012). The United States of education: The changing demographics of the United States and their schools. Retrieved: http://www.centerforpubliceducation.org/You-May-Also-Be-Interested-In-landing-page-level/Organizing-a-School-YMABI/The-United-States-of-education-The-changing-demographics-of-the-United-States-and-their-schools.html.

Chang, M., J. (1999). Does racial diversity matter?: The educational impact of a racially diverse undergraduate population. *Journal of College Student Development*. Baltimore 40.4 (Jul/Aug 1999): 377.

Chang, M., J., Denson, N., Saenz, V., Misa, K. (2006). The educational benefits of sustaining cross-racial interaction among undergraduates. *The Journal of Higher Education*. Vol. 77, Iss. 3, 2006. Retrieved: http://www.tandfonline.com/doi/abs/10.1080/00221546.2006.11778933.

Chickering, A. W., & Reisser, L. (1993). Education and identity (2nd ed.). San Francisco, CA: Jossey-Bass.

Clewell, B. C., C. C. de Cohen, L. Tsui, L. Forcier, E. Gao, N. Yung, N. Deterding N. West C. West. 2006. *Final Report on the Evaluation of the National Science Foundation Louis Stokes Alliances for Minority Participation Program*. Washington, DC: The Urban Institute.

Crenshaw, K., Gotanda, N., Peller, G., & Thomas, K., (Eds). (1995). Critical race theory: The key writings that formed the movement. New York: New Press.

Creswell, J., W. (2013). Research design: Qualitative, quantitative, and mixed methods approach (4th edition). Sage: London, Thousand Oaks, New Delhi.

Crisp, G., Nora, A., & Taggart, A. (2009). Student characteristics, pre-college, and environmental factors as predictors of majoring in and earning a STEM degree: An analysis of students attending a Hispanic Serving Institution. *American Educational Journal*, 46(4), 924-942.

DiMaggio, P., & Powell, W. (1983). The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. *American Sociological Review, 48*(2), 147-160. Retrieved: http://www.jstor.org/stable/2095101.

Eighteen Ninety Land-Grant Institutions: Retrieved: htttp://www.1890universities.org/history 2016.

Gurin, P., Dey, E. L., Hurtado, S., Gurin, G. (2002). Diversity and higher education: Theory and impact on education outcomes. Retrieved: https://igr.umich.edu/files/igr/Diversity%20and%20Higher%20Education.pdf.

Gyuyll, M., Madon, S., Prieto, L., and Scherr, K., C. (2010). The potential roles of self-fulfilliing prophesies, stigma consciousness, and stereotype threat in linking latino/a ethnicity and educational outcomes. *Journal of Issues*. 66(1): 113-30.

Fleming, J. (1983). Blacks in College. San Francisco: Jossey-Bass.

Flynn, D. (2016). STEM field persistence: The impact of engagement on postsecondary STEM persistence for underrepresented minority students. *Journal of Educational* Issues, 2277-2263. 2016, Vol. 2, No. 1. Retrieved: https://www.researchgate.net.

Haumann, L., R., M., Schofield, J., W., & Woods, R., L. (2007). Sense of belonging as a predictor of intentions to persist among african merican and white first-year college students. *Research in Higher Education*, Vol. 48, pp. 803-839.

Hrabowski, F. (2003). Closing the achievement gap in science and mathematics. *Educational Leadership.*

Hrabowski, F., & Pearson, W., Jr. (1993). Recruiting and retaining African American males in college science and engineering. *Journal of College Science Teaching*, 22, 234-238.

Hurtado, S., and Carter, D. F. (1997). Effects of college transition and perceptions of campus climate on Latino college students' sense of belonging. *Sociology Education*, 70, 324-245.

Hurtado, S., Milem, J.F., Clayton-Pedersen, A., & Allen, W. (1999). Enacting diverse learning environments: Improving the climate for racial/ethnic diversity in higher education institutions. Washington: ASHE-ERIC Higher Education Report Series: George Washington University Graduate School of Education.

Hurtado, S., Alvarez. C. L., Guillermo-Wann, C., Cuellar, M., Arellano, L. (2012). A Model for diverse learning environments. In: Smart J., Paulsen M. (eds) Higher Education Handbook of Theory and Research. Higher Education: Handbook of Theory and Research, Vol. 27. Springer, Dordecht.

Ingram, H. M., Schneider, A., L. (2007). Policy analysis for democracy." In Oxford Handbook of Public Policy, eds. Michael Moran, Martin Rein, and Robert E. Goodin. Oxford, UK: Oxford University Press.

Jackson, J. (2017). Remarks by the Jackson on grounds of unity, freedom, voter registration. Speech delivered at the University of Virginia, Charlottesville, VA. Retrieved: http://www.cavalierdaily.com/article/2017/09/rev-jesse-jackson-speaks-on-grounds-about-unity-freedom-voter-registration.

