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PERCEIVED ROLE OF INSTITUTIONAL SUPPORTS FOR AFRICAN AMERICAN COMMUNITY COLLEGE TRANSFER STUDENTS' ENGINEERING SUCCESS

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PERCEIVED ROLE OF INSTITUTIONAL SUPPORTS FOR

AFRICAN AMERICAN COMMUNITY COLLEGE TRANSFER STUDENTS'

ENGINEERING SUCCESS

A DISSERTATION APPROVED FOR THE
SCHOOL OF INDUSTRIAL AND SYSTEMS ENGINEERING

BY THE COMMITTEE CONSISTING OF

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DEDICATION

This dissertation is dedicated to my husband and children. Prescovie, you have supported this endeavor of my pursuit of a Ph.D. for many years. Without your constant love, unwavering support, and unyielding patience this would not have been possible. Gabrielle and Prescovie III, your understanding and encouragement has been inspirational and I am proud of the adults you have become. Continue to trust in the Lord with all your heart, and lean not on your own understanding, in all your ways acknowledge Him, and He shall direct your paths (Proverbs 3:5-6). As you rely on Him, your lives will continue to be filled with wonder and amazement. I love you all.

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ABSTRACT

Many obstacles can derail the success of African American community college engineering transfer students at predominately white research institutions (PWIs). The extent to which students successfully transition from community colleges into Colleges of Engineering could be a result of having minimal access to finances. A barrier to their retention could be the lack of awareness of and participation in co-curricular activities. Other challenges could include having inadequate opportunities to develop academic support systems, having limited availability of African American faculty role models, and encountering few occasions to participate in social networking activities. Potential challenges to increasing students' engineering success at (PWRIs) could depend on the availability of institutional supports. Institutional supports can be helpful to facilitate student retention, but these supports are not always implemented and centralized as functions under the College of Engineering (COE).

This study employed a Social Constructivism paradigm to understand African American community college transfer students' experiences as they transitioned into the COE at a public 4-year PWI. A Pragmatism lens was used to identify the institutional mechanisms that explained how students achieved engineering success. Three African American engineering transfer students participated in semi-structured interviews which allowed access to their unique narratives, their personal reflections, and their shared experiences. Data were complemented with three qualitative interview records from a 2006 study conducted by the Research Institute for STEM Education (RISE). These two datasets were compiled and analyzed. Recommendations were then framed using Swail's Geometric Model of Student Persistence and Retention to address the question of how institutional mechanisms and transitional experiences impact African American community college transfer students' engineering success.

Based upon the elements of the institutional factor of Swail's model and an analysis of the student narratives, this research proposes a new reorganized framework for the role of the institution in student persistence and retention. Recommendations focus on specific stages of the African American community college student's transition to the COE: recruitment and retention. Several key points that I propose re-conceptualizes Swail's framework. These key points include centralizing recruitment of African American community college pre-engineering students under the COE, institutionalizing student engagement by recognizing African American community college engineering transfer students as core members of the COE's team, and giving the current transfer students agency in retention. Institutions must also encourage and provide opportunities for students to serve as role models in the community. These are some of the ways that institutions must address student retention from a holistic approach to help students complete their engineering degrees.

CHAPTER 1: INTRODUCTION

Purpose of Study

This research focuses on the experiences of African American community college engineering transfer students at a public 4-year predominately White institution (PWI). The study identifies the College of Engineering's programs, policies, resources, and processes, hereafter referred to as *institutional mechanisms*, specifically available to enable transfer students' success in engineering. The research strives to understand the experiences transfer students encounter that influence their success in the College of Engineering and seeks to understand the extent to which they utilize the available institutional mechanisms. This research has three objectives:

1) What are the institutional mechanisms specifically available to this transfer population to enable their engineering success;
2) What are the experiences of transfer students as they enter the College of Engineering; and
3) What are the strategies African American community college engineering transfer students employ to be successful.

Significance of the Study

The United States ranking among other countries in terms of 4-year degree graduation rates is down and underrepresented minority students continue to lag behind other racial/ethnic groups in STEM degree completion. Thus it is time for the United States to refocus its efforts on education. Four decades ago, the United States (U.S.) excelled in four-year degree attainment (White House Government, 2016). Among 25-34 year old students, the U.S. was ranked first internationally. In 2016, this ranking fell to twelfth among nations. In addition, minority

students' 4-year graduation rates are disproportionate among racial/ethnic groups. The National Center for Education Statistics (NCES; 2014) confirmed the 6-year post-secondary graduation rate for both African Americans and American Indian/Alaska Natives was only 41% compared to 71% for Asian students. Further, the National Science Foundation (NSF; 2014) reports the rate of underrepresented minorities in STEM professions. Of the approximate 41 million college degree holders, only 6.8% were African American and 7.1% were Hispanic. Approximately two decades ago, NSF statistics disclosed African Americans and Hispanic students accounted for a relatively insignificant percentage of the more than 5 million individuals in the science and engineering (S&E) occupations; only 4.6% and 5.2%, respectively.

With an increasing population of minority students transferring from two-year institutions into STEM (Ogilvie, 2014), consideration of how they fare in the university environment is important. Furthermore, with few African American students in STEM, specifically engineering, research on this racial/ethnic minority transfer group makes this difficult to study. Research is critically needed to understand the experiences of African American transfer students in engineering, a smaller subset of the minority transfer students. Such research could inform how to best support these marginalized students.

The National Survey of Student Engagement (NSSE) 2014 Annual Report encourages universities to understand who is most or least academically engaged by analyzing students' learning experiences by populations. With respect to STEM and/or the collegiate experience, Scutt et al. (2013) assert that gender is an important factor in the analysis of educational research. Coupled with race/ethnicity, Ong et al. (2011) and Strayhorn & Saddler (2008) contend the intersection of gender and race/ethnicity is central to both educational research and policy. Lastly, Jenkins and Fink (2016) suggest further research is critical to determining institutional

factors that lead to a greater number of socio-economically disadvantaged students transferring to and completing college degrees.

CHAPTER 2: LITERATURE REVIEW

This literature review covers a range of information that will help develop the need for this research. The first part of the review presents data that will describe the achievement of community college students and how that helps lead them to a 4-year degree. Increasing the number of students attending college, completing certificates, and graduating with degrees are the metrics which have become the benchmark by which performance is measured (Bahr, 2013). The second part of the review looks at broader issues of factors that limit the ability of students to succeed in their 4-year degree program. The final section presents a summary of the literature's recommendations regarding how institutions (e.g., universities) can institutionalize mechanisms of support to help the transfer student.

2.1 The Perceived Value of a 4-year College Degree

In July of 2009, President Obama petitioned colleges and universities to increase the number of students completing certificates and receiving degrees. He proposed the American Graduation Initiative (AGI) proposal, the goal of which was to ameliorate the decline in high school (HS) graduations and subsequently increase college enrollments. As a nod of affirmation, the administration committed to invest $12 billion over 10 years in community colleges. Unbeknownst to many Americans, however, the final version and authorization of the Student Aid and Fiscal Responsibility Act failed to include the provision needed to implement the AGI and funds were not channeled to support the community colleges (Berube, 2010).

Within one year of President Obama's declaration, AGI precipitated the launch of the GradNation campaign an outgrowth of America's Promise Alliance (America's Promise Alliance, 2018). With five founding tenets, the program provides youth "A Healthy Start, Caring Adults, Effective Education, Opportunities to Make a Difference, and Safe Places." These

principles effect one of GradNation's primary goals: nationally, a 90% on-time high school graduation for the Class of 2020.

In 2011, the Corporation for Public Broadcasting (CPB) introduced the *American Graduate: Let's Make it Happen*. By using "storytelling, dialogue, partnerships, and classroom resources" to prepare youth for college and career success, CPB worked with communities to better understand the crisis leading to high school student attrition. Within the private sector, AT&T's Chairman and CEO Randall Stephenson announced in 2012 relaunching the Aspire program with a pledge of $250 million over five years. The focus of Aspire was to assist high school students graduate and prepare for college and future careers (Epstein, 2012). These are only a couple of illustrations of the initiatives implemented in response to President Obama's call to action.

Yet, the torrent winds of change in America's education system are gathering. Changes in the academic landscape are perhaps to the detriment of colleges and universities nationwide. In less than a decade, President Trump's White House administration has transformed America's perceived value of a college education. Publicly, the administration's view of Americans seeking a college education stands in stark contrast to the previous administration's value. The President's 2017 Inaugural Address describes fatherless children living within poverty stricken inner cities, students amidst an education system where they graduate bereft of knowledge (White House Government, 2017). This pronouncement may well have resulted in the average listening viewer surmising that students lack knowledge because they have floundered in anemic, blighted, inferior, and perhaps even underfunded schools. The President, however, squelched any notion that more funding is needed by asserting these same education systems are infused with cash. One year later, while presenting the State of the Union address in January of 2018,

Americans were advised to "invest in workforce development and job training" via vocational schooling as the pathway for American workers to "realize their full potential" (White House Government, 2018). This recommendation appeared to be in lieu of and precluded higher education. This then may lead U.S. citizens to question the value and relevance of a 4-year college degree.

This divestment in the nation's public education systems, specifically, the public's perceived value of a college degree, could be further supported by a 2015 report on college students' unemployment and millennials' slow wage growth. In an article on millennial college graduates, Newsweek (Goodman, 2015) reported the unemployment rate for graduates between the ages of 21 to 25 (i.e., millennials) rose from 16 percent in 2000 to 28 percent in 2012. Additionally, earnings for millennials were less than the wages earned for the same demographics in the previous decade. However, the National Center for Education Statistics economic outcomes report (Statistics, 2018) indicates for young adults age 25-34, the median annual earning for individuals with Bachelor's degrees was $50,000 compared to persons with an Associate's degree ($38,000). Further, the argument could be made that with fewer STEM job vacancies forecast in the year 2020, 2.6 million, compared to Blue Collar occupations at 10.2 million (Carnevale et al., 2013), it befits parents and educators alike to endorse vocational training.

The president's narrative about the value of education appears to be reflected in public opinion. In 2016, the Pew Research Center found that only sixty-seven percent of Americans believed 4-year degrees prepared students somewhat well for jobs that were well paying (Pew Research Center, 2016). Strikingly, in August of 2017, the Wall Street Journal/NBC News conducted a poll of 1,200 people and found 47% did not believe a four-year degree would result

in a good job and higher lifetime earnings than non-degreed individuals (Mitchell & Blekin, 2017a). Only a slightly higher margin of the population (2%) indicated they value the Bachelor's degree, down from a 13% margin ten years prior (Mitchell & Belkin, 2017b). The shift in momentum towards devaluing a 4-year degree was primarily attributed to a change in value by individuals who hold an Associates' degree or less (Mitchell & Belkin, 2017b). Additionally, Mitchell and Belkin (2017a) stressed Americans' views of education appear to be polarized along political lines. They juxtaposed persons who affiliate as either Democrats, middle and upper class individuals, and/or urban residents, against people who affiliate as either Republicans, poor, rural residents and/or working class, the latter of which disbelieve a college education is worth the cost (Mitchell & Belkin, 2017a). Although the public's perceived value of a 4-year degree may have waned, these perceptions belie the facts.

The Economic and Social Benefits of a 4-Year College Degree

Presently, in the era of tight labor markets where there are fewer qualified applicants relative to the number of available employment opportunities, people appear confident in job prospects (Liesman, 2018). The labor market outlook for 2018 is not quite as dismal as in 2015, three years earlier. CNBC polled 801 individuals on the economy and reported 66% of people between the ages of 18-34 were confident of being able to find a new job with comparable pay within their field and area of specialty (Liesman, 2018). Highly educated people, individuals with greater household incomes, and people who affiliate as Republicans all report their industries have stronger job markets (Liesman, 2018).

In line with the confident economic outlook and expectations is the potential lifetime earnings of a person with a college degree. The potential lifetime earnings for Bachelor's degree recipients compared to high school graduates or non-degreed individuals stand in stark contrast.

Men with a Bachelor's degree earn $2.43 million over their lifespan in comparison to men who attained a high school diploma, $1.54 million (Social Security Administration, 2015). Women gross $1.43 million with a Bachelor's degree during their lifetime but only $800,000 as high school graduates (Social Security Administration, 2015). Even for women who have earned graduate degrees, the lifetime earnings for men is greater than women: $3.05 million for men versus $1.86 million for women (Social Security Administration, 2015). In general, regardless of the level of education, 4-year degreed individuals earn more over their lifetime than non-degreed individuals. This directly contradicts the perceptions some people may place on the value of a 4-year degree.

Lastly and perhaps just as important, a Bachelor's degree provides societal benefits beyond just the personal income. Over one's lifetime, the Bachelor's degree provides a safeguard against the effects of unemployment as compared to the non-degreed individual (Schanzenbach et al., 2017). In addition, according to the College Board's report, "Education Pays 2016," individuals with Bachelor's degrees participate in more civic engagements, volunteerism, and healthy lifestyle activities than persons with a high-school degree or less. The College Board (Ma et al., 2016) reports that Bachelor's degree recipients and adults across the spectrum of higher education are more likely to have voted (45%) than non-degreed individuals (20%) in the 2014 mid-term elections. Additionally, the volunteerism rate is higher for adult bachelor's degree holders than high school graduates; 39% versus 16%, respectively. Evidence also suggests post-secondary education enhances both long-term economic and occupational outcomes (National Center for Education Statistics, 2015). All of which provide further validity to the value one can attribute to higher education.

Strategic Initiatives by Higher Education

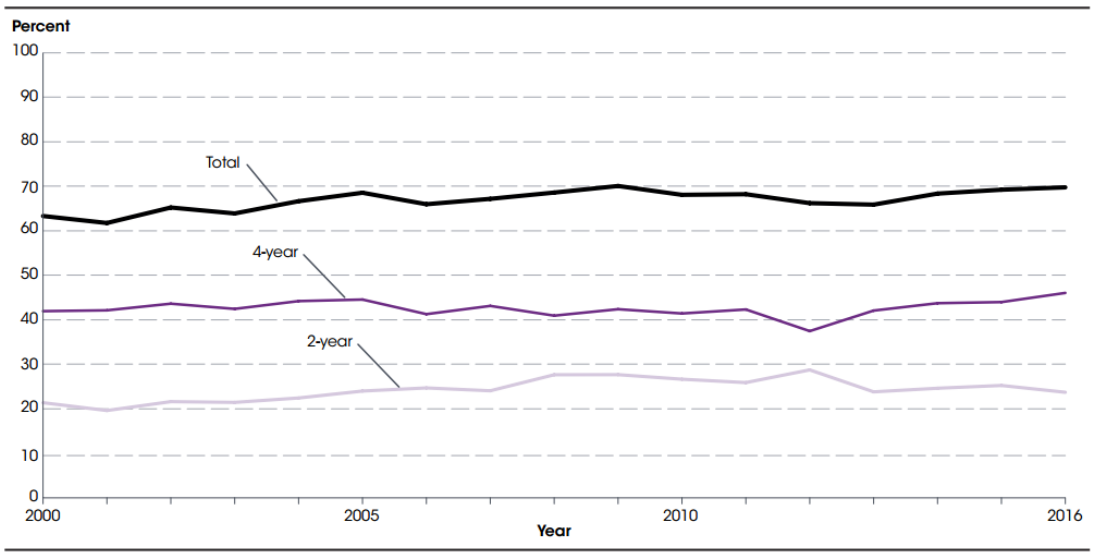
While the population may have disparate opinions about the value academic credentials add to American workers future economic potential, institutions of higher education are developing innovative solutions to broaden participation. In their paper, Brown & Kurzweil (2017) spotlight the strategic initiatives implemented at Franklin & Marshall College; University of California, Berkeley; University of Richmond; University of Texas at Austin; and Vassar College. These institutions explicitly committed to the admission and academic achievement of low and moderate income students to enhance their preparation for the professional workforce. The primary mechanism that underlies these commitments is financial support. The schools have employed strategies such as moving to need-based scholarships, strategic use of one-time monies, reducing non-instructional costs at the institution to avoid passing those to students.

Not only will the resourcefulness of colleges and universities improve educational access and economic outcomes for impoverished students, community colleges are developing workforce initiatives designed to enhance American workers' skillsets. Within this sphere, the Chancellor for California's Community Colleges may have an answer and is poised to revamp the current credit for seat-time (classroom) and online course delivery model via a new online community college system for both workforce employees and employers (Sanchez, 2018). Whereas current online courses are tied to an academic calendar, this new concept decouples enrollment and the time that students can begin courses from the start of a semester. The Chancellor is seeking partners from the health care and medical sectors, manufacturing industry representatives, as well as building to provide assistance with developing content for short term skills training. California's governor supports the Chancellor's innovation with a proposed $100 million line item in his budget to finance the startup.

2.2 COLLEGE ENROLLMENT

Direct College Entrants in 2- or 4-Year Academic Institutions

Although most students enter some type of college immediately following high school, the demographic composition and point of entry dramatically differ. Figure 1 depicts the percentage of individuals aged 16 to 24 who were direct college entrants from 2000 to 2016. Accordingly, in 2016, approximately 70 % of all students completing high school enrolled in college. This is measurably up from 2000 when 63% of high school graduates enrolled in college. Of all college-bound students, 46% enrolled in a 4-year institution compared to 23% who attended community college.

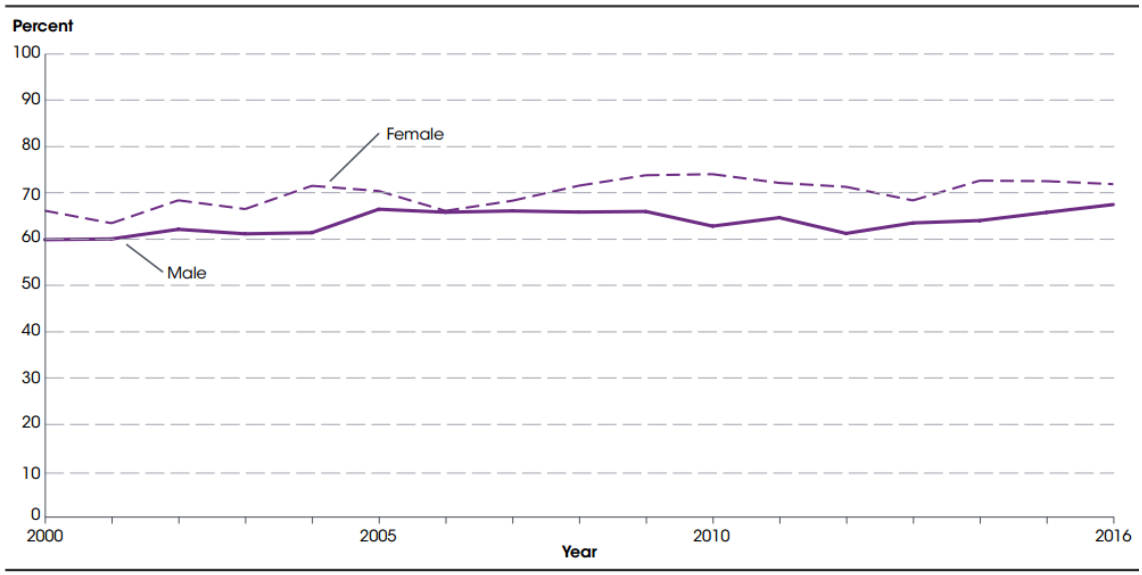


NOTE: High school completers are individuals ages 16 to 24 who graduated from high school or completed a GED or other high school equivalency credential prior to October of the calendar year.
SOURCE: U.S. Department of Commerce, Census Bureau, Current Population Survey (CPS), October Supplement, 2000 through 2016. See *Digest of Education Statistics 2017*, table 302.10.