Kuh, G. D., Kinzie, J., Buckley, J. A., Bridges, B., K., and Hayek, J. C. (2006). What matters to student success: A review of the literature. Commissioned report for the national symposium on postsecondary student success: Spearheading a dialog on student success. Retrieved: https://nces.ed.gov/npec/pdf/kuh_team_report.pdf.

Ladson-Billings, G., Tate, W.F., (1995). Toward Critical Race Theory of Education. *Teachers College Record*, vol. 97, Number 1, Fall 1995.

Landis, R., (2005). Retention by design: Achieving excellence in minority engineering education. Retrieved: www.ecs.csun.edu/ecs/docs/retention_by_design.doc.

Landivar, L.C. (2013). *Disparities in STEM employment by sex, race, and Hispanic Origin*, American Community Survey Reports, ACS-24, U.S. Census Bureau, Washington, D.C.

Li, Q., Swaminathan, H., Tang, J. (2009). Development of a classification system for engineering student characteristics affecting college enrollment and retention. *Journal of Engineering Education*, 98: 361-376. doi: 10.10002/j.2168-9830.2009.tb01033.x.

Matsuda, M., Lawrence, C., Delgado, R., & Crenshaw, K., (1993). Words that wound: Critical race theory, assaultive language speech, and the first amendment. Boulder, CO: Westview.

Marra, R. M., Rodgers, K. A., Shen, D., Bogue B. (2012). Leaving engineering: A multi-year single institution study. Journal of Engineering Education. January 2012, vol. 101; pp 6-27. Retrieved: http://www.engr.psu.edu/awe/misc/JEE-9168-Marra.pdf.

Medina Luis D. (2015). Culture and cognition : The relationship between self-construals and cognitive fluency. UC San Diego: b8987572. Retrieved: http://escholarship.org/uc/item/36z392sr

Meyer, J., & Rowan, B. (1977). Institutionalized Organizations: Formal Structure as Myth and Ceremony. *American Journal of Sociology, 83*(2), 340-363. Retrieved: http://www.jstor.org/stable/2778293.

Meyer, S. (2003). The impact of service-learning on academic outcomes: A statewide study of Michigan Learn and Serve grantees. Paper presented at the Third Annual International Conference on Service-Learning Research, Salt Lake City, UT.

Mills, N. (2012). The Corporatization of Higher Education. Dissent, 59 (4), 6–9. doi:10.1353/dss.2012.0087.

Minnesota Office of Higher Education. (2011). Increasing the college completion of underrepresented students in STEM. Retrieved: https://www.ohe.state.mn.us/pdf/STEMCompletionReport.pdf.

Morrill Act of 1862. (1862). Retrieved: http://www.u-s-history.com/pages/h3967.html.

Morrill Act of 1890. (1890). Retrieved: http://www.webref.org/agriculture/m/morrill_act_of_1890.htm

Morrill, J.S. (1862). The 1980 land grant universities. Retrieved: http://www.1890universities.org/history

Munoz, J., Murphy A. (Murguia, E, Padilla, R., Pavel, M. (1991) Ethnicity and the Concept of Social Integration in Tinto's Model of Institutional Departure. *Journal of College Student Development.*

Munoz, J., Murphy A. (2014). Climate matters: Campus leadership for educational success. Association of American College & Universities. Retrieved: www.aacu.org.

Museus, S. D., Nichols, A. H. & Lambert, A.D. (2008). Racial differences in the effects of campus racial climate on degree completion: A structural equation model.

Museus, S.D., & Liverman, D. (2010). High-performing institutions and their implications for studying under-represented minority students in STEM. *New Directions for Institutional Research*, 2010 (148), 17-27.doi:10.1002/ir.358.

Myer, B., Starobin, S., S., Laanan, F., S., & Russell, D. Office of Community College Research and Policy, (2012). Examining student engagement and transfer intentions among community college STEM students. The OCCRP Research Brief, 6. Ames, IA: Office of Community College Research and Policy.

National Academy of Public Administration (NAPA) Standing Panel on Social Equity in Governance (n.d). Retrieved: www.napawash.org/aa_social_equity/index.html.

National Academy of Sciences (2010). U.S. must involve underrepresented minorities in science and engineering to maintain competitive edge. Retrieved: http://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=12984

Nora, A., & Cabrera, A. F. (1996). The role of perceptions in prejudice and discrimination and the adjustment of minority students to college. *Journal of Higher Education*, 67(2), 119-148.

Nunez, A., (2009). Modeling the effects of diversity experiences and multiple capitals on Latina/o college students' academic self-confidence. *Journal of Hispanic Higher Education* 8 (2): 179-96.

Obama, B. (2009). Remarks by the president on innovation and sustainable growth. Speech delivered at Hudson Valley Community College, Troy, NY. Retrieved from http://www.whitehouse.gov/video/President-Obama-Speaks-to-Hudson-Valley-Community-College.

Parker, L., & Villalpando, O. (2007). A racialized perspective on education leadership: Critical race theory in educational administration. Education Administration Quarterly, 43(5), 519-524DOI 10.1177/0013161X07307795.

Piaget, J. (1932). The moral judgment of the child. London: Kegan Paul.

Pascarella, E., & Terenzini, P. (2005). *How college affects students. II A third decade of research*. San Francisco, CA: Jossey-Bass.

Pascarella, E., & Terenzini, P. (1991). How college affects students. San Francisco: Jossey-Bass.

Perry, S.W, (2005). *Social equity for the long haul: Preparing culturally competent public administrator*. Retrieved from https://theses.lib.vt.edu/theses/available/etd-11282005-141500/unrestricted/slwperrydissertation.pdf.

Plessy vs. Ferguson, Judgement, Decided May 18, 1896; Records of the Supreme Court of the United States; Record Group 267; *Plessy v. Ferguson*, 163, #15248, National Archives.

Porchea, S., Allen, J., Robbins, S., B., & Phelps, R. (2010). Predictors of long-term enrollment and degree outcomes for community college students: Integrating academic, psychosocial, socio-demographic, and situational factors. *Journal of Higher Education*, 81, 750-778.

Readings, B. (1971). The university in ruins. Cambridge, MA: Harvard University Press, 1996.

Reeder, M. C., & Schmitt, N. (2013). Motivational and judgment predictors of african american academic achievement at pwis and hbcus. *Journal of College Student Development*, *54*(1), 29-42. DOI: 10.1353/csd.2013.0006.

Rhee, B. (2008). Institutional climate and student departure: A multinomial multilevel modeling approach. *The Review of Higher Education*, 31, 161-183. Retrieved: http://muse.jhu.edu/article/230082

Riegle-Crumb, C., King, B. (2010). Questioning a white male advantage in STEM: Examining disparities in college major by gender and race/ethnicity. Retrieve: http://edr.sagepub.com/content/39/9/656 doi: 10.3102/0013189X10391657 EDUCATIONAL RESEARCHER 2010 39: 656 Catherine Riegle-Crumb and Barbara King Race/Ethnicity Q

Rodgers, K. A., Summers, J.J., (2008). African American students at predominantly white institutions: A motivational and self-systems approach to understanding retention. Educational Psychology Review, v20 n2 p171-190. Retrieved: https://eric.ed.gov/?id=EJ791096

Rudolph, F. (1990). *The American College and University: A History,* 2nd edition. Athens: University of Georgia Press.

Sandel, M. (1984) The Procedural Republic and the Unencumbered Self, *Political Theory* (12), pp. 81-96, at p.82.

Schneider, A.L., Ingram, H. (1997). Policy design. Lawrence, Kansas: University Press of Kansas 1997.

Scott, R., W. (2004). Institutional theory. Encyclopedia of Social Theory. George Ritzer, ed. Thousand Oaks, CA: Sage.

Selznick, P. (1957). *Leadership in administration: A sociological interpretation*. New York: Row, Peterson and Company.

Seymour, E., & Hewitt, N.M. (1994). Talking about leaving: Factors contributing to high attrition rates among science, mathematics, and engineering undergraduate majors. Boulder, CO: University of Colorado, Bureau of Sociological Research.

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

Slanton-Salazar, R. (1997). A social capital framework for understanding socialization of racial minority children and youths. *Harvard Educational Review*. Vol. 67(1), pp. 1-41.

Slaton, A.E. (2010), "Race, rigor, and selectivity in US engineering", *The History of an Occupational Color Line*. Cambridge, MA: Harvard University Press.

Smallwood, A., J. (2007). Challenges African American students face when adjusting to predominantly white institutions. Retrieved: http://scholarworks.waldenu.edu/dissertations/1465/

Solorzano, D., G., Yosso, T., J. (2002). Critical race methodology: Counter-storytelling as an analytical framework for education research. Qualitative Inquiry, Vol 8, No. 1, 2002.

Solorzano, D., G., Yosso, T., J., Smith, W., A., Ceja, M. (2009). Critical race theory, racial microaggressions, and campus racial climate for latina/o undergraduates. Harvard Educational Review, Vol. 79 No. 4, Winter 2009.

South, S., Bonjean, C., Markham, W., & Corder, J. (1982). Social Structure and Intergroup Interaction: Men and Women of the Federal Bureaucracy. *American Sociological Review, 47*(5), 587-599. Retrieved from http://www.jstor.org/stable/2095160.