Figure 1. Percentage of 16-24 year old High School Students Enrolled in 2- or 4-year Academic Institutions Immediately Following High School Completion (Source: National Center for Education Statistics, Immediate College Enrollment Rate (Jan 2018 update)).

Further, as depicted in Figure 2, from 2000 to 2016 the total percentage of females entering 2- and 4-year academic institutions directly from high school outpaced male student enrollment. NCES reports 72 % of females immediately enrolled into college after completing

high school in 2016 compared to 67% of male students. This rate of enrollment is up from 2000 for both genders. In 2000, females enrolled at a rate of about 67% whereas male students enrolled at a rate of 60%. Although women continue to enroll at higher rates than men, overall, the enrollment trend for both genders has increased through 2016.

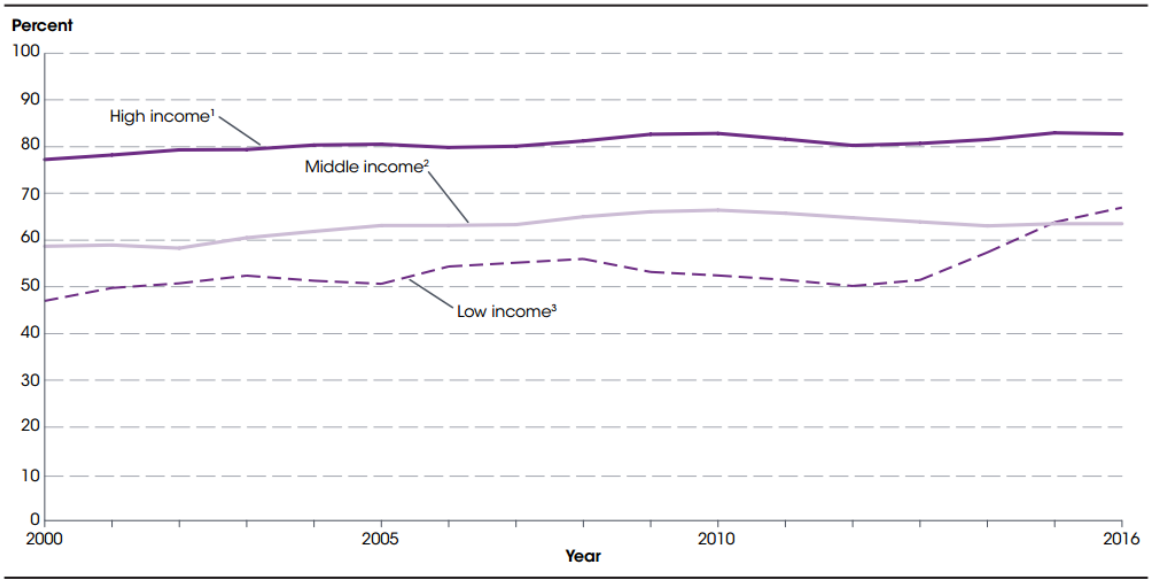


NOTE: High school completers are individuals ages 16 to 24 who graduated from high school or completed a GED or other high school equivalency credential prior to October of the calendar year.
SOURCE: U.S. Department of Commerce, Census Bureau, Current Population Survey (CPS), October Supplement, 2000 through 2016. See *Digest of Education Statistics 2017*, table 302.10.

Figure 2. Percentage of 16-24 year old High School Students Enrolled in 2- or 4-year Academic Institutions Immediately Following High School Completion by Sex (Source: National Center for Education Statistics, Immediate College Enrollment Rate (Jan 2018 update)).

As evident in Figure 3, students from more affluent households (i.e., the top 20% of family incomes) have a greater percentage of direct to college enrollment than students from middle to low-income families. In 2016, students from high-income families entered college immediately following high school at the rate of 83%. For middle and low- income families, the enrollment rate was less than 70%. Furthermore, one might expect middle income families to have a greater proportion of students entering college after high school than low-income families. In recent years, however, NCES revealed that students from households where the family income is in the bottom 20% enrolled at a rate of 67%, compared to 64% of students from

middle-income families. In other words, students from low-income families had a 3% greater direct to college entry than students from moderate income families. Additionally, the gap in college enrollment between high-income students and middle-income students remained relatively consistent from 2000 to 2016. However, the gap between high- to low-income students narrowed from 30% to 16%.

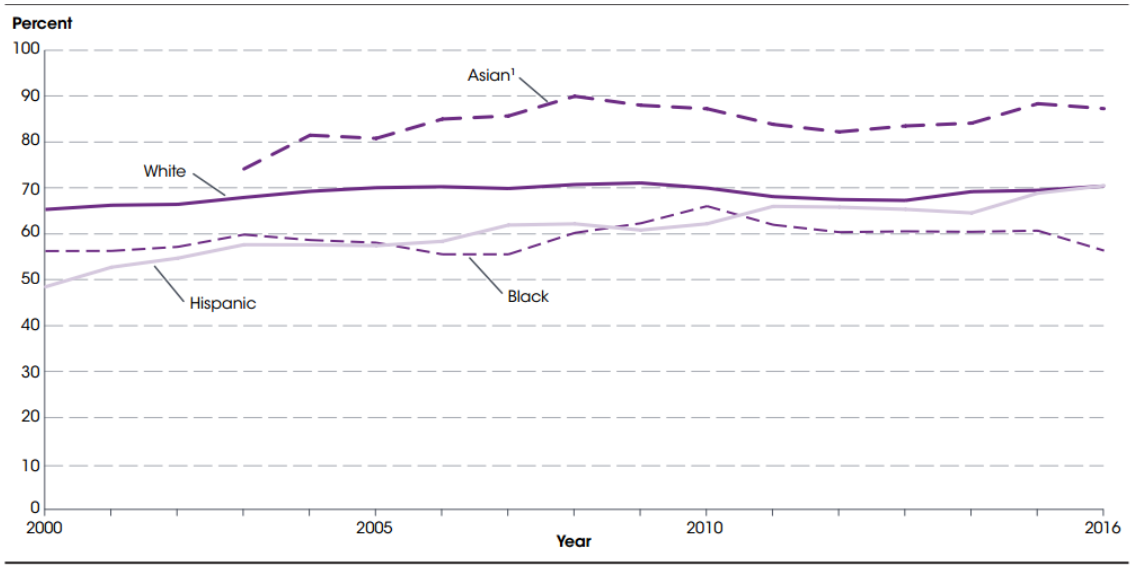


¹ High income refers to the top 20 percent of all family incomes.
² Middle income refers to the 60 percent in between the bottom 20 percent and the top 20 percent of all family incomes.
³ Low income refers to the bottom 20 percent of all family incomes.
NOTE: High school completers are individuals ages 16 to 24 who graduated from high school or completed a GED or other high school equivalency credential prior to October of the calendar year. Due to some short-term data fluctuations associated with small sample sizes, percentages for income groups were calculated based on 3-year moving averages, except in 2016, when estimates were calculated based on a 2-year moving average (an average of 2015 and 2016).
SOURCE: U.S. Department of Commerce, Census Bureau, Current Population Survey (CPS), October Supplement, 2000 through 2016. See *Digest of Education Statistics 2017*, table 302.30.

Figure 3. Percentage of 16-24 year old High School Students Enrolled in 2- or 4-year Academic Institutions Immediately Following High School Completion by Family Income (Source: National Center for Education Statistics, Immediate College Enrollment Rate (Jan 2018 update)).

Figure 4 depicts immediate college enrollment by race/ethnicity from 2000 to 2016. NCES provided data on Asian students' college enrollment starting in 2003. At that time, 74% of Asian students enrolled in college immediately following high school completion. In 2016, 87% of Asian students enrolled in college immediately following high school. The rate at which Asian students enter college persistently exceeds all other racial/ethnic groups. Remarkable is the 16% gap between Asian and White students (71%) college enrollment. Between 2000 and 2014, the

immediate college enrollment rate for Hispanic and African American students tracked each other. Hispanic students increased slightly over time. Within the last two years reported, however, NCES shows the two racial/ethnic groups on divergent paths. In 2016, the percentage of Hispanic direct college entrants (71%) had reached that of White students. Conversely, African American direct college entrants began a downward trajectory in 2015 with the latest reporting of 56% in 2016. While there is a definite trend upward for Hispanic students, the trend for Black students appears quite flat. Also, data excluding persons selecting 2 or more races is problematic with a growing trend in claiming all identities.



¹ The separate collection of data on Asian high school completers did not begin until 2003.
NOTE: High school completers are individuals ages 16 to 24 who graduated from high school or completed a GED or other high school equivalency credential prior to October of the calendar year. Due to some short-term data fluctuations associated with small sample sizes, percentages for racial/ethnic groups were calculated based on 3-year moving averages with the following exceptions: The percentages for 2016 were calculated based on a 2-year moving average (an average of 2015 and 2016), and the 2003 percentage for Asian high school completers was based on a 2-year moving average (an average of 2003 and 2004). From 2003 onward, data for White, Black, and Asian high school completers exclude persons identifying themselves as of Two or more races. Race categories exclude persons of Hispanic ethnicity.
SOURCE: U.S. Department of Commerce, Census Bureau, Current Population Survey (CPS), October Supplement, 2000 through 2016. See *Digest of Education Statistics 2017*, table 302.20.

Figure 4. Percentage of 16-24 year old High School Students Enrolled in 2- or 4-year Academic Institutions Immediately Following High School Completion by Race/Ethnicity (Source: National Center for Education Statistics, Immediate College Enrollment Rate by Race./Ethnicity (Jan 2018 update)).

STEM Degree Attainment Among Students in the United States (U.S.)

NCES (2017c) reports the number of students completing STEM degrees increased from the fall of 2008 until the spring of 2016. In 2008, colleges and universities conferred 243,031

degrees in STEM majors. Seven years later 354,806 degrees were awarded. This surge signifies an overall percentage increase of 46.0% from 2008 to 2016.

The overall landscape changes when one focuses on racial/ethnic subsets of the population. By far, White students represent the racial/ethnic group with the greatest percentage of degrees earned in STEM. In 2008-09, they completed 166,477 (or 71.6%) STEM degrees, which eclipsed all other racial/ethnic groups. In 2015-16, White students earned 214,125 degrees in STEM. Although the number of degrees awarded to White students increased, the percentage relative to the other racial/ethnic groups decreased to 64.6%.

The sharp decline in STEM degrees awarded to White students is countered by the upward trajectory of the STEM degree recipients among Hispanic students. In 2008-09, Hispanic students earned 16,206 (7.0%) STEM degrees. Seven year later, Hispanic students earned 10.9% of the STEM degrees. Overall, Hispanic students experienced the greatest growth (36,031) and percentage increase (122.3%) in number of STEM degrees completed from the 2008-09 to 2015-16 academic years (National Center for Education Statistics, 2017c). STEM degree attainment for African American students has shown little improvement. After a brief two-year period of growth between 2008 and 2010, the trend reversed and had a damping effect on the increase in STEM degree attainment. Even with a 30.9% increase in the number of African Americans earning STEM degrees from 2008-09 (17,621) to 2015-16 (23,065), the percentage was down from 7.6% to 7.0% over this same time. Relative to the other racial/ethnic groups, African Americans are falling behind in STEM degree attainment (National Center for Education Statistics, 2017c)

While African Americans are a small fraction of the STEM degrees awarded,

American Indians and Alaska Natives represent less than one percent. In 2008-09, American Indians and Alaska Natives had the fewest number of individuals earning STEM degrees (1,592 or 0.7%) compared to the other ethnic/racial groups. The STEM degree completion rate of American Indians/Alaska Natives declined by 15.1% from 2008-09 to 2015-16. Unfortunately, the relative decrease is also seen in a decrease in the absolute number of STEM degrees earned, from 1,592 in 2008-09 to 1,351 in 2015-16. In 2015-16, American Indians/Alaska Natives represented only 0.4% of the student population earning STEM degrees.

When one reflects upon the progression in STEM degree attainment among all the racial/ethnic groups, it is clear that achievement is markedly different among the different groups. Over the 7-year period, Hispanic students went from earning 7% of all STEM degrees to approximately 11%. Asian or Pacific Islander students showed a slight increase going from achieving 13% of STEM degrees to 13.5%. However, American Indian/Alaska Native persons are not achieving STEM degrees at parity with their representation in the population. African American students also decreased in the percentage of STEM degrees earned, yet maintained a slight increase in the total number of STEM degrees. While the percentage of STEM degrees awarded to White students also declined, White students remain the population earning the most STEM degrees. Overall, American Indian/Native Alaskan students earn incredibly few STEM degrees. African American students complete fewer STEM degrees than Asian, White, and Hispanic students.

Engineering Degree Attainment Among Students by Race/Ethnicity

In 2002, academic institutions awarded a total of 56,339 engineering degrees to U.S. citizens and permanent residents. The total number of engineering degrees increased to 76,932 in 2012 and 116,000 in 2017. Of all degrees conferred in 2017, 377,000 were awarded in STEM

(National Center for Education Statistics, 2019). This indicates engineering degrees comprised 30.8% of the STEM degrees.

Figure 5 reveals the 10-year trend from 2002 through 2012 for the percent of engineering degrees conferred to Asian, White, Hispanic, African American, and American Indian or Alaska Native students. Excluded from the illustration are temporary visa holders and individuals classified under Other Race or Unknown. White students represented the largest share of engineering degree recipients and American Indian/Alaska Native the smallest. As shown in the figure, Asian students completed 12.6% of engineering degrees in 2002 which tied the combined total percentage of engineering degrees awarded to Hispanic (7.3%) and African American (5.3%) students. White students exceeded all other racial/ethnic groups by completing 70.5%

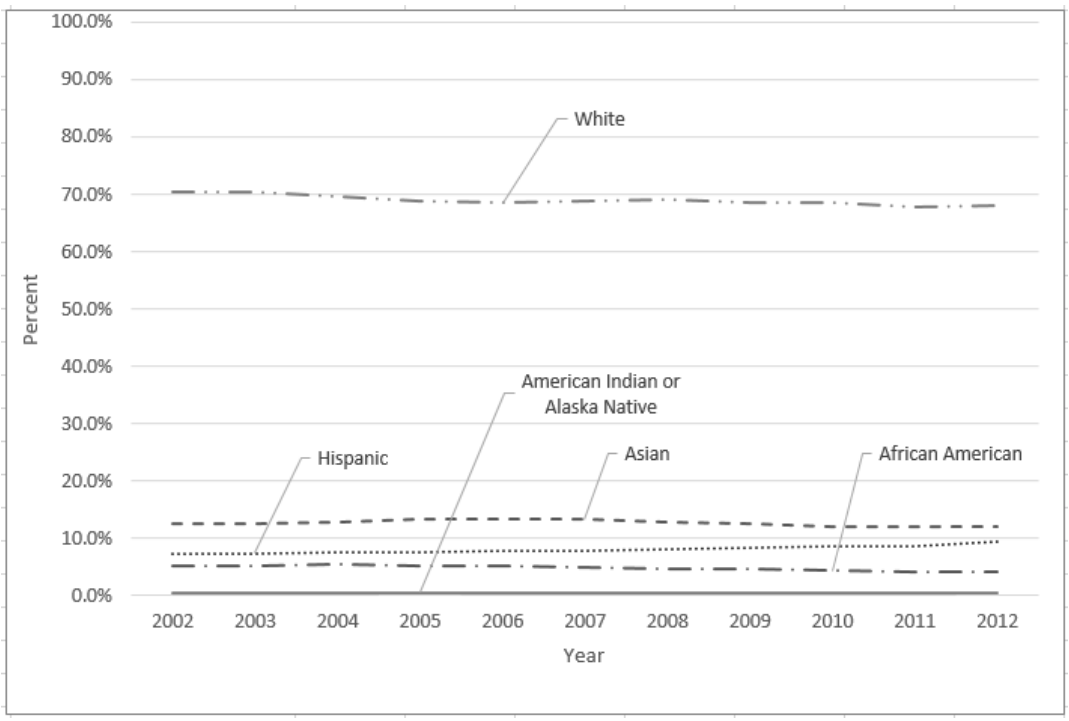


Figure 5. Percentage of engineering degrees awarded by race/ethnicity from 2002 to 2012. (Source: Data extracted from the National Science Foundation's Science and Engineering Degrees, by Race/Ethnicity of Recipients: 2002-2012 Detailed Statistical Tables |NSF 15-321| May 2015.)

of engineering degrees in 2002. American Indian/Alaska Native, the smallest racial/ethnic group, reported 0.5% of engineering degrees awarded.

Similar to the trend supported in STEM degree completion, Hispanic students outnumber African Americans in engineering degree attainment. This gap may widen given anticipated changes in population demographics. In 2016, native-born African Americans were estimated to exceed the native-born Hispanic population by approximately 526,000 people (US Census' Demographic Turning Points for the Unites States: Population Projections for 2020 to 2060). By 2030, the Hispanic population is projected to surpass the African American population by approximately 8.5 million people. This evolution in Hispanic students obtaining STEM, and specifically engineering, degrees may simply be the prologue to their population expansion within the US.

To further contextualize the importance of understanding why this research into African American engineering degree completion is vital, in 2002 African American students earned 5% of the engineering degrees in the United States. In 2007, the numbers had not changed; only 5% of the engineering degrees conferred were earned by African American students. As recently as 2012, only 4% of degrees earned were earned by African Americans students. According to data from the NCES from 2013 to 2015, there was a relatively flat trend in the percent of engineering degrees awarded to African Americans. NCES reports, during this period, 4-year public institutions conferred 92,169 engineering degrees of which African Americans were awarded 4.0% (3,687) of engineering degrees, compared to 8.8% (8,131) for Hispanics and 11.6% (10,717) Asian/Pacific Islanders (National Center for Education Statistics, 2017a). In the following year, there was no substantial change in the percent of engineering degrees awarded to African Americans and only modest gains for Hispanics. This data continues to underscore the

challenge of increasing the number and relative percentage of African American engineering degree recipients. Yet, to thoroughly understand why the percentage of engineering degrees awarded to African Americans are lower relative to degrees completed in Science, Technology, and Mathematics is beyond the scope of this research.

It is important to recognize that the national statistics on engineering degrees do not count all students completing engineering degrees. The National Center for Education Statistics Institution of Education Sciences mandates that states, local colleges and universities report graduation rates on "full-time, first-time, degree-/certificate-seeking students who started and finished at the same institution" (Integrated Postsecondary Education Data System, 2016). This compendium of data collected in the Integrated Postsecondary Education Data System (IPEDS) excludes the disclosure of Bachelor's degrees that transfer and part-time students attain. As an indication of the important role community colleges have in higher education for African American students and a potential untapped market for engineering students, in 2010, community colleges accounted for 49% of African American students who enrolled in college for the first-time (Community College Research Center, 2020). However, community college transfer degree recipients in STEM, and specifically in engineering, go unreported. Thus, one cannot analyze nor compare the achievements of African American (or any race/ethnicity) community college engineering transfer students to African American engineering full-time, first-time students on a national, regional, or state level. This lack of a national narrative and discourse on African American community college engineering transfer students' achievement and the absence of a longitudinal dataset partly spur interest in this research. Furthermore, the important, albeit under examined intersection of race (i.e., African American), institutional status

(i.e., community college transfer students) and academic discipline (i.e., engineering), motivate this study.

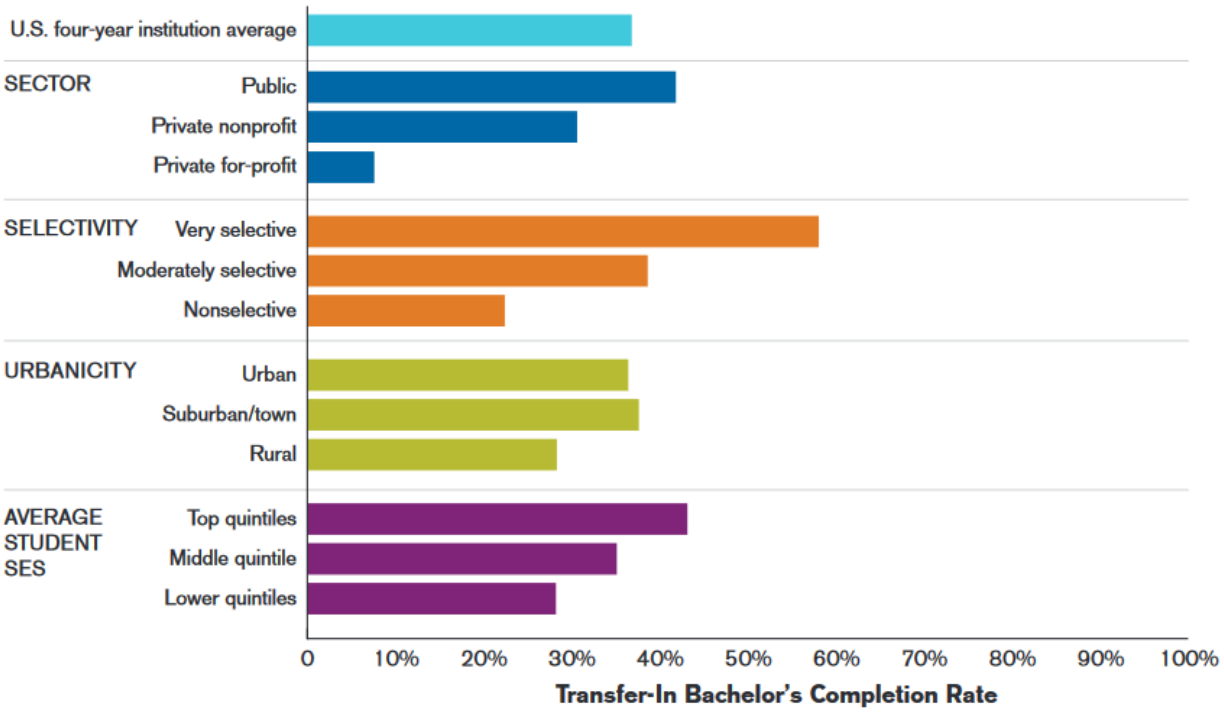
2.3 COMMUNITY COLLEGE

Achievement and Persistence of Community College Students

Jenkins and Fink (2016) analyzed community college transfer statistics of 43 states with three or more higher education institutions. They found across the United States an average of 42% of community college transfer students earned Bachelor's degrees within six years of starting college. Of the top ten states nationally, no state reported 50% or more of its community college transfer students completing higher education with a Bachelor's degrees. Iowa and Washington had the largest percent of community college students achieving Bachelor degrees, 49% each. South Dakota and West Virginia reported the fewest Bachelor recipients of community college transfer students, 13% and 20%, respectively. Additionally, 58% of Florida's community college transfer students completed their Associate's Certificate and 45% of these transfer students completed their Bachelor's degree.

Four years earlier in 2007, Jenkins and Fink (2016) studied the Bachelor's degree completion for a cohort of community college students who began as full time degree seeking in the fall semester of 2007. The researchers studied transfer student by institutional characteristic (see Figure 6). Characteristics included sector, level of selectivity, location, and average student socio economic status (SES). They found 11% more transfer students graduate from public 4-year institutions than from private nonprofits. Private for-profits graduate only 8% of transfer students within six years. Students who enrolled in very selective institutions after community college were approximately 19% more likely to complete the Bachelor's degree than those who attended a moderately selective institution and 36% more likely to graduate than transfer

students who attended not-selective institutions. Within six years of college entry, universities in cities, suburbs, and rural communities graduated transfer students with Bachelor's degrees at 36%, 38%, and 28%, respectively. Finally, institutions serving higher socio-economic status community college transfer students graduated 43% of transfer students. In comparison, only 28% of transfer students who attended institutions serving a greater proportion of students from lower quintiles earned a Bachelor's degree.



Source: Community College Research Center. Tracking Transfer New Measures of Institutional and State Effectiveness in Helping Community College Students Attain Bachelor's Degrees, pg. 22.

Figure 6. Percentage of Students who Earned Bachelor's Degrees Within Six Years After First Enrolling in Community College by Institutional Characteristics (Source: Community College Research Center. Tracking Transfer New Measures of Institutional and State Effectiveness in Helping Community College Students Attain Bachelor's Degrees, pg. 22.)

The National Center for Education Statistics 2017 report entitled *The Condition of Education* reflects the dismal persistence rates for community college attendees compared to students who began their attendance at 4-year institutions. Nationally, only 57% of students who began post-secondary studies at community colleges in the 2011-2012 academic year persisted

through the spring of 2014. Among African American students only, 48% persisted to 2014; Whites, Hispanics, and Asians or Pacific Islanders had greater rates of persistence (i.e., 58%, 59%, and 65%, respectively). During this same period, the persistence rate for students attending 4-year institutions was higher for all racial/ethnic groups. Overall persistence for students starting at 4-year institutions was 80% compared to 57% at community colleges. African American students also performed better when starting at a 4-year institution (69%), but still had the lowest rate of persistence of all groups.

Jenkins and Fink (2016) defined transfer students as those who enrolled in a college or university within six years of the first-time ever enrolling as degree-seeking students at a community college. According to the 2017 National Student Clearinghouse's Tracking Transfer report, 852,439 students enrolled in community colleges in the fall 2010. While just over 30% of community college students from the 2010 cohort transferred to a 4-year institution, of these, 42% completed a STEM degree. This means the Bachelor's Degree recipients represent only 13% of the original starting cohort.

Student Demographics

A review of the NCES 2014-001 report on *STEM Attrition: College Students Paths Into and Out of STEM Fields* shows the volatility in student departures at 2-year colleges between 2003 and 2009. This instability of community college students to subsequently transfer to 4-year institutions becomes clear when examining programs of study. Among the students entering STEM fields, some 69% were gone by the end of 2009. Unfortunately, once these transfer students get to the 4-year institution less than half of them finish. Understanding the receiving institution's role to facilitate community college transfer success, specifically among African American engineering students, is the focus of this research.

The National Center for Education Statistics compiled data from the 2004/09 Beginning Postsecondary Students Longitudinal Study and the 2009 Postsecondary Education Transcript Study. Table 1 depicts the analytical results of STEM attrition for students pursuing Associate's degrees over the six year timeframe. Students either dropped out of college without a certificate or degree or changed to a non-STEM field. Approximately 4% more students left college without a certificate or 2-year degree than those who switched to a non-STEM major. Males dropped out of college at a 5.3% higher proportion than females. Males also changed from a STEM field to a non-STEM field 13.8% less often than females. Within the racial/ethnic groups identified, Black students were the most likely to drop out of school compared to Asians who were the least likely to depart. Percentage-wise, Asian students were also the least likely to change to a non-STEM major, whereas Hispanic students were the most likely to change to a non-STEM degree. Black students, however, changed from STEM to non-STEM degrees at 1.3% less than did Hispanic students. This was not a substantial difference between the two racial populations. Students whose parents had only some college education were the most likely to drop out of college. Students whose household incomes were in the lowest 25% were also the most likely to drop out of college. Also of interest, students from the lower 25% to less than 50% household incomes were most likely to switch to a non-STEM discipline.

Table 1. Percentage of Associate's Degrees; Students Who Switched From STEM

Demographic, precollege academic, and postsecondary enrollment characteristics	STEM entrants among beginning associate's degree students	
	Left PSE without a degree or certificate[1]	Switched major to a non-STEM field
Total	**36.5**	**32.8**
Sex		
Male	38.0	28.8
Female	32.7	42.6
Race/ethnicity[2]		
White	35.8	30.3
Black	41.5	36.3
Hispanic	39.9	37.6
Asian	26.2	28.1
All other races	33.4 !	48.9
Highest education of parents		
High school or less	35.8	34.2
Some college	42.1	31.5
Bachelor's degree or higher	31.6	32.8
Income level in 2003–04[3]		
Lowest 25 percent	45.9	25.1
Lower middle 25 percent	27.9	38.8
Upper middle 25 percent	29.6	34.1
Highest 25 percent	42.6	34.1

! Interpret data with caution. Estimate is unstable because the standard error represents more than 30 percent of the estimate.
‡ Reporting standards not met.
[1] "PSE" refers to postsecondary education. "Students who left PSE without a degree or certificate" are also referred to as students who dropped out of college or college dropouts in the text.
[2] Black includes African American, Hispanic includes Latino, and "All other races" includes American Indian, Alaska Native, Native Hawaiian, other Pacific Islanders, and individuals who indicated Two or more races or Other.
[3] The total income in 2002 for independent students or parents of dependent students.
[4] Information for this variable is only available for students under age 24. Those age 24 or above (about 16 percent of the

Table 1. Percentage of associate's degree students who entered a STEM discipline but then switched to a non-STEM field by gender, race, parents' educational attainment and SES status. (Source: U.S. Department of Education National Center for Education Statistics 2014-01. STEM Attrition: College Students' Paths Into and Out of STEM Fields, Statistical Analysis Report).

For some students, demographic and socio-economic factors determine whether they will attend community college or enroll in a 4-year institution**.** As such, the demographic characteristics of students attending local colleges and regional universities dramatically differ

from the characteristics of the general student populace of community colleges (Reyes, 2011). Community college students are generally the first in their family to attend, enroll part-time and work throughout the year, and the family usually lacks a plan to pay for college (Ipsos Public Affairs, 2016). This is further indicated in the patterns of enrollment at universities and supported by the fact that low to middle income families enroll at universities at a lower rate immediately following high school. In the Condition of Education 2017 report, the authors suggest the lack of financial capital may be associated with the rate at which students from low- to middle-income families enroll in college immediately following high school (National Center for Education Statistics, 2017b). In a review of 2015 data, the study authors cast a spotlight on the fact that college enrollment was immediately preceded by high school graduation for only 63% of students from low to middle-income families. This was in comparison to 83% of students from high-income families.

Because of financial insecurity, tuition costs at 4-year institutions may be a strong deterrent for some people. This may prevent some students from participating in higher education altogether. Other students may result to seeking direct enrollment at community colleges. In 2010, Anderson-Rowland (2013) conducted a study of sixty-one transfer and non-transfer scholarship recipients required to enroll in the Academic Success and Professional Development class at Arizona State University. She found that over 70% chose the community college route because of the low tuition. Within the 48% of students who cited low tuition, men were almost three times as likely as women to reference finances. In her second distribution of the study in 2012, she found that 76.6% of the 111 study participants opted for the community college route because it was less expensive than four-year colleges and universities. Again, four times more men than women mentioned low tuition as a factor in their selection of the

community college route. As some students may come from socio-economically depressed family households, without access to additional financial resources, community college may be the critical missing link between high school graduation and 4-year degree attainment. Of the 69% of high school graduates who immediately enrolled in college, roughly one out of every four began at a community college in 2015 (McFarland et al., 2017). Handel and Williams (2012) assert the transfer pathway to a 4-year college or university degree is the most critical avenue equalizing the stratification between the minority high school graduate and the underserved Bachelor's degree recipient.

2.4 Barriers to Student Retention

Financial Insufficiency: A Precursor to STEM Attrition

Anderson-Rowland (2013) surveyed community college transfer students in 2010 and 2012 to determine the reason students chose to attend community college as well as at what point they decided to transfer to a four-year college. She observed similar results for both survey distributions and offered several reasons why students began their college studies at community college. Listed in their respective order, the top four reasons that students cited for attending community college were lower tuition, proximity to home, smaller class sizes, and friendly professors who enjoy teaching. More than 35% of students surveyed in both research studies indicated these reasons.

The primary reason cited for attending community college was the lower cost of tuition. Approximately 77% of students surveyed in 2012 and 79% of students in 2010 indicated lower tuition was the major reason for attending community college. The second most often cited reason for attending a community college was "Close to Home" with 63% of survey responses. Overall, males responded 9% higher than did females. Approximately 51% of students

acknowledge “Smaller Classes” was a factor in their decision to attend a community college, with the reason reported more by females than by males. Similarly, more females than males cited the aspect of “friendly professors who enjoy teaching” as a reason to attend community college. Overall, approximately 36% of students mentioned this as a reason for attending community college.

Estrada et al. (2016) conducted a literature review to explore the obstacles that prevent persistence of undergraduate URM students studying STEM disciplines. Their findings noted that resource disparities, such as inadequate financial means, inhibited African Americans and other underrepresented minority groups attending universities and their academic success in STEM. Further, the NCES *Status and Trends in the Education of Racial and Ethnic Groups 2017* documents that African Americans and other minority student populations need monetary assistance to attend colleges and universities full time, as well as to be sustained throughout their college tenure. As such, in the 2010-11 academic year, NCES reports 85% of full-time, full-year African American students received grants, in contrast to only 69% of Whites and 63% of Asians or Pacific Islanders. Furthermore, approximately 72% of African Americans received loans as compared to a 51% of Whites and only 38% of Asian students. The implications of this research support Anderson-Rowlands’s (2013) findings that students attend community college because of the lower tuition costs.

Palmer et al. (2009) also noted that minority students’ ability to obtain financial resources may present additional barriers to academic success. Financial resource constraints may have the toxic effect of averting African American engineering students’ degree completion. Self-imposed actions to obtain part- or full-time employment to bridge the financial insufficiency gap can also pose an obstacle to students while in pursuit of their engineering degree.

Employment by reason of financial insecurity has the ripple effect of reducing time to study and negating opportunities to participate in internships or STEM organization (Estrada et al., 2016). Tuition and fees may be escalating with the changes in the political climate, the defunding of public higher education (Mcnutt, 2017), and the loss of tuition from international students. This could ultimately make it harder for our U.S. resident students to finance and successfully complete an undergraduate degree.

Unless institutions are prepared to address students' unmet financial needs, in addition to academic preparation and psychosocial concerns, Castleman et al. (2016) report interventions to increase STEM degree production may not materialize. To increase retention, some universities are crediting financial advisors and implementing micro grants with assisting more students to graduate (McNeal, 2016). Georgia State is one such university removing the financial barriers to degree attainment. A member of the Coalition of Urban Serving Universities, Georgia State is using predictive analytics to identify students at risk of dropping out due to academics and financial insufficiency. The Financial Management Center at Georgia State alerts advisors to reach out to students when they show indicators of financial risk. Of the more than 800 risk factors tracked, two of the financial red flags include, "making late payments on bills for school or failing to send verification documents to receive federal financial aids (McNeal, 2016)."

Georgia State's early warning system is showing results. In 2016 and after hiring 42 additional academic advisors, they redirected 2,000 students who inadvertently registered for courses that were not applicable to their field of study. Graduation rates increased by nine percent over the past four years. McNeal reports the college completion gap between the overall student body and low income minority students and first-generation students has closed.

In a study of university retention programs, graduation, and student success, Anderson and Steele (2016) interviewed administrators and leaders at ten urban-serving universities. They found three models emerged from these interviews, which aligned with degree completion programs. The Reactive Model is initiated when a student fails to register by a class deadline, fails to make a payment and drops a course, or does not enroll in the subsequent semester. Eligible students are "within around 30-40 credits or one-two semesters of graduating" (USU & APLU, 2016). The "Skin In The Game" Model requires students to take on some of the financial risk by fulfilling some preset criteria. This may be in the form of a loan that is forgiven upon graduation. Failure to graduate results in repayment of the loan with interest. The Two-Pronged Model provides first-year grants to supplement existing financial aid packages. Additionally, students needing financial assistance to finish or resume a degree and at risk of dropping out or who had previously stopped out are also able to receive support.

Financial constraints are not the only elements which distinguish African American students from their peers of majority race who attend community college or universities. According to the NCES (National Center for Education Statistics, 2017d), African American students on average earned fewer Accelerated Placement/ International Baccalaureate (AP/IB) course credits than their White and Asian peers in high school (i.e., 2.7, 3.1, and 4.5 credits, respectively). Further, calculus was the highest math course earned by only 6 percent of African Americans as compared to 18 percent of Whites and 45 percent of Asians or Pacific Islanders.

Psychosocial Pressures

Iverson and Jaggers, authors of the article "Racial Profiling as Institutional Practice: Theorizing the Experiences of African American Male Undergraduates", argue that in some academic environments inherent stereotypical assumptions about African American men impact

their interactions with people in authority as well as influence decisions made on their behalf. Frequently, African American men are viewed as being unmotivated (Brooks et al., 2012). Critical to African American men's academic experiences is this perception of their lack of motivation. If allowed to persist, it could lead to destructive practices such as "bad advising, poor teaching and learning, and lack of trust between African American males and faculty, staff, and peers" (Iverson & Jaggers, 2015).

At the 2017 National Diversity Women's Business Leadership Conference, speakers asserted that women abandon STEM careers due to isolation, hostility, lack of support and feelings of marginalization (Wright, 2017). Comparable barriers and challenges may impede the academic achievement of African Americans in STEM disciplines manifesting as internal, external, and/or institutional dynamics. For such, feelings of inadequacy, diminished confidence, and a lack of academic self-efficacy may be symptomatic of internalized disorders which undermine the minority student's academic pursuit in STEM disciplines (MacPhee et al., 2013).

Presently, in this racially charged environment (Robinson et al., 2016) peer interactions resulting in micro aggression experiences (defined as "subtle, stunning, often automatic, and non-verbal exchanges which are 'put downs' of African Americans by offenders", Pierce et al., 1977) can manifest in self-doubt, frustration, and isolation (Robinson et al., 2016). African American students in STEM may also experience these challenges which are external to their ability to control.

Some African American students internalize perceptions that their race, age, and gender are inherent detractors in academic settings. Innate characteristics of age, ethnicity, and gender may be construed as limiting and may limit African American students' potential academic performance. Constrictive academic environments which present less than egalitarian social

norms, tolerance of biases, and stereotypical peer and faculty perceptions may further contribute to impeding African American engineering students' educational experiences (Bennett & Sekaquaptewa, 2014). In a study of African American engineering students in three different academic institutions (predominately white, a HBCU, and an ethnically diverse institution), Sparks (2015) reveals African Americans perceived race as limiting the perception others had of their academic achievement. Underrepresented minority student may be stereotyped (Boysen & Vogel, 2009) and hypersensitive to ostensibly innocuous but veiled acts of discrimination in faculty-student interactions. This can be evident in lower expectations that faculty express of African American students' academic abilities (Solorzano et al., 2000). In addition to race, Reyes (2011) identified age, gender, and preconceptions of transfer students' academic merit as barriers to women of color successfully transferring into STEM academic disciplines included age, gender, and preconceptions of transfer students' academic merit. Moreover, women of color may also experience academic challenges which results from being isolated from study groups with the inevitable effect of feelings that one does not belong (Tate & Linn, 2005). Foor et al. (2013) identified that women, in general, may be systematically excluded from competitive engineering teams thus limiting their co-curricular opportunities.