University of Illinois at Chicago (2016). UIC Strategic Priorities: Leveraging our strengths to shape our future. Retrieved: https://strategicpriorities.uic.edu.

Strayhorn, T.L. (2008). The invisible man: Factors affecting the retention of low-income African American males. *National Association of Student Affairs Professionals Journal*, Vol. 11, pp. 68-87.

Strayhorn, T. L. (2013). Impact of institutional climates of MSIs and their ability to foster success for racial and ethnic minority students in STEM. In R. T. Palmer, D. C. Miramba, & M. Gasman (Eds.), *Fostering success of ethnic and racial minorities in STEM: The role of minority serving institutions* (pp. 33–45). New York, NY: Routledge.

Swail, W. S. (with Redd, K. E., and Perna, L. W.). (2003). *Retaining Minority Students in Higher Education: A Framework for Success.* ASHE-ERIC Higher Education Report No. 2. Washington, DC: The George Washington University, School of Education and Human Development.

Thomasian, J. (2011). Building a science, technology, engineering, and math education agenda: An update of state actions. Washington, D.C.: National Governors Association (NGA), Center for Best Practices. Retrieved: http://www.nga.org/files/live/sites/NGA/files/pdf/1112STEMGUIDE.PDF.

Tierney, W.G. (1992). An anthropological analysis of student participation in college. *Journal of Higher Education*, 63, 603-618.

Tinto, V. (1975). Dropout from higher education: A theoretical synthesis of recent research. *Review of Educational Research* 45, 89-125.

Tinto, V. (1987). Stages of student departure: Reflections on the longitudinal character of student leaving. *The Journal of Higher Education, 59*(4), 438-455. doi:102307/1981920. December 19, 2016.

Tinto, V. (1993). *Leaving college: Rethinking the causes and cures of student attrition* (2nd Ed.). Chicago, IL: University of Chicago Press.

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

Titus. M. (2004). An examination of the influence of financial context on student persistence at 4-year colleges and universities: A multilevel approach. *Journal of Higher Education*.

U.S. Census Bureau (2012). U.S. Census Bureau projections show a slower, growing, older, more diverse nation a half century from now. Retrieved: https://www.census.gov/newsroom/releases/archives/population/cb12-243.html.

U.S. Department of Commerce, Economics and Statistics Administration, Census. (2013). The relationship between science and engineering education and employment in STEM occupations: American Community Survey Report. Retrieved from https://www.census.gov/prod/2013pubs/acs-23.pdf.

U.S. Department of Commerce, Economics and Statistics Administration. (2011). Education supports racial and ethnic equality system. Retrieved: http://www.esa.doc.gov/sites/default/files/education_supports_racial_and_ethnic_equality_in_stem.pdf.

U.S. Department of Labor (2007), U.S. Bureau of Labor Statistics (BL, 2007). Employment projections program. Retrieved: http://www,bls.gov/emp/ep_table_102.htm.

U.S. Department of Education (2013), Office of Planning, Evaluation and Policy Development, Office of the Under Secretary. Advancing diversity and inclusion in higher education: Key data and highlights focusing on race and ethnicity and promising practices. Retrieved: https://www2.ed.gov/rschstat/research/pubs/advancing-diversity-inclusion.pdf

Verdell, A. C., & Keith, J. M., & Warnock, J., & White, V. M. (2016). *Best Practices for Underrepresented Minority Students in an Engineering Summer Bridge Program* Paper presented at 2016 ASEE Annual Conference & Exposition, New Orleans, Louisiana. 10.18260/p.26198.

Washburn, M., H., Lord, S., M., Camacho, M., M., Layton, R., A., Long, R., A. (2009). Who's persisting in engineering? A comparative analysis of female and male asian, black, hispanic, native American and white students. *Journal of Women and Minorities in Science and Engineering*, vol. 15, pp. 167–190, 2009.

Weber, M. (1952). *The protestant ethic and the spirit of capitalism*. New York: Charles Scribner's Sons.

Weber, M. (1968). *Economy and society: An outline of interpretive sociology*. New York: Bedminster Press.

www.1890universities.org/history Retrieved: htttp://www.1890universities.org/history

Yi, P. (2008). Institutional climate and student departure: A multinomial multilevel modeling approach. *The Review of Higher Education*, Vol. 31, No. 2 Winter 2008, pp. 161-183.

Yosso, T., Solorzano, D., Ceja, M. (2000). Critical race theory, racial microaggressions, and campus racial climate: The experience of African American college students. The Journal of Negro Education, vol 69, No. ½, Knocking at freedom's door: Race, equity, and affirmative action in U.S. higher education (Winter – Spring 2000), pp. 60-73.