The Limited Availability of Faculty Role Models in STEM

The psychosocial pressures African American students experience in STEM disciplines may be compounded by the absence of members within the professorate with whom they can identify. In 2013, almost half of the engineering colleges and universities had no African American tenured or tenured track engineering faculty (Robinson et al., 2016). Sinanan (2012) posits African American male students' success may be attributable to the presence of other African American students, faculty, staff, as well as their expectations of faculty and their sense

of inclusion. Consequently, the rarity of the African American faculty member, along with the rate at which African Americans are leaving STEM professions, results in these students having few, if any, faculty with whom they can identify in academia or in STEM professions. The potential effects can be overwhelming in the engineering fields as few engineering students are African American and male.

More importantly, to address the negative characterization of African American and Latino/a students, Bensimon (2007) hypothesizes that faculty are positioned to become active participants in minority student success. From a university perspective, faculty are agents of the institution within which they operate. Hence, as institutional agents, they facilitate or mitigate student success. However, while some research universities have a few African American STEM faculty, their effectiveness may be thwarted. Limited minority professors at PWIs and a lack of solid mentorships from senior faculty (Orelus, 2013) may impact African American professors' ability to effectively teach. Professors of color may experience greater emotional toil mentoring racial minorities than their majority status counterparts in similar activities (Waymer, 2012). Their effectiveness to teach, conduct research, and mentor may be minimized by the sheer enormity of the number of minority students campus-wide who may naturally tend to seek out these relationships.

Kim et al. (2011) affirm tenets of programs which foster women's long term interest and self-confidence in engineering include having women role models (Ramsey et al., 2013), utilizing senior women to host social activities; as well as incorporating women speakers from academia inclusive of government to facilitate research seminars. Notwithstanding, Wentling and Camacho (2008) identified mentors as instrumental to the success of women engineers in undergraduate school; while Ramsey et al. (2013) noted the benefits women derived from peer

role models in a STEM academic environment. Walton et al. (2015) suggest female engineering students may mitigate experiencing the psychology of feeling one does not belong or the social marginalization of being a minority in a white male dominated class. To alleviate these stressors and sources of threat, one may begin by ascribing a non-threatening narrative such as going through the academic transition process or acknowledging important self-identifies and personal value statements via journaling.

2.5 Institutional Practice

Institutional Practice and Academic Achievement

Articles which ascribe a definition to the term institutional practice as relates to student retention and persistence and ultimate academic achievement in a university environment were not evident over the course of the literature review. Hence, I have chosen to operationalize the term Institutional Practice to mean those actions impacting the College of Engineering environment which are outgrowths of the university's mission and initiatives intended to increase minority students' academic achievement. As is reflected in the work of Nixon et al. (2013), "climate involves organization members' perceptions of the organization or situation, that is, their perceptions of what it is like in terms of practices, policies, procedures, routines and rewards" (p. 60). Consequently, climate is the result of institutional practice and is used to capture African American engineering transfer students' perceptions of institutional practices (i.e., academic climate). Furthermore, throughout this research, institution and College of Engineering are used interchangeably.

Researchers have growing interest in the role of institutional factors and practices as relates to historically underrepresented students' achievement and overall student persistence. Bauman et al. (2005) assert the responsibility for achieving equitable outcomes for historically

underrepresented students is not strictly a function of the student's motivation and precollege academic experience, but the responsibility of the institution and thereby reflected in its performance. Dadashova et al. (2010) underscore the need for institutions to serve the diverse needs of a multicultural student body as well as identify an administrator who has the authority, resources, and responsibility to improve student persistence. Hossler et al. (2008) purport institutional practices, such as transition support for students, fosters their persistence. Institutional practices underpin and therefore sustain the goal of student success.

In addition to institutional practices, the students' ability to socially integrate into the campus environment is of consequence (Frishberg et al., 2010). The opportunities, resources, people, networks, and information afforded individuals are attributes of Social Integration. Those attributes have potential to lead to economic advantage as students assimilate into campus organizations. Guiffrida (2003) asserts that research into the social integration of African Americans at PWIs be reformed to examine the experiences of individuals from homes that were located in predominately white communities as separate from those located in minority neighborhoods. Although students from both backgrounds can easily assimilate into the culture of the institution, the comfort level with which they relate to their minority peers in class or their ability to integrate socially may be substantially different.

For some African American male students at PWIs, leadership and active engagement in social organizations are the primary ways in which to obtain social capital (Harper, 2008). Kuh (2003) defines student engagement as "the time and energy students devote to educationally sound activities inside and outside of the classroom, and the policies and practices that institutions use to induce students to take part in these activities" (p. 25). A matter of concern is the extent to which African American male engineering transfer students understand the

significance of their social integration and that it is incumbent upon them to become actively involved. Administrators at institutions must also understand how they can promote African American male engineering transfer students active participation (Kuh, 2003). Once engaged, it is these students who are then better equipped and positioned to mentor future African American male students.

In addition to students' social integration and engagement, the universities' programs and services influence students' collective experiences. Therefore, to increase African American community college engineering transfer students' academic achievement, one must understand their transition experience and the programs and services extended to which they participate. Evidence of the institutional commitment to the African American engineering transfer student may exist. But the extent to which these transfer students are cognizant of the opportunities to become academically engaged is examined in this research. Of critical importance to my research is the perception African American community college engineering transfer students have of the College of Engineering's institutional factors attributed to their academic success.

Since 2000, the National Survey of Student Engagement (NSSE), an auxiliary unit of the Center for Postsecondary Research and Planning at Indiana University School of Education, has surveyed over 1,600 colleges and universities about collegiate quality. NSSE defines student engagement as a function of two factors (Center for Postsecondary Research, 2018): (1) "The amount of time and effort students put into their studies and other educationally purposeful activities." (2) "How the institution deploys its resources and organizes the curriculum and other learning opportunities to get students to participate in activities that decades of research studies show are linked to student learning." Using the definition of student engagement as a backdrop, it is imperative that this research address the involvement of African American community

college engineering transfer students in purposeful activities such as, cooperative education, internships, and undergraduate research programs; and their perception of access to these co-curricular activities (Eagan Jr et al., 2013).

Role of Institutional Practices in Students' Success

While the benefits of research experiences on undergraduate engineering students have been discussed, institutional practices factor into the analysis of engineering students' success. Wentling and Camacho (2008) concluded that teaching assistants, effective professors, and those who motivate female engineering students promote student success. Further, the importance institutions place on teaching versus faculty research can be demonstrated by the ease or dis-ease with which students needing assistance can interact with faculty as well as the extent to which faculty avail themselves to students (Foor et al., 2007). Mandatory research may restrict faculty accessibility.

As evidenced by their research, Stump et al. (2011) concluded students' performance increased when they experienced peer-to-peer interactions on homework assignments, deliberated over new materials, and shared ideas. Thus, if the university via the CoE advances collaborative learning environments internal and external to the classroom, this should result in student achievement (Stump et al., 2011). This knowledge convergence via collaborative learning opportunities has the additional benefit of expanding students' social capital within engineering disciplines.

Ramsey et al. (2013) report stronger STEM identity in undergraduate women exposed to counter-stereotypic environments infused with welcoming cues. Using the University of Michigan's WISE (Women in Science and Engineering) residential program as the focal point, the authors suggest that having positive reading materials related to women in STEM, visible

markers of their STEM majors (i.e. t-shirts, backpacks, pens, pencils, etc.), and peer role models such as study group leaders might contribute to increased persistence in STEM. Furthermore, whether the program is residential or commuter-based is of less consequence as study participants did not significantly differ on the factor of living environments.

To support educationally disadvantaged students, Youngman and Egelhoff (2003) recommend developing materials to underscore the challenges that may lie ahead (Miller et al., 2015) while equally stressing that the struggle is worth the life-long financial benefits. Moreover, students can succeed if they believe and put forth the effort (Jones et al., 2013). There are strategies that work to enhance student success and they range from the role of research at the institution to how critical information is messaged to students.

The Impact of Co-Curricular Activities on Student Retention in STEM

Engineering co-ops, internships, and undergraduate research opportunities (i.e. co-curricular activities) can be said to provide students the application and contextualization of foundational knowledge, concepts, and theories presented during classroom lectures and practicums to real world experiences (Kim et al., 2011). Cooperative education (co-op) programs alternate semesters of work with academic attendance (Strubel et al., 2015). Co-ops may provide these students the salient motivating factor to foster continued interest in the engineering curriculum while increasing students' grade point averages (Strubel et al., 2015). This increased interest may ultimately lead to course mastery and predict future academic performance (Jagacinski, 2013). Equally important is the opportunity undergraduate women have to participate in internships (Wentling & Camacho, 2008). Yet, without the opportunity to participate in co-curricular activities, the African American community college engineering transfer students may have only rudimentary knowledge of potential career and employment

opportunities (Foor et al., 2007). This could pose a barrier to their retention and is an area of interest for this research.

According to Foor et al. (2007), some engineering students from traditionally underrepresented racial and ethnic groups lack the basic tenets needed for success in engineering disciplines. This includes the ability to conduct research as some students enter engineering disciplines with varying levels of research skills and abilities to locate information. Kim et al. (2011) assert the extent to which women persist in engineering is emblematic of those having opportunities to participate in faculty mentored research experiences. These experiences consist of concerted involvement of graduate students and faculty with undergraduate groups whereby participants develop research competence and sense of community. Adam (2012) concluded STEM persistence rates increased by nearly 12% for women of color who participated in faculty-led research programs. While participating in faculty led research experiences is advantageous, so too are opportunities for minority women to teach, publish, present, and solicit funding via submitting grant proposals (DeCuir-Gunby et al., 2013). Schultz et al. (2011) resolved that undergraduate research experience was a central factor to minority students' persistence in scientific research careers. Such co-curricular research experiences could mitigate under-developed success skills and could accelerate student achievement. Under-represented minority engineering students may lack the academic preparation, cultural and social capital, knowledge of academic and career options, access to financial resources, and fail to have an innate belief in their own ability (Enriquez, 2015).

In an exploratory qualitative research study of the experiences of six African American female students participating in a 10-week STEM undergraduate research program, Jackson-Smith (2015) found the women spoke of the experience as having increased their self-efficacy,

taught them to be motivated and persist despite being perceived as less than academically qualified by some of their fellow engineering classmates, and developed within them a sense of belonging. Further, participants learned how to conduct research studies as well as were given the opportunity to take ownership and thus lead research projects. Participants also learned that unintended research results did not necessarily imply a lack of ability, skill, talent, or incompetence. Jackson-Smith (2015) also observed that interacting with professionals in their chosen disciplines via workshops and projects provided a support group of likeminded individuals, countered the effects of negative perceptions and stereo-type threat.

Results of Jackson-Smith's study supports Bensimon's research on student engagement. Bensimon (2007) hypothesized the quality of minority students' engagement activities may be of lesser social and economic value than for majority students. Limitations may lie in the extent to which they are provided leadership opportunities which afford access to creating social networks of influential faculty and board members. Devoid the institution making a concerted effort to be equity-minded and gender conscious, the social integration experiences of African American community college engineering transfer students may be relegated to experiences of little consequence. Eagan Jr. et al. (2013) and Jackson-Smith (2015) established that as participants are afforded the chance to participate in undergraduate research programs, they are able to socialize their research experiences into the mainstream academic culture. Thus, students develop quality networks and access social capital in the forms of research mentors, faculty advisors, and fellow research colleagues. This newly realized social capital may translate into economic value.

Undergraduate research opportunities may provide a vehicle by which African American community college engineering transfer students begin to identify as engineers. Jones et al.

(2013) in their study of engineering identification and the association to stereotype threat on first year women's achievement and persistence concluded engineering identification results in undergraduate women having greater perceptions of their ability and higher engineering GPAs. Further, they found engineering identification is a major factor in achievement and persistence. Therefore, the extent to which newly admitted African American community college engineering transfer students are knowledgeable of as well as successfully compete for co-curricular opportunities can influence their relationship with faculty. If for no other reason, lack of opportunity could result in further marginalization within engineering classes as professors are likely to call upon students with engineering experiences to provide real world examples of discussion topics (Foor et al., 2007). Further exacerbating this dilemma, Moss-Racusin et al. (2012) observe female students may be constrained by biases which favor male students. If female students are inhibited by professors' inherent preferences to call upon male students, the double minority, African American female student, may be side-lined and unintentionally excluded from class discussions.

Faculty may be one of the primary factors through which students identify and characterize university practices. Milem et al. (2005) provide a framework for describing an academic climate which includes faculty hiring practices. Given the quest to increase students' participation and success in STEM disciplines (Nixon et al., 2013), educational researchers may need to understand African American male students' relationships with and perceptions of faculty. To this end, equity-mindedness is a term which characterizes practitioners who act as agents to empower minority students to become successful (Bensimon, 2007). Elaborating on the characteristics of an equity-minded individual, Bensimon (2007) states,

> They are more cognizant that exclusionary practices, institutional racism, and power asymmetries impact opportunities and outcomes

> for African American and Latina/o students. Equity-minded individuals attribute unequal outcomes among African American and Latina/o students to institution-based dysfunctions, while deficit-minded individuals construe unequal outcomes as originating from student characteristics. Thus equity-minded individuals reflect on their own and their colleagues' role in and responsibility for student success.

Therefore, the extent to which African American community college engineering transfer students perceive faculty as being equity-minded may speak volumes about the quality of the institution, its faculty hiring practices, and its receptivity to minority experiences. Furthermore, the institution's practices of hiring equity-minded faculty may be important to the academic success of aspiring African American men.

Paramount to retention in engineering disciplines is high-quality teaching (Felder et al., 2011). With the rapid evolution of technology, advancing dynamics in how students receive information, and changing student demographics, the presentation and delivery of subject matter may need revisiting. Universities can no longer pander to the pedagogical techniques of old such as the "chalk-and-talk" method of teaching in most engineering curriculums (Mills & Treagust, 2003). Teaching practices which fail to relate course content to alleviating problems within society or appeal to a generation of students growing accustomed to short visual bursts of information may be ineffective (Felder et al., 2011). Faculty should incorporate innovative real world applications and interdisciplinary problems into lectures to further engage all students and add relevancy of the academic curriculum to technological advancements. Such teaching improvements could better motivate African American community college engineering transfer students to persist in engineering.

CHAPTER 3: METHODOLOGY

The study identifies the College of Engineering's programs, policies, resources, and processes, hereafter referred to as *institutional mechanisms,* specifically available to enable transfer students' success in engineering. The research strives to understand the experiences transfer students may encounter that influence their success in the College of Engineering and seeks to understand the extent to which they utilize the available institutional mechanisms. This research has three objectives:

1) What are the institutional mechanisms specifically available to this transfer population to enable their engineering success?
2) What are the experiences of transfer students as they enter the College of Engineering?
3) What are the strategies African American community college engineering transfer students employ to be successful?

This research focused on the experiences of African American students who transferred into the College of Engineering at a public 4-year predominately White research institution. In this study, the term *transitional student* was used to refer to students who previously completed courses at an institution of higher education but did not complete an undergraduate degree at that same institution. The term *concurrent student* was used to refer to students who were previously attending an academic institution (e.g., high school or an institution of higher education) while simultaneously enrolled at this university. Collectively, I referred to transitional and concurrent students as *transfer students*.

Rational for Research Design

While quantitative studies abound within the field of engineering education, to address this research, I applied a qualitative approach. The qualitative methodology has utility in capturing the essence of an individual's experiences. The information pertinent to my research and the reasons for selecting this methodology include understanding transfer students' emotions, feelings, inherent beliefs, perceptions, as well as their experiences in the College of Engineering (CoE). As a group, transfer students are understudied and we have limited information that speaks to their experiences and how to increase their success in college. Also as a group, African Americans are underrepresented in engineering disciplines. This research therefore looked at the intersection of those two populations in order to understand the African American transfer students' experiences and the CoE's institutional mechanisms that these students attribute to their success in engineering.

I have several additional reasons for choosing a qualitative methodology as opposed to a quantitative study. I am interested in understanding intersectionality as it relates to what obstacles are created by the juncture of the transfer student, the African American student, and the engineering student. I also want to understand how their identity as transfer students, their identity as African Americans, and their possible additional identities that come with being non-traditional students, may present challenges in the College of Engineering and how they prevail over these challenges. With quantitative studies, the researcher describes the numerical characteristics of the data and explores relationships or hypothesizes cause and effect between or among stated factors and/or conditions. Qualitative techniques expose the participants' experiences through personal reflection and through sharing of their stories. As the researcher, interviews allow me access to the transfer students' unique narratives and their shared

experiences. These qualitative data reveal the strategies transfer students use to be successful in engineering. From these students' stories, I offer possible solutions that the College of Engineering can take to increase the success of transfer students in engineering. I also explore how to translate and apply these best practices to future incoming African American community college engineering transfer students.

Creswell (2007) contends that conducting qualitative research requires investigators to identify, consciously consider, and apply three critical components to developing the qualitative study. These critical components include identifying the researcher's "philosophical assumptions", situating the study within established paradigms, and encasing the study within a theoretical framework. He also describes the practical application of ontology as, "Researcher uses quotes and themes in words of participants and provides evidence of different perspectives".

From an ontological view, my interest is in the transfer students' narratives and their outcomes as shaped by their personal experiences. These experiences differ by the various identities that one has. However, together there is commonality, even as each transfer student may have a unique perspective of their experiences in the CoE. Because they share multiple identities as African Americans, engineering and transfer students, their distinctive outlooks and their individual experiences may still differ by the students' other identities.

The first critical component of this qualitative study is to identify my "philosophical assumption": it is that community college transfer students face challenges when they arrive at a university. The bases of this assumption and my existing beliefs are formed by:

1) Applying my experiences as an African American woman in a PWI;
2) Applying my experience transitioning into a university as a freshman engineering student;

3) Applying my experience transferring between different universities;
4) Applying my experience utilizing the CoE's institutional mechanisms;
5) Applying my experience transferring credits from a community college; and
6) Applying my experience as a member of an academic student cohort.

Transfer students enter a university at various times. Their entrance may be after one semester, it may be after one year, or it may be after two years. Students entrance into the university may be direct from high school with some community college credits taught in their high school. But generally two years into a program, engineering curriculum has been established, traditional students have declared a major, and class sizes have decreased through attrition. Because college is demanding and engineering can be even more demanding, traditional students may band together to form study groups just to survive within this system. As these subgroups are forming, students may be developing relationships and progressing through the engineering discipline together. After one or two years, the community college engineering transfer student is placed within this new operating system where they may encounter academic and social challenges without the advantage of a peer support group (Massi et al., 2012). Being new to the engineering program, new to the engineering faculty, and new to the student body, this outsider may need to quickly develop navigational skills. The transfer student is likely to need to learn to traverse a large campus and steer through a myriad of academic and social programs while exceling in their engineering courses and trying to fit in to these pre-established student subgroups. To academically succeed, it may be helpful for the student to develop supportive working relationships with their professors, the staff, their advisor, and their fellow classmates.

In addition to the challenges of being a transfer student, their identity as a racial/ethnic minority may create a multitude of anxieties, problems, and reservations while adjusting to the CoE's predominately White student environment. MacPhee et al. (2013) identified that African American women feel socially isolated without being a member of a student cohort. This feeling extends to a sentiment of being devoid of having someone to discuss problems or concerns about class lectures or homework assignments. This is likely not exclusive to African American women but may extend to other racial/ethnic groups, men, and transfer students in general. Family obligations and/or factors which are prevalent in non-traditional students may directly impact the African American transfer students' flexibility to participate in academic support programs. Xu (2018) reports that arranging time to meet with professors during regular office hours may not be feasible for some students. Palmer et al. (2010) found that students who did not have access to assistance with homework assignments in mathematics courses or help to verify analytical procedures often failed these courses. Sparks (2015) found that being so identifiably a minority, the African American student's ethnic/racial identity poses challenges: they perceive that their identity strongly affects their peers' perception of the African American students' academic achievement. This perception may result in some African American women being challenged to socially assimilate into engineering project teams (Foor et al., 2013). This challenge to blend in on project teams is likely not confined to the African American female but can include other ethnic/racial minorities as well. Pre-established student cohorts, feelings of isolation, and rigid office hours can make adjusting to the CoE's predominately White student environment quite daunting for some students, especially if they have the double identity of being both African American students and community college transfer students. Academically, these experiences may create challenges which could result in lower academic performance.

Given these challenges exist, my belief system has been formed by my experience of feeling comradery with my peers on team projects, having supportive faculty to identify resources and to direct my path while attending multiple colleges and universities, receiving financial assistance to pursue STEM higher education, and being a member of a student cohort. From an ontological perspective, these experiences have helped me to understand that institutional mechanisms can be beneficial in enabling students' success and compelled me to address this particular issue with respect to the transfer student. My inherent motivation for conducting this study is to begin to redress the lack of a national narrative and discourse on the institutional factors attributed to African American community college engineering transfer students' success. My philosophical assumptions are further augmented in the Personal Reflection section of this research.

The second component of a qualitative study that has to be understood is the ability to situate the researcher's belief system within an established paradigm. Crotty (1998) describes paradigm as "an overarching conceptual construct, a particular way in which scientist make sense of the world or some segment of the world" (p. 35). In this qualitative space, the lens through which researchers view the landscape is often described as paradigms. These paradigms present the researcher's worldview.

To address my study, I will employ both a Social Constructivism and a Pragmatism paradigm. Interwoven within these paradigms is my ability to interview transfer students' about their perceptions of the CoE's institutional mechanisms they attribute to their success in engineering. From a Social Constructivism worldview, I will seek meaning and understanding from the transfer students' experiences as they negotiate and interact with professors, peers, and others in the CoE. The Pragmatism lens is outcomes based and through this lens I will identify

the institutional mechanisms that explain how the transfer students achieved success in their engineering disciplines. The Pragmatism approach neither constricts me to specific types of data to collect, nor binds me to a pre-determined method of analysis. Instead, I am able to utilize data collection techniques best suited for conducting my research.

The third critical component of a qualitative study is to encase the study within an "interpretive and theoretical framework" (Creswell, 2007). He reports that within the discipline of literature, researchers' form community around basic tenets of studying, interpreting and discussing issues germane to their specific area of interest but not all members are affiliated with the same "body of literature". Swail et al., (2003) Geometric Model of Student Persistence and Achievement is the formative structure for this research: it closely captures relevant aspects of the African American community college transfer student's experience that is important to my research. I will use Financial Aid, Academic and Student Services, Curriculum and Instruction, and Recruitment and Admissions as the structural supports represented in the Institutional Factors of the Geometric Model of Student Persistence and Achievement Framework. These form key pillars stabilizing the foundation of the transfer process from a 2-year institution to a 4-year STEM degree.

As I am interested in the College of Engineering's programs, policies, resources, and processes available to the African American community college transfer student, the Geometric Model of Student Persistence and Achievement captures those institutional mechanisms pertinent to my research. This framework was used to inform the development of the interview protocol. I applied it to capture the transfer students' perceptions of their experiences within the CoE's institutional setting and the institutional mechanisms available to enable their success. I explored the transfer students' perceptions of the impact their multiple identities (i.e., as African

Americans, community college transfer students, and engineering students) have on their interactions with their professors, peers, and others. I examined the transfer students' experiences and observed their utilization of the College of Engineering's institutional mechanisms. The Geometric Model of Student Persistence and Achievement framework housed the structure by which I develop, construct, and mold this research.

Personal Reflection

My identity is my greatest strength in conducting this research. I am an African American female. I am a PhD engineering student. I work in the defense industry. I am a wife and mother of two adult children. I am a lifelong learner and have attended more than eight colleges and universities in the United States while supporting my military spouse. Historically and throughout my academic and Department of Defense careers, I may be one of a handful of people who understands the challenges of these multiple identities. Given my experience, I know the importance of systems which enable students' success in engineering. This study will identify the College of Engineering's institutional mechanisms that enable African American community college transfer students' success in engineering.

Like the majority of college students, I entered higher education directly following high school graduation majoring in mechanical engineering. I completed my Bachelors of Science Degree in Applied Mathematics after becoming a wife and mother. Shortly thereafter, I began working in K-12 public education. After completing my Masters of Science degree in Applied Mathematics, I began teaching part-time in the evenings as an Adjunct Faculty member in the Mathematics Department at a local college. While working full-time and teaching part-time, I began the PhD program at a regional university. I listened to class lectures on tape while commuting back and forth from work to the university and then to home late at night. With a

military spouse on deployment, the challenges became too overwhelming. After a few semesters in the Statistics program, I left.

Meandering around in the Oklahoma City Public Schools system and then in marketing research at an insurance company, I decided to strike out on my own. I launched TDA Consulting, Inc. For nine years, I successfully owned and operated a research and evaluation company until the financial crisis of 2008. In that same year, I began work in the very masculine industry of weapons and national defense for the Department of Defense. As an African American woman in a White male dominated career field, I have experienced challenges. These experiences provide me with a unique perspective.

It is while working for the U.S. Air Force that I was afforded the opportunity to continue my studies in higher education. I was a part of the initial student cohort accepted into a Master's of Science program for engineering students at a PWRI. In all of my prior years attending higher education, I had never been a member of a student cohort. My experience in this student cohort of Tinker Air Force Base employees was invaluable. Members in the cohort worked full-time and several of us were in the same courses each semester; this cohort became vital to my success. My peers helped me to understand some very abstract, complex, and theoretical concepts taught in class. When I had questions about homework exercises and could not meet with the instructor, someone was usually able to help. Otherwise, one of my peers in the cohort would schedule time to meet with the instructor to get help. After meeting with the instructor, this person would usually have a better understanding of the course material. They would then share this knowledge with me and others who had similar challenges with the homework assignment. This translated into me being better able to complete homework assignments and more importantly better equipped to do well on exams.

It is these college experiences and the encouragement of my peers in the cohort, faculty, spouse, and others that have driven me forward. Over the last two decades, I have exhibited endurance and fortitude to persist. As a non-traditional student, I have more than 20 years in STEM higher education. In spite of working full-time, I continue to strive towards completing the PhD terminal degree. These are added strengths that I bring, which compel me to conduct this research.

Way Forward

My work and educational experiences cannot overshadow the importance and relevance I believe the immigrant and international community have been on my perspective. Researchers who conduct similar studies should consider investigating these populations. In a sentence, the plight of the minority population has opened my eyes to the current political climate and upheaval at play in America. Without the immigrant and international communities' respective contributions, the words Emma Lazarus penned and immortally engraved onto the Statue of Liberty welcoming all people into the United States would represent a bygone era. This is not the domestic tranquility alluded to in the preamble to America's constitution. The synergies of immigrants and international students within the US educational systems enhance the academic, personal growth, and culture of wealth for all students. Originating in America's colleges and universities, these interactions have had and will continue to have a positive impact on the establishment and prolongation of this United States democracy.

These interactions are particularly critical to our under-represented populations who may lack the socio-economic status to have the experiences that bring them into contact with global perspectives. Collectively, each population adds to diversity of ideas, intellectual pursuits, workforce skills, and community. America's institutions are at the forefront and leading edge of

providing innocuous places for creative activity and expression, exploration of ideas, and meritorious instruction to occur. Academic instructors facilitate collaboration among people with dissimilar backgrounds, experiences, and opinions. These unique experiences build an inclusive culture and add to the fabric of society.

As I think broadly about this research, I understand the limitations in this study are the narrow focus on a single population of native born students. In the future, my plan is to expand the study population to begin to look at other underrepresented populations, as well as the growing number of international students and how they thrive in American colleges and universities.

Qualitative Methodology

To contextualize the study, I used phenomenology as the primary methodology. Phenomenology will provide the overall direction and guidance into the research. An accessible and core method of conducting a phenomenological investigation is with interviews. Creswell (2007, p.57) reports "a phenomenological study describes the meaning for several individuals of their lived experiences of a concept or a phenomenon." During an interview, individuals or groups engage in dialogue about a specific problem, issue, or concern they have in common. This approach provides an opportunity for individuals (or individual group members) to express their actions, attitudes, behaviors, beliefs, feelings, interpretations, opinions, and/or perceptions about the study topic. The narrative format allows the individual to expound upon the discussion and to share additional insight. The interviewer is able to probe deeper and deeper into the meaning of a participant's response. The researcher can then apply these insights into and expand their understanding of the topic as perceived and experienced by the study participants. These shared experiences subsequently aid the researcher with identifying themes and patterns in the data.

To build the interview protocol, I conducted an artifact analysis of the CoE's website. This review consisted of analyzing the existing online materials to understand the availability of support programs, resources, and educational activities. I used this artifact analysis, the existing literature review, and the theoretical framework to inform my interview protocol (see Appendix A). I also used this analysis to determine whether the transfer students are knowledgeable of and perceive these CoE institutional mechanisms as enhancing student learning. The research determined how instrumental these institutional mechanisms are to enabling the African American community college transfer student's success in engineering.

To recruit the study participants, I used electronic flyers to advertise the research and its purpose to the African American students enrolled in the CoE transfer class. Students were offered a nominal incentive to participate (e.g., gift card). The flyer contained my contact information (i.e., telephone number and email address), the research topic, criteria for selection, and the location for the interviews. Students were asked to contact me via a text, a phone call, or an email to schedule a date and time for their interview. I also used purposive sampling to identify the students who transferred from a community college prior to their enrollment at the university and select these students for participation. Gay and Airasian (2000) describe purposive sampling as the researcher uses their knowledge and/or experience to identify the criterion for which to select the sample population. The criteria I used include African American student, community college transfer, and engineering major.

Two days before each interview, I contacted each student via text message to confirm the date and the time of their interview and reaffirm the purpose of the study. If the student was unavailable, I attempted to reschedule at a more convenient time. On the day of the interview and after the student arrived, I asked the student to complete and sign an informed consent document.

To maintain confidentiality, I assigned each student a unique alphanumeric code representing the total credits completed at the community (i.e., Partial – P or Associates Degree – A), gender (i.e., Male – M or Female - F), their enrollment status (i.e., Part-time – PT or Full-time - FT), and a three digit sequential number. Using this alphanumeric code, I gave the student a brief (i.e., one page) survey to complete (see Appendix B). The survey inquired about their demographic information, community college coursework, current academic discipline, and the length of time at this university. After completing the paper survey, I collected the form and wrote the code on the interview protocol and on the paper I planned to use to collect my field notes. While explaining the interview protocol, I asked permission to digitally record the interview and indicated their response on the form with their initials. The interviews lasted approximately 90 minutes. The participant's involvement concluded at the end of the interview. I provided each student a gift card and thanked them for their assistance. My goal was to conduct at least ten one-on-one semi-structured interviews of African American community college engineering transfer students.

After transcribing the interviews, I conducted data analysis. I took notes as I read through each transcript to get a feel for that student's experiences, story, and path as well as to understand the codes that I would use in NVivo to align to my framework. These codes became nodes in the software. I then read each transcript more carefully, coding the data to the nodes that I created, wherever the expressions, feelings, or sentiments came up. After reading, coding, re-reading and re-coding, I began to pay particular attention to the experiences and perceptions students shared.

I started with 5 groupings, which represented the subcomponents of Swail's Institutional Factor: Recruitment and Admissions, Academic Services, Curriculum and Instruction, Student

Services, and Financial Aid. As I read through the transcripts, I coded large passages of the transcription to each of those subcomponents and left the other passage of the text un-coded. I went back through on a separate review to identify meaning in the narratives and put these meanings into smaller groupings. Lastly, I read through the text to identify things that were important, decide if something was distinct (i.e., mental health)/or similar to a node previously created.

Given the nature and potential sensitivity of this research, I had to maintain a presence of mind. I had an obligation to remain conscious of my personal biases that could inadvertently spill over into the design of the interview protocol. To minimize subjectivity, I remained aware of my preconceived beliefs that could directly influence how I conducted the interview. I was conscious of my internal dialogue and its impact on how I interpreted the data or composed the findings. To ensure my objectivity, I developed an interview script that had specific prompts and probes to engage the participant during the interview. This protocol was designed to avoid leading questions that could influence a participant's response. While conducting the interview, if the participant digressed or I was side tracked, the script was used as an anchor. It recalibrated me to the appropriate and relevant topic of discussion. After completing the interviews, I discussed my interpretations with my committee chairperson and reframed my interpretations as necessary based on our conversations. All of the interview data was reported to minimize any instance of omitting data which may not have supported my views.

Theoretical Frameworks for Institutional Models

While I chose to use Swail's Geometric Model as the framework for which to analyze the outcomes of my research, I acknowledge there are other models which focus on the institution's impact upon African American students' academic success. In particular, Arroyo and Gasman

(2014) developed an institutional framework for Black college student success based on research of HBCUs. Their research was grounded in a compilation of existing literature of HBCU's impact on specific racial/ethnic student demographics and on the supportive environment postulated at these institutions. Their research framework used a three-pronged approach: *diverse applicant population*; *supportive environment*; and *graduate outcomes*.

Arroyo and Gasman's model considers the diversity of students' experiences (e.g., the applicant pool) as they apply for admittance into HBCUs. This is accomplished by recognizing students come from a variety of backgrounds and a multitude of experiences, which could include wealth and affluence or poverty and disadvantage. Once admitted into the institution, the supportive environment is decomposed into two areas: *institutional entry point;* and *reciprocal processes and outcomes*. Students' prior experiences coupled with HBCUs' accessible admissions policies and reasonably priced tuition describe the entry point into the institution. Those elements characterize and provide context for the HBCU's supportive environments.

Core to their assertion of HBCUs providing a supportive environment is the homogeneity of the student body composition, which includes students' racial/ethnic demographics and cultural backgrounds. Arroyo and Gasman recognize those student characteristics increased social networking and interpersonal relationships amongst students at HBCUs. While students have similar identities, it is within the reciprocal processes and outcomes that Arroyo and Gasman begin to address the formation of students' identity, cultivate students' value systems, and build on students' academic achievement. Each of those elements within the model is recursive, such that the student moves back and forth among any of the three areas prior to graduation. Student's identity is formed by recognizing HBCUs' ability to provide role models and opportunities for students to participate in leadership activities. HBCUs endeavor to mold its

students' value system by cultivating social norms of citizenry, character, and capability. Furthermore, Arroyo and Gasman contend that HBCUs offer its graduates opportunities for learning, such that they are on par with students from non-HBCU institutions for other academic opportunities upon graduating. The compilation of the elements in the institutional entry point and the reciprocal processes and outcomes are attributed to students' academic achievement.

The framework for this research is the Geometric Model of Student Persistence and Achievement (Swail et al., 2003). Figure 7 depicts the major components and minor subcomponents of the model. The strength of this student centric model is the representation of the various dynamics of the student's experience to include the cognitive, social, and institutional factors. These major factors are comprised of elements that are depicted external to the triangle and then grouped according to the cognitive, social and institutional attributes represented. These attributes constitute the sides of the triangle and are indicative of the student's inherent resources and of the institutional support the student receives. Institutional factors form the base of the triangle. Components of these factors represent the solid foundation upon which an academic institution can first identify and then meet the student's or student cohort's collective needs.

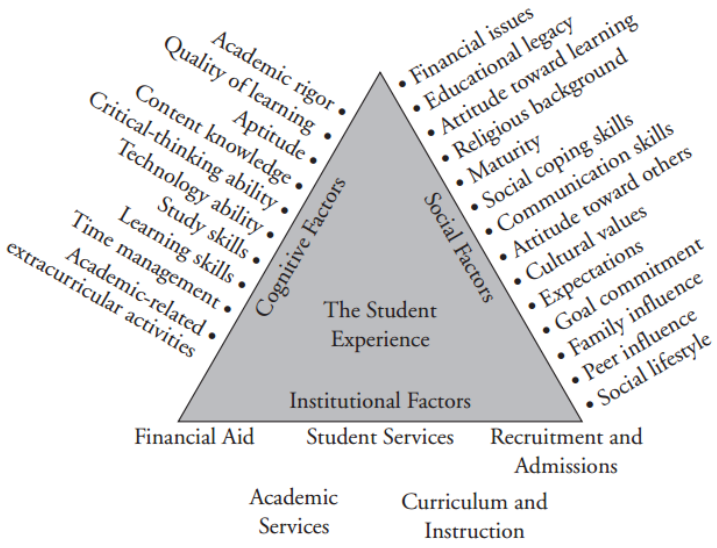


Figure 7. Swail's Geometric Model of Student Persistence and Achievement Framework (Source: Retaining Minority Students in Higher Education A Framework for Success. Watson Scott Swail with Kenneth E. Redd and Laura W. Perna Vol 30, No 2).

The triangle in Figure 8 is depicted in a theoretically ideal state, which indicates a student brings equal levels of cognitive and social skills upon entrance into higher education. The institution then applies an equal amount of resources to supplement the student's overall educational experience to form an equilateral triangle. Each student's uniqueness and the institutional level of support required, however, necessitate a fluid framework. The framework can be used to demonstrate a student's distinct cognitive and social characteristics in addition to the institutional level of support. For example, Figure 8 depicts a student who has an excellent educational background, resulting in a vast supply of academic resources, but seems to struggle socially. This student may be capable of using the institutional resources and their existing high cognitive abilities to cultivate new social skills and thereby adapt to the environment and succeed in higher education. It is the student's inherent abilities (i.e., social and cognitive) and the institutional support provided that result in each student receiving the requisite resources which may result in the student's success.

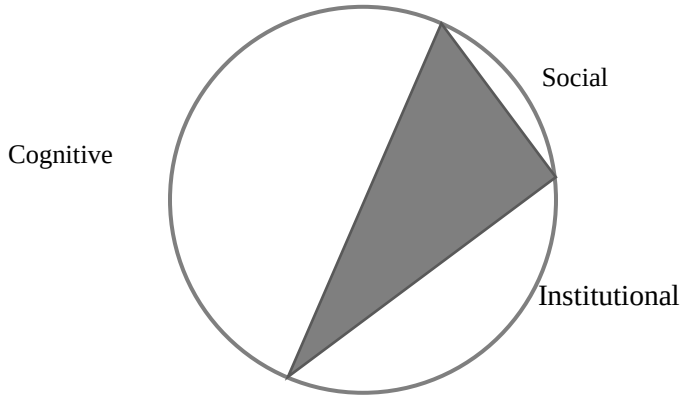


Figure 8. A depiction of Swail's Illustration of A Student with Exceptionally High Cognitive Abilities but Low Social Skills. (Source: The Art of Student Retention A Handbook of Practitioners and Administrators Educational Policy Institute. Dr. Watson Scott Swail).

A centralized function in higher education institutions is financial aid. Castleman et al. (2016); Schudde and Scott-Clayton (2014) report that financial aid is a critical resource for some students to plan subsequent coursework and requires students make satisfactory progress from one academic period to the next. To facilitate students' academic success and to leverage financial aid to modify academic behavior, some institutions are initiating efforts to mitigate their students' financial burdens (Godow, 2015). These efforts include:

1) Removing loans from the most at-risk students' financial aid packages;
2) Linking financial aid to students taking a total of 30 credit hours combined for the fall and spring terms;
3) Requiring students to meet with their academic advisor annually;
4) Requiring students to meet registration deadlines for priority courses; and
5) Requiring students to adhere to their pre-established degree plans.

The CoE may help to mitigate transfer students' financial burdens, while increasing their retention, by linking the CoE with the Financial Aid Services office to design a similar initiative.

This resourcefulness could be crucial to some students' success. As Ornelas & Solorzano (2004) found, Latina/o transfer students lacked knowledge of the institution's financial aid resources. Their discovery may be directly applicable and relevant to the African American community college transfer students.

While financial aid resources can be critical to some African American transfer students, so too can the services institutions provide to enable a smooth transition between community college and the university. These academic and student services can be important for minority students by increasing their cognitive acumen and social skills thereby facilitating their success at the institution. Bauman et al. (2005) determined equitable higher education outcomes for historically underrepresented students is a responsibility of the institution. In the framework, this accountability is depicted in the overall category of Institutional. Without delineating specifics, Hossler et al. (2008) report transition support services, identified as Student Services in the framework, aid student retention. Their research suggests, however, that neither orientation programs nor first-year experience programs predicted student retention. Cromley et al. (2016) found institutional support services such as academic support centers that house tutoring services, host time management and study strategy workshops, and provide "testing and accommodations for learning disabilities", depicted as Academic Services in the framework, can impact student achievement and retention.

Even when categorized as traditional students, African Americans often face additional challenges in higher education institutions. These challenges are reflected in the Geometric Model of Student Persistence and Achievement as Social Factors and include financial issues, educational legacy, peer influence, and social coping skills. Factors that are similar to those cited in the framework include financial insufficiency (Anderson-Rowland, 2013; Castleman et al.,

2016; Estrada et al., 2016), educational gaps (Wilson & Lowry, 2017), peer influence (Stump et al., 2011), and social and coping skills in higher education (Bensimon, 2007; Frishberg et al., 2010). The perceived attitudes and the perceptions of others (Reyes, 2011) as well as cultural norms (Shehab et al., 2007) may also present challenges that can influence an African American community college transfer student's academic success. Maturity level, family influence, social lifestyle, and overall expectations of a non-traditional student may differ from the traditional student. Combining the transfer student's non-traditional student characteristics with a lack of awareness or utilization of the existing institutional mechanisms, their seclusion, a grueling schedule, and with no perceivable peer cohort, their journey to degree completion becomes more difficult. As a result, fewer African American community college engineering transfer students are likely to complete the program compared to other underrepresented ethnic/racial groups.

Additionally, one needs to consider the students' ability to reach academic milestones (Calcagno et al., 2007) and their need to achieve competency through remediation (Bahr, 2013). These factors are aligned to the Cognitive Factors displayed in the Geometric Model of Student Persistence and Achievement. They are depicted in the framework as prior quality of learning, content of knowledge, and level of preparation. The transfer students' ability to adapt to the university environment may require that they develop new study and time management skills (Cromley et al., 2016). Community college students who are new to a university may also need to identify, locate, and participate in extracurricular activities related to academic enhancement (Frishberg, Lee, Fletcher, & Webster, 2010). These prior research studies support the application of cognitive factors to the transfer students' achievement.

CHAPTER 4: INTERVIEW RESPONSE AND ANALYSIS

Data collection and analysis for this research was reviewed and approved by the Institutional Review Board of the University of Oklahoma (IRB No. 10442). Student participants were selected from those actively enrolled in the College of Engineering (CoE) during the Spring of 2019. Table 2 depicts the student enrollment by demographics in the CoE for the Fall of 2018 (the cohort definition for the 2018-2019 academic year). Nineteen percent of all students enrolled were transfer students. Black or African American students represented 4% of the total number of undergraduate students enrolled in the CoE and just less than 6% of all transfer students. Of the 41 Black or African American transfer students in the CoE, three of them participated in this research, which was slightly less than 10%.

Table 2. Fall 2018 CoE Student Enrollment by Demographics

	All CoE Students	CoE Transfer Students	% of Total Transfer
Total Undergraduate enrollment	3630	694	
Women Enrolled	895	128	18.44%
URM Enrollment	1282	272	39.19%
Black or African American	149	41	5.91%
Asian	383	91	13.11%
Native Hawaiian or Other Pacific Islander	3	1	0.14%
American Indian or Alaskan Native	103	19	2.74%
Hispanic	352	68	9.80%
Multi Race	292	52	7.49%

The three interviews were supplemented with additional data from the Research Institution for STEM Education (RISE) de-identified 2006 dataset (Shehab et al., 2008-10). Six total student interviews, three direct interview participants and three from the RISE supplemental data (Walden et al., 2018), formed the data set for analysis. To aggregate the data, items from the

2006 interview protocol data set were mapped into items from the interview protocol for this study. Three student interview data and related items from the 2006 data set were then input into Nvivo 12.0 software for analysis.

4.1 IDENTITY & CONFIDENCE

Diversity Within the African American Engineering Transfer Community

Table 3 describes the transfer student participants. These transfer students represent a non-homogenous group of students. Four students reported their identity as male and two students as female. The financial assistance students receive varies from personal resources, student loans and grants, to scholarships. The pathways to this university are unique to each transfer student. Prior to attending this university, students have attended post-secondary institutions, such as community colleges and/or other 4-year institutions. Some students have also attended community colleges while concurrently enrolled in high schools.

Table 3. Student Characteristics by Gender, Financial Assistance, and Institution Attended

Student Name	Gender	Financial Assistance	Prior Institution Attended	Reasons for attending institution prior to this university
DeAndre	Male	Scholarships; prior work	Community College	High school diploma from another country.
Jolene	Female	Scholarships	4-yr University Transfer; CC	Took summer classes at the community college.
Julie	Female	Loans and Grants	4-yr University Transfer	Leave this state after HS to attend a "great" engineering school".
Matthew	Male	Loans/grants; Scholarships	Community College	Transferred courses from the community college.
Michael	Male	On campus job, Loans	Internal University Transfer; HS CC	High school concurrent; internal transfer
Samuel	Male	Loans/grants; Scholarships	HS and University Concurrent	High school and University concurrent classes.

Community College (CC); High School (HS); Internal university transfer includes students who are enrolled at the university but major in non-engineering fields. 4-yr university transfers include students from other 4-year colleges and/or universities.

Table 3. Description of student characteristics by gender, type of financial assistance received, the institution attended prior to attending this university, and the reason for attending the institution.

DeAndre's pathway to the 4-year university began on the continent of Africa. After graduating high school, he moved to the United States (US). While in the US, he served in the United States military for several years. After military service, he sought enrollment at this university. A CoE advisor suggested that he enroll in a local community college because he was unable to retrieve his high school diploma. While at the community college, he completed his associate's degree. He later successfully transferred into the College of Engineering at this university.

Jolene began her pathway to this university as a transfer student from Dallas, Texas. She graduated high school in Texas. Upon graduating high school, she enrolled in a university in Texas. During a summer session, she decided to take classes at a local community college. Jolene alternated between taking classes at a university and a community college. Alternating

between the university and the community college was a way for Jolene to keep cost down. She also was able to split up the location of where she would take her classes. Jolene knew she would eventually need to transfer to another 4-year institution to get a degree because the university she attended did not offer a degree in her preferred field of study. Family and friends influenced her decision to transfer to this university. She successfully transferred and continued her coursework in her preferred engineering major.

Julie's circuitous route to this university began as a graduate of a local in-state high school. She left this state in pursuit of experiencing a "great engineering school" on the east coast. She attended a university for three (3) years prior to coming back to this state for a summer break. She enrolled and was admitted into University College as an Undergraduate Visitor in the summer of 2013. She returned to the university on the east coast in the fall of 2013 and remained a student until the spring of 2014. For the 2015 academic year, records do not indicate that Julie attended a post-secondary institution. In the spring of 2016, Julie returned to this state and this university as an Exploratory Student. She was successfully admitted into the College of Engineering in the spring of 2017.

Matthew's route to this university began as a graduate of a STEM preparatory high school in Texas. There he completed a pre-engineering program and also took concurrent classes offered via a local community college. These community college courses were taught by teachers from the high school and were held at the high school. While in high school, university recruiters frequently came to talk to students about [this university's] engineering program. Recruiters also provided students with scholarship applications to complete. After completing a scholarship application, Matthew received notice that he was awarded a scholarship. Receiving the financial support was instrumental to Matthew's decision of where to attend college. So too was reflecting

upon the number of students that he knew who attended [this university]. Ultimately, Matthew decided to enroll in [this university] and the College of Engineering.

Michael was a current student at this university. His pathway to the College of Engineering was a more direct route. After deciding that he wanted to transfer from his present field of study into engineering, he spoke with a College of Engineering advisor. She explained the transfer process, the program of study, and reassured him that his ambivalence was natural. After meeting with the advisor, Michael successfully transferred into the College of Engineering.

Samuel's pathway to the 4-year university began with graduating from a STEM preparatory high school in this state. While in high school, he took concurrent courses offered by local community colleges. Faculty from the community colleges came to the high school to provide instruction. These courses prepared Samuel for entry into this university. College level coursework smoothed the transition between high school and college and reduced his course load. Samuel successfully transitioned from high school into the College of Engineering.

The Impetus and Confidence to Become an Engineer

There is not a consistent theme of how or why the CoE's African American transfer students choose to seek engineering degrees. These reasons are as diverse as are the students. These reasons can be as rudimentary as to better align a course of study to one's interest or fundamentally future oriented as a way for one to better prepare for career opportunities.

> *[Michael] [0:03:08] I was a [STEM] major, and … I was thinking of switching over to [an Engineering discipline]. … {The CoE Advisor} just said, if you like doing [this specific application of engineering] and this looks like something you [would] like to do then the College of Engineering is for you.*

While students may have a multiplicity of motives for choosing engineering, the characterization of participants in this study are unique to each African American transfer

student. For one study participant, the realization and/or practicality of engineering as a future career made this discipline a more palpable program of study even while his interests lie in a different area.

> *[Samuel] 150: I was really looking into some of the things that I care about ... which is more related to Sociology, education and those kinds of things. And I thought, well, what would I do with those degrees?*

For some African American transfer students, their identities impact their level of confidence and the extent to which they feel prepared to forge a journey towards their future engineering ambitions. Both Matthew and Michael desire to become engineers but their confidence and their pathway to the CoE are vastly different. Matthew's confidence to become an engineer was an outgrowth of his experience as a student concurrently enrolled in college courses at a pre-engineering high school academy.

> *[Matthew] ¶25: P: "Okay, I can do this. If I'm taking the classes, if this is how it's going to be in college and I'm doing this well," it kind of gives you that confidence boost …*

As an internal university transfer student, Michael's confidence developed as a result of understanding the similarities between his two degree programs. These two programs were his initial program of study and his current engineering discipline. The ability to translate the knowledge and skills learned in one discipline to another discipline facilitated Michael's acclimation into his current program of study. In the passage below, Michael reflects on the effect that his transfer status has on his feeling of confidence.

> *[Michael][1:28:11 It was in a sense [because] I was coming from [a different discipline], and like a lot of my classes did [not] necessarily transfer over. I felt like I was [not] able to take much of what I already knew [from my other major] and apply it [to engineering], but ... once I actually got into the [engineering] program I found that ... there were a lot of similarities to what I was already learning.*

Elements both inside and outside the classroom contribute to the student's confidence, such as the psychosocial interrelationships between faculty and students. This may also contribute to their confidence. Findings from this study indicate that how students' perceive faculty supporting and empathizing with students are influential in developing students' confidence.

> *[**Julie**][0:12:30]... I was fortunate enough to find [a professor] in College of Engineering who actually wanted to listen to me and wanted to support me. ...*

The perception that faculty are approachable and relatable reflect the social or communal aspects of faculty-student relationships. DeAndre describes this in the passage below.

> *DeAndre [01:21:49] He [engineering professor] [is] also the one person that has encourage[d] me most in my {academic} career. {The professors should} be approachable, {and students should} be able to talk to [the professors]... [to] build your confidence and ... like tell you that hey it's {making the first grade of C on a test} okay, and we are here for you...*

In the excerpt below, Michael addresses the impact of faculty on his level of confidence to become an engineer.

> *[Michael][1:28:40] I think it's been my {CoE faculty} ... showing ... they didn't always think like this. They didn't always understand the material, that they also struggled, and so that [is pretty impactful to] me.*

Role Models as Recruiting Agents: Help me find my way

The decision to attend this university and to choose engineering as a major may require critical reflection. Students may need to analyze, critically ponder, and seriously deliberate on these decisions before taking action. Occasionally, when family and/or friends have embarked upon a similar trail, the decision to take the same course of action is less fraught with ambivalence. For some students, this decision to transition into an engineering discipline post high school is facilitated after finding role models as these individuals give some African American transfer students models to emulate.

¶301: P: [Jolene] Oh, my sister graduated from here and she knows a lot [of people here], like her friends graduated in [a specific engineering discipline], with a [specific] Engineering degree. ...And my parents ... knew some faculty, you know, administrators and all that, here.

[Matthew] ¶423: The Engineering Program was good. I knew a couple of people ahead of me that went here and ... they liked it ¶25: P: ... [Knowing people who attended the CoE] was important because I could relate to them and then I was thinking, "Well, if they can do, I can do it." ... I was trying to get that insight. "Is it hard? What kind of classes are you taking?" And they had pretty good things to say and so I was just like, "Okay."

In the passage below, Matthew provides insight into how he decided which university to attend when being recruited by several institutions. His perception of the college recruiters' attitudes, demeanor, and sincerity were instrumental in his selection to attend this university. The recruiting experience at this institution and his perception of the people he met during the exploration of the university were also important. Below Matthew compares interacting with recruiters of other universities to the people he met on a recruiting trip to this university. The individuals with whom he interacts, however, leave such a profound impression upon him that it influences his decision of which university to attend.

[Matthew] ¶437: The people that did go through ... those schools, they liked it but then you can kind of tell that it was forced, like they were recruiters. Of course they had to say that, whereas... the people from [this university], it [was] like genuine. They really did like it.

In general, the study participants had few, if any, issues with transferring into this university and the College of Engineering regardless of the method of recruitment (e.g., one's personal decision or direct recruitment). While direct engagement is one approach to recruiting to this university and the CoE, other students may traverse less direct routes. Some non-traditional students face unforeseen challenges that could deter them from seeking admissions into the CoE. In the CoE admissions process, these students may have extenuating circumstances that require a holistic assessment of their situation. This may necessitate the need to treat these

transfer students as the exception rather than as the rule. For these transfer students, it may be imperative for the CoE to understand their pathway.

Additionally, the possibility exists that some transfer students will have unfulfilled academic requirements and lack strong support systems. This could further reduce the number of applicants seeking admissions into the CoE. This was the case for Julie who is non-representative of this transfer student population studied. Julie's previous university experience presented incredible personal obstacles that derailed her academic pursuits at the prior university, misrepresented her intellectual potential, and minimized her potential capability. These difficulties led to her grades falling drastically, moving back to [this state], and seeking mental health support. Given these extenuating circumstances, she does not ascribe her uncommon experiences at the prior institution as ones that African American students will generally have at 4-year institutions.

> *[**Julie**][0:02:54]... I would say that there are a lot of non-traditional students who are very talented, and would be very talented engineers. And are very much capable of completing the program ... And I think it's very important for College of Engineering to actually listen to the whole story that a student has to say behind their academic profile. And behind all their other accomplishments and other things that they do in academia and professionally related to engineering.*

Building the Numbers: Where are the African American Engineering Students?

African American engineering students in this study recognize they are isolated. There are few students at the community college who look like them. There are few students in this university who look like them. This section presents the evidence that universities may need to focus on building the numbers of African American students in engineering at the community college level. Here is what students have to say about the problem.

In the passage below, DeAndre reflects on the isolation he experienced at the community college and the scarcity of African American students in engineering at this level. DeAndre's

assertion suggests that universities may need to build the number of African American students in engineering at community colleges. For the few African American engineering students who attend community colleges, recruiters may need to recruit at community colleges while in addition to recruiting at STEM academies and charter schools. While responding to the question of what would be different to try to recruit more African American students, he contemplates the fact that in this community college there were few African American students in the engineering program with whom he could identify or who shared similar engineering identities.

> *[DeAndre][00:03:31] Ah, there [are] very few. At least from my class days, I was the only African-American that graduated from the Engineering Department at least at [this CC]. And, there's another African-American that was following me, I think he [is] graduating next semester.*

For transfer students within this study population, their recruitment and pathway into the CoE vary as these students come from high schools, community colleges, and 4-year universities. The 4-year university transfer students are either internal transfers from within this university or transfer students from other 4-year institutions. The CoE recruiting from other 4-year institutions is highly improbable. The implausibility of universities recruiting within or at other universities is reflected in Michael's comment. He is also an internal university transfer student. When asked if the College of Engineering did anything to recruit him, Michael responds, *"Not really. ... There were [not] any recruitment efforts made."* As a result, high schools and community colleges appear to be the last vestiges of non-profit institutions from which universities recruit prospective African American students. It is generally known and understood, however, that universities recruit at high schools. My findings suggest that high school recruiting may not be occurring ubiquitously as thought. *[Michael] [1:33:05] ...We never had any ... specific days where... the recruiter came to our school...*

A seemingly untapped opportunity is recruitment at community colleges. These institutions may be an untapped resource for recruiting African American engineering transfer students. DeAndre's comment is indicative of the possibility that community college students may need to be pro-active in their pursuit of the engineering degree.

> *DeAndre [00:00:31.0], I don't know that I was recruited per se. However, I sought out this program even before I went to the community college.*

In this sample, there appears to be few African American students entering the engineering programs in community colleges. Participants report that they do not know of many students who come from the community college to the engineering program. Other students express frustration that no effort is made to encourage them to pursue 4-year degrees after community college. DeAndre's frustration that he experienced while attending the community college is evident. He was unaware if the CoE recruits at community colleges. Findings suggest that the CoE may not be recruiting at any of the local 2-year institutions. They could therefore be prime locations to provide potential students information on the various opportunities in engineering.

> *DeAndre [01:29:39] I went there [community college for] two years. And not one time did anybody talk to me about transferring to anywhere. ... This not a terminal college.*

While direct recruiting is one method of increasing African American students' enrollment into the CoE, this may not be sufficient in and of itself to attract some potential candidates. Recruiting local students may be challenged by their perceptions about the university. In the passage below, a local student describes having false perceptions about the university, primarily due to assumptions made about the limited impact of the university's activities. These false perceptions could be countered by presenting more information about how the university impacts opportunities nationally and internationally.

*[**Julie**][0:06:54] … my perception of [the university] was, looks like a great school, looks like they're learning some stuff but it's in [the state]. And even just looking at competition teams, or engineering teams that students participate in you just think well that's just at [the university]. Or they may go to a national competition but at the end of the day, they're just doing this in a community in [the state], or in [the university's] College of Engineering community. And yeah, I did not realize that students even participate in research opportunities that connect them with institutions like NASA, and national and international companies.*

Students' Pre-Transfer Experiences with Advisors

Evidence from this study suggests that having advisors who are knowledgeable and well-versed on engineering curriculum is imperative. In their absence and without their guidance, students may be required to verify curriculum requirements, to search out pre-requisite courses, and to align their course schedules to class offerings. This is reflected in Samuel's experience. Upon entering the university, Samuel received curriculum advice from another campus resource. By heeding this advice, Samuel was situated out of the normal cycle for course rotations, primarily due to the sequence in which pre-requisite courses are offered. As a result, Samuel was forced to delay his graduation. In the excerpt below, he discusses the curriculum advice he was given.

[Samuel] 292: I don't know if they know necessarily the ins and outs of the College of Engineering; things like, you have to take Physics your freshman years, the spring freshman year, to be on schedule for all the way through [the engineering program]… I didn't know this information.... I didn't know it was going to push everything to the end.

Students teetering between the choice to remain in their current discipline of study or choose a new academic field of study may need help to make this decision. Academic Advisors can be situated to be that sounding board. They can be pivotal to providing students the information on the degree options available that are well suited for students. This was the case for Michael an

African American 4-year university internal transfer student. He contemplated whether to transfer into the College of Engineering.

> *[Michael] [0:03:08] I was a [non-engineering] major and ... I was thinking of switching over to [engineering]. ...One of my {instructors suggested}...that I go [talk] to the [engineering] advisor... to see how [transferring] would look... I [would] say, probably the biggest influence in terms of like recruiting me to the program was the [engineering] advisor. ... I went to talk to her before... I officially committed to enrolling in the College of Engineering, and she … talked me through how my [academic] year would look... She … showed me how it [would] be a little bit different {than my current program} and how the department is structured.*

Academic Advisors may not champion one college or program of study over another. Their intent may not be to sway a student's opinion. The College of Engineering Advisors readily listen to and help students to make cogent decisions. These decisions result in the students determining the programs of study that are in their best interest. This is how Michael explains his decision to transfer to the College of Engineering.

> *[Michael] [0:03:08] [The engineering advisor] didn't necessarily try to convince me [to transfer to engineering]. She just said, if you like doing this {an application of engineering} and this looks like something you [would] like to do then the College of Engineering is for you. But as far as like... pushing me in that direction it was more like she wanted to make sure that it was my decision.... I think she did a lot in terms of like reassuring me in my decision.*

Unlike Michael, DeAndre had no familiarity with this university and the College of Engineering. This African American community college transfer student came to the university seeking assistance with the engineering program and requesting help from Academic Advisors. He sought this advice before enrolling into a community college. As an older non-traditional student, transitioning from being a full-time employee to a full-time engineering student, DeAndre needed help. Academic Advisors were available to DeAndre and they were influential. They provided supportive and individualized advice. Initially, this advice was difficult for

DeAndre to accept. In the passage below, DeAndre contends with the advisor's suggestion to temporarily forgo attending the university in favor of beginning at the community college.

> *DeAndre [00:02:00] ...Initially I was like, no. ... I don't want to go to a community college. I want to go to a four-year college.*

Analysis of DeAndre's dialogue suggests the Academic Advisor was cognizant of how DeAndre perceived the message relayed. The advisor was adept at quickly identifying, tracking and then potentially deflecting DeAndre's erroneously perceived message. This Academic Advisor transitioned the message from one of personal affront to one of collaboration and support. DeAndre's dialogue suggests that this Academic Advisor had the understanding and skill to patiently wait before moving forward in the conversation with DeAndre. The advisor allowed DeAndre the time to first internalize the suggestion, ponder the consequences, and then decide whether to act on the recommendation. Upon reflection, DeAndre recognized that the advice he received was appropriate for him. This guidance enabled DeAndre to successfully navigate his academic path to engineering. The passage below lends credence to the perspective that regardless of where a student is coming into engineering, Academic Advisors provide crucial services to transfer students in the transfer process. In this excerpt, DeAndre reflects on the advice an engineering advisor provided.

> *DeAndre [00:02:00] ... I think [it] helped a lot, because I learned a lot about college without the tremendous stress of being in {the university} earlier on...*

4.2 THE UNOFFICIAL STUDENT ADVISOR

The Unofficial Student Advisor as an Influencer

In this paper, influencers are defined as individuals who actively engage students to change their academic trajectory. These are people other than student affairs staff or academic who interact professionally in the academic environment with students. Influencers do this by

purposely providing students with a sense of direction while on their academic pathway. This direction may be with respect to aligning students' educational backgrounds and interests with post-secondary academic aspirations. They provide students with context for future academic decision making in higher education. Influencers can be instrumental in helping students determine college majors. Samuel's discussion reflects the impact an Influencer had on his future plans. When asked, "When did you decide that you wanted to be an engineer?" Samuel responds as follows:

> *P: When Industrial Engineers came from the university, my senior year. I always knew I was interested in Math and science, since elementary school, but not engineering. I didn't know the different fields of Engineering or anything like that.*

Students who attend high schools dedicated to STEM preparation (e.g., magnet schools) are likely to encounter Influencers. Influencers can be positioned to kindle the students' creativity, ideation, and passion about STEM disciplines. They can assist by placing the students on the route to pursue professional degrees. In the excerpts below, Matthew and Samuel explain how university recruiters, who serve in the capacity as Influencers, solicited students to attend this university.

> *¶423: P: [Matthew] They were really recruiting heavily at our school you know and I thought [this] university, there really were a lot of people that were coming here, and so I was like: "Okay," so something different you know. It was something different. The Engineering Program was good. I knew a couple of people ahead of me that went here and, you know, they liked it, and so I filled out the scholarship application and I got the scholarship and I was pretty much like: "Hey. I'm going to try that. I'm going to go there."*

> *[Samuel] 152: This University came and talked ... I visited this University, they brought me back up for another visit, I got four or five scholarships in the mail and here I am. It was a lot of things like my senior year there was a guy who was coordinating the Multicultural Engineering Program. ... And my regional recruiter, she was the same way. Like, "Hey you should do the [specific program identifier] Scholars Program.*

Students who are unable to attend STEM preparatory high schools may not encounter Influencers. These Influencers could chart courses for students that lead directly to the study of engineering at universities. When asked if he knew he wanted to be an engineer while a high school student, Samuel responds, "*Huh uh, absolutely not."* The inability to access someone who inspires students to pursue engineering may limit their contextual knowledge of engineering and the work of engineers. This lack of contextual knowledge about the engineering profession is reflected in Samuel's understanding of mechanical engineers.

> ¶26: *P: "I was really saying okay that [specific engineering discipline is] something I could do and I'm interested in those things. I didn't want to be tied to, like, a tool belt, so I didn't want to do, like, a, well, in my mind I would see, like, Mechanical Engineers are, like, building with their hands.*

University staff often serve as Influencers, unofficial student advisors who have programmatic knowledge of campus resources. They also have the knowledge to direct engineering students to resources that could aid in their retention. These unofficial advisors can be well versed in both academic and student support services and campus organizations. They can be instrumental in helping students to understand the academic resources available on campus. In the passage below, Michael explains the support student affairs staff provided him. The added value student affairs staff provide is reflective of Michael's follow through to use these campus resources.

> *[Michael] [0:01:24] In terms of like different groups and organizations I'd use once I actually got into the College of Engineering. ... There have been two so far. I [have] had ... brief contact with both. First one was DEP [Diversity Enrichment Program], or MEP [Multicultural Engineering Program].... I talked with the director over there ... she helped me ... find a lot of resources and ... different tutoring options that I could use if I needed some [help], for ... different classes. ... [The] other one was NSBE. [National Society of Black Engineers]*

Pre-Admissions into the CoE and Early Academic Advising

Admissions into the College of Engineering may be stressful for some students who transfer into the university from out-of-state. This stress may be compounded when a student is routinely requesting assistance from various university officials who are not identified as the dedicated focal point for specific transfer students. Without a direct point of contact or liaison between the student and a university administrator, these students may shoulder added burdens, such as ensuring that the students' requisite paperwork for admissions has been successfully transmitted, received, and documented.

> *[Jolene] ¶659: P: Transferring here has been difficult for me. I just mostly put all the stuff on myself. I just call – every little question I call, so they probably know me. I just [placed that burden] upon myself... Like, enrolling for my classes I had to keep calling back and checking [to see] if they got my transcripts... and just checking back [for] the pre-[requisites] and all that and just calling back and forth, ...*

Admissions into the CoE may be difficult for students whose academic transcripts reflect below average GPAs. Historically, GPAs are one of the criteria that universities have used to assess a student's academic potential. Even with a low GPA, admissions into the CoE is, however, attainable for some students. Julie represented one such unique case in point.

Julie transferred from another university after encountering overwhelming circumstances at her previous institution. This gave Julie difficulty as she sought admissions into this university and its College of Engineering. A less than stellar academic record gave university officials pause when considering her admissions. A potential engineering candidate who appeared on paper as a less than stellar candidate, painted a troubling picture for success. Nevertheless, Julie had the fortitude and support system to persist. Through the petition process, Julie's admissions strategy and persistence resulted in her admission into the College of Engineering and her desired engineering discipline.

*[**Julie**][0:01:04] I fought to get in [to] this engineering program. I transferred from [another university], and I had some really extenuating circumstances there. My GPA dropped really low, [It] was below [a] 2.0 when I transferred to this university actually. ... I was just let in on academic probation. ... Yes, so I was not in College of Engineering at first, I wanted to get into the [specific engineering] program.*

Research from this study suggests that as an institutional component, Academic Advisors have an important role to assist students with academic planning and providing guidance to transition to the University. In the passage below, two of three students describe having positive experiences and perceptions of their advisors. DeAndre's positive experience is primarily due to the advisor's skill to facilitate his enrollment at both the community college and this university.

DeAndre [00:01:23] ... one of the advisors like she was really helpful in helping me ... get enrolled at [the] community college and then, [to] later on, come here.

Jolene's positive perception of the advisor is primarily a result of adhering to the advice given regarding course load.

[Jolene] ¶385: P: When I got advised, [the advisor] was telling me not to take too many courses my first semester here ... and that helped me at least.

Julie's advisors provided an avenue by which she could continue her education in a STEM discipline. From the student's perspective, Julie's pathway is a testament to the strategies upon which African American transfer students depend. Her ultimate entrance into the CoE is a reflection of Julie's persistence and determination. These are some of the strategies, which serve as catalyst that African American transfer students use to be successful in engineering.

*[**Julie**][0:01:04] When I met with [the] advisors, they just explained to me [that] your GPA isn't high enough. Probably best you don't go for [specific] engineering... eventually I ended up having to file a petition with College of Engineering to be admitted into [specific engineering] program despite my GPA.*

Career Advice: Students' Aspirations and Career Goals

Some of this study's participants have initiated conversations with faculty about their aspirations and career goals. These self-directed conversations with faculty are often beneficial as students are made to feel connected to the CoE community through these one-to-one interactions. These interactions are single points of connections into the CoE community. This perception of inclusivity may be important for African American students as they are underrepresented in the CoE at this university. For DeAndre, this faculty-student conversation resulted in a feeling of inclusivity.

> *DeAndre [00:16:33] I think [it has] been really helpful because you [are] just not feeling all left out.*

Faculty-student conversations may also be advantageous as students can receive information pertinent to their situation. These conversations may provide important career advice. Faculty-student conversations may also lead to faculty suggestions of how a student can direct their intentions and efforts in productive ways to potentially secure future employment. These conversations are operationalized demonstrations of social capital (Enriquez, 2015). These conversations are also avenues by which students participate in engagements that are of potential social and economic value, which research has identified as important for student success. Bensimon (2007) found that African American students may lack participation in engagements that lead to quality social networks.

Findings from this research reflect that some African American transfer students are engaging in networks which broaden their social capital. Other students are using these networks to better understand processes. As reflected in the passages below, it is clear that Julie knew that establishing faculty-student relationships are important. However, instead of taking the opportunity to work towards building a relationship with her professor when she spoke with him,

she chose to focus more on the tactical aspects of the transition process. She did not leverage the conversation with her faculty as effectively as DeAndre.

> *[**Julie**][1:13:51] For career advice, I have approached [engineering] faculty, just asking them mostly about what it would entail to kind of transition to [an engineering discipline].*

DeAndre appeared to understand the value of these relationships. He spoke with his professor about his future aspirations and career goals. DeAndre's passage reflects the magnitude and importance he placed on building a relationship with faculty. This relationship provided him the additional social capital to understand the CoE system and to be successful in engineering.

> *DeAndre [00:15:03] ... [The professor and I] spoke at length about my aspirations, what I want to do. ...and I told him about my [employment background]. And he spoke about ... talking to different [industry specific] companies ... the recruiters. [Try] to get to know them. You don't necessarily have to want to work there or anything, just to get the feel of... what you like best about [the company], what you don't like about it. Where do you want to direct your ... [focus]....? What do you want to do specifically in [this industry]?*

African American engineering transfer students may not recognize the possible benefits of having conversations with faculty. These conversations can, however, be motivational as Michael expresses, "*I felt more confident on like what the future was going to look like."* Faculty-student conversations about students' aspirations and career goals can potentially advance students' future careers. However, not all African American engineering transfer students may feel comfortable initiating these conversations nor confident approaching faculty members who do not look like them. Students are unified in how they feel when professors validate their career interests. DeAndre describes how he feels empowered when his professor expresses interest in him.

> *DeAndre [00:15:03] ... it gives you some empowerment, some courage, some ..., you know ... someone else cares. Like, hey, he cares about my future. It's just not just me, you know?*

Occasionally, a professor may initiate the conversation with a student to speak about their aspirations and career goals. This research finds that if faculty initiate these conversations, the students perceive that the faculty care about the students' aspirations and future career goals. In other words, the faculty appear to show sincere interest in helping the students accrue cultural capital. With anything less than a deep hearted conversation, the students may be left feeling unfulfilled, dissatisfied, or as if the conversation did not meet their expectations. This was the case with Michael as he discusses a meeting with his instructor. The conversation left him wanting more.

> *[Michael] [0:13:04] ...This [was] ... because I went to [instructor's] office hours [to ask] for help on an exam. And then [the instructor] ... asked me, what do you [want to] do ... with your [discipline specific] degree? [The instructor] was just curious. ... but we didn't go too in depth as far as, like, what it's supposed to look like, in terms of, like, my junior year, like internship, or then my like, senior year, maybe like a co-op, and then like once I'm graduating like how to find a job. None of that was ever discussed with me. It still hasn't been so far. Nothing too in depth, just like more general.*

4.3 TRANSITION EXPERIENCES

Experiences at the Receiving Institution

For some African American transfer students in this study, the process of transitioning into CoE did not flow as easily as they might have imagined. Some transfer students experienced consternation when they learned of the additional courses required to complete the engineering program, bewilderment about the extended time needed to complete their degree, and surprise at the lack of information readily available to understand the transfer process. Other students were amazed at their success thus far in the program or were confident of their position within the body of engineering students. With respect to the university environment, students generally found this university to be a welcoming place.

Students' Knowledge of the Engineering Curriculum

When the students' expectation of understanding the engineering course requirements is unrealized, the transition experience can become daunting. Some students express frustration with having to independently determine which courses will transfer and meet the curriculum requirements for the university and the CoE. Some students believe they must independently fumble through the process of determining which courses to take. This is the case with Jolene.

> *[Jolene] ¶665: P: I guess just getting your coursework right to transfer, picking the right courses [before you transfer].*

DeAndre believes that the students at his community college have severely limited access to information on this university's engineering programs. He is acutely aware of the lack of information available to students on the courses which comprise an engineering curriculum for a specific discipline. Community college administrators also seem to have little information.

> *DeAndre [01:05:16] ... I was very close to the department head ... [I would] talk to him on a regular basis. And ask him, what do you think about this? ... And, sometimes [he would] be like I don't know, I can't help, I can't help you there.*

For some study participants, their first experience with academic advising was not with an engineering advisor. With the lack of cultural capital, as relates to understanding how the university is structured and the CoE advising process, these students assumed they received good advice when they were advised. However, they did not understand how to evaluate the relevance of that advice to their engineering program and its curriculum. The students' lack of knowledge may lead them to believe that any academic advisor can provide sufficient curriculum advice on any of the university's disciplines including engineering. This implicit understanding is reflected in the passage below as Samuel expresses exasperation over the advice an academic advisor provided, which led to him getting off track in the engineering curriculum sequence.

[Samuel] 290: Well, too late to try to play catch up. Like that Physics I was a pre-requisite ... for a lot of [classes]. So once I took Physics I over the summer, hoping to get right back on track, it just didn't work out that way.

Students in this study express a presumption that information on the courses required to complete an engineering curriculum should be easily accessible to transfer students. However, when they could not find relevant curriculum information and requirements, students expressed frustration. For Michael, the resulting frustration and confusion is mitigated after meeting with an appropriate engineering advisor.

[Michael] [0:09:48] ... the transition altogether was a bit weird, because there [were] a lot of classes, that ... I didn't know, you had to take in engineering. [Until] I had my advising appointment with her.

Some of this study's participant appear to be blind-sided when they fully comprehend the ramifications of transitioning into the engineering discipline. The transition process for these students can be perceived as overwhelming when they realize the impact of their decision to transfer. These students express frustration with realizing that some of the classes they previously took at the community college will not transfer. They express frustration about being unaware of the additional time required to complete the engineering degree. This idea of needing more time to graduate is incredulous to some students. Michel had goals of completing his engineering degree in four years but realized those goals were unattainable. Changing majors increased the amount of time Michael needed to graduate.

[Michael] *[0:15:17]... I realized I had a whole another year to tack on... I came into college with the mindset that "I'm just [going to] be here for four years and then I'm [going to] get out" and so once I switched [majors] I was like "Oh, I can't do that anymore".*

DeAndre had a similar expectation of graduating within a set timeframe and a similar realization that this would not occur as Michael.

DeAndre [00:06:39] I lost a year of college ... [Because] I took the classes [at the community college] that did not transfer properly to the [engineering] program

that I [am] going [into at this university]. {No other surprise} apart from [the fact] that I'm going to be graduating a year later than I expected.

Impact of Identity on Student Success

Some of this study's participants have developed the ability to maintain a positive mindset which gives these students an innate strength that allows them to adapt to their environment and then to excel within it. In the passage below, Michael appears to be in awe that he is one of a few African American engineering students in the CoE and in disbelief of his accomplishments in the engineering program thus far. He recognizes that he is making inroads into the engineering program despite the doubt that may sometimes creep into his consciousness. His strength emanates from his recognition that in spite of being a minority, he is succeeding in his engineering degree.

[Michael][1:35:57] But then, other times, like I find myself thinking, wow there aren't a lot of people like me here and …that must mean I'm doing something right. And so like I try to use that to say, well I've gotten here this far. So, obviously I'm doing something right. I try to figure out what it is that I'm doing right and then see if I can continue from there.

Unlike Michael, Julie expresses an internal strength that is interwoven into her identity as an African American female in the CoE. It is her recognition of being in the CoE, coupled with her identity as an African American female, that drives her to embrace the CoE and all that it has to offer. With her desire to continue her education at this institution after the bachelors' degree, she aspires to embark upon philanthropy as a means of giving back for all that the university has afforded her. Julie describes this sense of accomplishment and pride in the excerpt below.

*[**Julie**][1:46:04] I would say that one of my motivators is how proud I am to be where I am and to be who I am. And, yeah, that is one of the motivators that really keeps me going and really wants me to push to finish my degree and also go to grad school and also just give back to the university and plan (events).*

Michael and Julie have learned to persist and embrace their environment. As a result, they both exude a sense of accomplishment and pride.

Students' Preconceptions about the CoE

African American transfer students in this study may have preconceived ideas about the university's engineering program that are misinformed. They may underestimate the amount of time needed for independent study to prepare for an engineering class. Cromley et al. (2016) identified time management and study strategy workshops as institutional support services that facilitate student achievement. Students may over estimate the number of credit hours that they can successfully accomplish each semester. They may lack understanding of the workload required for engineering classes. As students indicated these are concerns, collectively, faculty may need to address and dispel these ideas sooner rather than later in the transition into the CoE.

Matthew, a graduate of a STEM high school while concurrently enrolled in college, talks about how hard it was for him to manage his time coming from a very structured high school environment and going into a very open college environment. Unlike high school where the class schedule is fixed and students work their time around that set schedule, Matthew is now in total control of both his class schedule and time.

> *[Matthew] ¶423: P… biggest surprise… [was] that I had to [manage my time]…. [You] go from a set schedule in high school then I come here with all this free time. I was just like, "Whoa." Yeah, that was a big shock…*

Jolene explains in the excerpt below that she did not understand how to manage her time when she initially came to this university. She also did not understand how to study effectively.

> *[Jolene] ¶29: P... just [studying] like I used to do in high school. But then when I got [to college], the classes were a [lot] harder than {high school}. And not just like I couldn't… I didn't know how to balance yet. ...I believe time and studying. Not just studying to go to the library and act like you're studying, but studying efficiently and understanding, because I did that a lot.*

Similar to Jolene, DeAndre also talks about time management but his concern is with the amount of preparation required for a class and the workload based on the number of credit hours. For DeAndre, there is a vast difference in the workload required between the community college and the CoE. Given the magnitude of the work required for each CoE class, he subsequently reduces the number of credit hours in which he enrolls. DeAndre's experience seems to confirm the work of Lloyd and Eckhardt, 2010, who found that some students at community colleges fail to allow ample time to study and prepare for abstract concepts in science. This finding likely also translates to students studying theoretical engineering concepts at the university.

> *DeAndre [00:10:05] I think the level or amount of work [for the CoE classes]. I was used to taking 18, 20 credit hours [at the community college], no problem or big deal. And this semester, I'm only taking 13, and I'm overwhelmed...*

The Social Community

Some African American transfer students in this study describe this institution as a welcoming environment. The environment is such that students perceive a sense of belonging, contentment, and refuge. They are pleasantly surprised at the ease with which they are made to feel welcomed and a part of the community. This feeling of being welcome extends to the inclusivity students speak about when describing their study groups.

> *[Matthew] ¶585: P: ... the environment here at [this institution] is definitely… what they portray to other people, [it] is really home, [a] hometown feeling and everybody likes everyone…*
> *[Samuel] 476: I really have fit in at [this institution] as far as I'm very comfortable with myself. I get along with most people.*
>
> ***[Julie]****[1:37:47] I've always felt welcomed at this institution.*

After having served in the United States military, DeAndre may be accustomed to working with racially and ethnically diverse groups of people. This teaming environment experienced in the military may serve to provide him a similar sense of belonging at this university and may help

to explain the diversity found within his study group. DeAndre experiences a feeling of inclusivity in this study group even with it being racially and ethnically diverse. He describes his study group in the passage below.

> *DeAndre [00:43:09]...There [is] me [an] African-American, my friend [Manuel] is Hispanic. ... [Jerry] is ...Indonesian or something. It's some kind of Asian [ethnicity]. And we have .., an Indian friend of mine. [There are] two of them actually, that are from India. And then [we have a] Caucasian friend of mine as well, so it's very mixed [LAUGH]. DeAndre [00:43:51] I think I feel included. Like we are all from different backgrounds. We're all different, so it's like very inclusive.*

Developing relationships may be harder for transfer students who are not extroverts. Some transfer students who enter the CoE as freshmen take several years before they feel comfortable initiating conversations with their peers. If this were the norm, the African American engineering transfer students who enter the university with a few years left to graduate with their engineering degrees could potentially graduate without developing meaningful and deep relationships or friendships with their peers. *[Matthew] ¶213: P: It was like my junior year… that was when I started kind of like … talking to people [within] my major, studying with them and things like that, so.* For the African American engineering transfer student, this issue of developing relationships may be compounded by being racially underrepresented and by not having a racial peer group.

> *[Michael][1:00:27] Guiding [us] in making the connections to other African American students. Since there [are so few of] us, it's really hard to like find us....*

Without these relationships, the feeling of community may be lost on these students.

Student Organizations

African American engineering transfer students' social integration may be impacted by their involvement in academic and non-academic activities. Previously, social integration was

operationalized in the context of campus organizations as the opportunities, resources, people, networks, and information afforded individuals with the potential to lead to economic advantage. Thus, the extent to which African American transfer students attain social integration may be a direct result of the emphasis the university and the CoE officials place on campus organizations providing these services and the students participating in these activities (Kuh, 2003). In the excerpt below, DeAndre discusses how the National Society of Black Engineers has been a resource for him. He believes that this organization is one in which all African American students should become acquainted.

> *DeAndre [01:14:01] ... African-Americans Engineering Association [NSBE] ... [has] a really good support system... I think that [is] one of the biggest support systems for African-Americans...*

Michael discusses how he was encouraged to join campus organizations by an African American campus official. The campus official understood the support and services these organizations provide and implied that these services may be important for African American students.

> *[Michael][1:23:49] I think {the campus official is} the only one that explicitly told me to like try to develop like a [support system]. And that's also because she was a woman of color, she's African American also. I think she kind of understood that I would need like that [support]... I think ... the only two places, I know of so far, are MEP (Multicultural Engineering Program) and the NSBE (National Society of Black Engineers). And those are like the only two places like I know where if you are African American and you are looking for like support in the engineering field, those would be the two places you go to.*

More specifically, student organizations can also provide community and financial support for African American students. Estrada et al. (2016) identified insufficient financial capital and/or support as a barrier to STEM academic success among underrepresented minority groups. In the passage below, Samuel talks of the financial support received from one such

organization. When asked about experiencing a sense of community at this university and how this has been beneficial, Samuel responds:

> *¶170: P: Definitely the Multicultural Engineering Program.*
> *¶171: I: Is that a good thing for you?*
> *¶172: P: Yes, it's been great as far as financial support...*

The Class Environment

The class environment is influenced by many factors including class size and the role that faculty take. In this study, the CoE class environment is stimulating and exciting for some transfer students while others find the environment to be intimidating and perhaps overwhelming. In this environment and for some transfer students, the CoE class was the first place where students encountered classes that had large numbers of students and expressed concern with the rapid pace at which faculty presented materials. Students were excited to learn about technical applications that are areas of interest to them. The CoE class was also the first place where some students experienced identity concerns because of the lack of racial/ethnic diversity. Those were some of the areas addressed in this study.

The Size of the CoE Classes and the Pace of Instruction

Class size can be perceived as a deterrent for some African American students to attend universities in favor of the community college. Anderson-Rowland (2013) identified smaller classes and friendly professors as two reasons why students begin their academic careers at two-year institutions. Both DeAndre and Jolene express such concerns over the size of the University's CoE classes and over their ability to engage with the professors given the large number of students in the engineering classes.

> *DeAndre [00:02:00] … some of the lower level classes here, seem they are like 100, 200 kids in one class. And there {at the community college}, even a lower*

level class is like ... a small group of people and you have like more interaction [with] the professors and that helps a lot.

Jolene specifically addressed how class size impacts student perceptions of faculty interest in student well-being.

[Jolene] ¶251: P: I would say because the classes were so big the professors didn't care as much about the students. Or not like they didn't care, but they, it [is] like [there is only] so much they can do because there [are] so [many] students.

Samuel expresses concern that faculty fail to recognize the range of student learning and thus don't adjust to the pace of instruction.

[Samuel] 122: I think sometimes the Calculus or Math [professors] at [this university] get kind of caught up on those students who are understanding everything and leave everybody else behind.

Samuel also expresses discomfort in courses where teaching assistants fail to speak fluent English and fail to get academic concepts across to students due to language barriers.

[Samuel] 306: I think one factor may be that it was right after my freshman year. So freshman year classes, like, Chemistry for example, I think three or four hundred students, and there was a lab session with TA. It was okay that the TA did [not] know good English but on top of that [he] did [not] care that he did [not] know good English. He made no effort to be understandable or talk a little slower. So that experience was really bad. I could [not] understand [anything] that was going on in the whole class.

Application of Engineering to the Real World and Team Work

Students in this study are motivated by their personal areas of interest. The interaction between interest, motivation, and learning is strengthened when faculty relate learning to students' interests. Students' interests are further peaked in classes that link course instruction to engineering applications. Fundamentally, the application of knowledge to solve technical problems is an exercise which may stimulate students' motivation to learn. African American transfer students also report this as important. In the passage below, DeAndre discusses how connecting class assignments to engineering applications is motivational.

DeAndre [00:29:02] ... However, I think if you can apply what you learned in class outside of class. ... that would ... motivate me. For instance [in] this project...You have to think [outside of] the box. You have to come up with this ... extra light material that... [is] malleable. You have to come up with all these equations that you are already learning in class. You have to apply them. And it's really cool, I think.

Michael discusses the benefits of utilizing real world examples to understand the abstractions and complexities of mathematics.

[Michael] [0:24:20] They [are] very helpful because when we're dealing with ... especially math, it's usually just numbers on paper, and so it's very hard to visualize what that actually means. And so to have real world examples, that's very helpful. [For example,] you can find how fast a pool would fill up using derivatives or you can find the surface area of ... an ice-cream cone using like integrals... It´s like real world examples and they´re simple to understand too....

Julie discusses how a practical application of engineering analysis helped her to understand the concept of reliability. When asked if these applications are helpful, Julie responds as follows:

*[**Julie**][0:22:42] Yes very. Very, especially I'll give an example... we had to perform a fatigue analysis on [a component] to try to figure out when the part would fail after it's been used for so long. And that was showing an actual application that was hands-on experience with it. And that was great. Even the grading, treated it more like it'd be treated in a work place. Like, if you ask two people to work on something and one person has presented you something that's of better quality, then why would you not use that person to work. So, that was all even incorporated, and that was a great experience.*

Learning can occur in an environment where team-work is essential. For some African American transfer students, however, participating in team-work may be difficult as scheduling conflicts may occur. Several of the transfer students who participated in this research study maintained either a regular work schedule or had dependent children.

*[**Julie**][1:04:04] I think College of Engineering actually needs to take the time to figure out what activities can transfer students participate in that actually work well with their schedules and the different needs that they have from freshman students.*

Teaming experiences can provide the transfer student with a sense of accomplishment, a sense of confidence, and a belief in ones' self. They can embrace feeling and being a part of the larger community - the [University] family. As DeAndre expresses, "Let's do this battle together."

> *DeAndre [00:31:07] I think [team work is] cool. It makes me think beyond just me. It makes me be a part of a team ... and it makes me believe in myself, as well, you know. I can do this, it's possible.... Team building, and ... networking among students. Yes, so that ... keeps me very engaged.*

Formal Academic Support

Cromley et al. (2016) found that institutional support services, such as tutoring centers, facilitate student achievement. While math tutoring is often provided for lower-level math courses, many transfer students complete these courses at the community college. The concern for some engineering transfer students, however, is with the perceived insufficient support available for the upper level mathematics courses that they must take at this university.

One formal or structural approach the university provides for academic support is via the Math Center. The Math Center's hours of operations from 10:00 am to 6:00 pm appear such that students requiring assistance should be able to receive help. The center's operating hours, however, are curtailed for the upper level math courses. The hours of operation advertised on their website are "limited hours only". In the passage below, DeAndre expresses his desire for more tutoring dedicated to upper level math courses and expresses irritation with the inability to get the assistance needed at the Math Center. This is due to the number of tutors available and the limited number of days the Math Center is open for differential equations.

> *DeAndre [00:32:27] [Studying] outside of class [that] helps, but what would help more would be [to have] a differential... equation's specifically tutor, at the Math Tutoring Center. There's a couple of them and they're only open Monday and Wednesdays between, I [want to] say, noon and 1:00, something like that. They're only open for an hour, so two hours in [the] whole entire week. Your... homework is not worth two hours, your homework [is] worth like four [or] five hours. If I have, like, three, four hours of help that would be great. I mean, I'm not trying to*

go there and sit, one [on] one with the tutor all day long. But, it [would] be nice to ... be able to go there and sometimes, at that time that they're there, you can't make it. But you still need help regardless.

DeAndre also describes the frustration he feels when the help is unavailable. *It's terrible sometimes when you need help.*

A similar issue occurs with the instructors' office hours. In the passage below, Michael expresses frustration in the limited office hours that his instructors provide. These office hours are such that he is unable to visit with his instructors.

[Michael][1:07:11]... What I find a lot of times is that the office hours for my [professors] ... [they are] held during [the] afternoons ... from like 12:00 to 1:00, which is when I have like all my classes, I am usually like a 9:30 till like 3:00 where I just have like all my classes throughout the whole day. ... It [is] very hard to like schedule that time {to meet with my instructors}.

Informal Academic Support

Study groups and study sessions are types of informal academic support students often develop. For some engineering courses, instructors relate the act of fostering study groups to the experience with group work students will have when they begin their professional careers. This was the case for Julie. Her instructor encouraged students to form study groups.

*[**Julie**][0:35:57] I [would] say [for] some classes {instructors encourage} us to have group projects. In other [classes] even if they [are] individual assignments, [instructors] actually say, you should be talking to your peers. If you don't know how to do something, or you need help, that's what you're [going to] do in industry.*

DeAndre acknowledges that his first-year engineering course instructor promoted the idea of students developing study groups. DeAndre's experience of participating in a study group may have been a direct result of the instructor motivating students to do so.

DeAndre [01:11:29] I think one of the things the {first-year engineering course instructor} always talked about here is having like a study group ... And you know, that ... would help with ... studies. ... It [is] important at least for a student.

DeAndre also talked about study groups when he spoke of the support the National Society of Black Engineers (NSBE) provides.

> *DeAndre [01:14:01] … [NSBE has a study session]… I think that [is] one of the biggest support systems for African-Americans...*

Some African American transfer students' study groups are composed of racially and ethnically diverse groups of students. Of interest, these transfer students tend to have more experience academically and/or professionally than the other study participants and appear to understand the value of diverse relationships. These academic and professional experiences, as a result, may afford these transfer students an understanding of how to work with people who have dissimilar racial/ethnic identities.

In the excerpt below, Julie focuses on the positive social aspect of her study group by identifying the motivation, support, and strength that she draws from the group.

> *[**Julie**][0:40:32] I would say [the study group] had a great impact [on me] because it [is] other people going through the same thing and you all are motivated to push through and you're motivated about engineering, but you don't always feel like you can go on all the time and to be around people going through the same thing keeps me more motivated than I would be if I was doing everything by myself. And you feel less overwhelmed.*

Transfer students may experience the onset of anxiety and frustration when the homework for one engineering course may take hours to complete. Anxiety and frustration coupled with the lack of homework assistance may lead to a feeling of hopelessness. Michael believes that his lack of a study group to discuss homework assignments contributes to the stress he experiences in the CoE. *[Michael] [1:33:39] I guess if I had study groups the stress would be less because then I ... would [not] spend so much time trying to solve problems like on my own.*

Other African American transfer students in this study did not have regular study groups in which they participated. For these students, they generally studied with a few people. Jolene, however, recognizes the benefit that a study group could provide in preparation for future tests.

> *[Jolene] ¶571: P: I mostly study with a friend ... I am just like the person that studies in the library and everybody doesn't study there, so. ... I think ... I should study in a group with my tests coming up....*

Racial Diversity in CoE Classes

Minority students are characterized as experiencing feelings of isolation on campuses at PWI (Landry, 2002). Diversity may be key to some students avoiding the feeling of isolation in the classroom. Life experiences may help students to have a broader perspective of diversity. Exposure to other cultures may broaden their perspective of what diversity can be but in spite of students' experiences and perspectives, they may still not feel that they are well represented. They may still experience a sense of isolation in an environment perceived as diverse. This can be experienced when a student represents a subset of one of the smallest underrepresented minority groups in engineering.

DeAndre recognizes that the CoE is racially diverse but this diversity is also fragmented as there are only a few students with whom he can identify. When so few African American students enter the engineering discipline, feelings of isolation may remain unresolved throughout a student's academic career. DeAndre alludes to this dichotomy between having a sense of diversity and still feeling left out.

> *DeAndre [01:24:27] I think the College of Engineering is very diverse... I have friends from everywhere... [in my] study group alone [there are] like five different ethnicities or backgrounds. ... [but] sometimes you can feel [left out]. Um, especially when... 90% of your classmates are ... not African-American. You just got this 10%...*

DeAndre and Michael share different perspectives on diversity in the CoE. Whereas DeAndre recognizes diversity in the CoE, Michael perceives little diversity to exist. DeAndre's

perspective may be a consequence of him graduating from a high school in Africa. He has a broader definition of diversity and recognizes diversity in the engineering student body and in his study group. Michael, conversely, appears to focus on diversity as it pertains to his own identity. His perspective may represent a more US centric view of diversity and his own identity as an African American. Michael may view the CoE's diversity through this lens and recognize that the African American student population is less represented in the CoE relative to their representation in the US.

> *[Michael] [1:31:49] I feel like ... diversity is lacking. I don't know the actual percentages. But I do know that African Americans in general are like one of the smallest demographics on campus.*

DeAndre and Michael address diversity from the aspect of racial composition in the CoE environment. Julie, as the only female in this study who spoke about diversity, expresses a more personal and distinctive viewpoint. Tate & Linn (2005) indicate minority women feel isolation and/or detachment when they are excluded from study groups. Julie discusses feeling isolation even while participating in her study group in which she is the only minority student. Initially, she appears to subconsciously compare her previous institution to the CoE by responding, *[Julie] [1:40:42] "I have not had too many personal issues as a result of diversity at [this] university."* In a discussion of the study group, Julie recounts an internal dialogue that plays subconsciously as she interacts with non-minority students for the first time.

> *[**Julie**][0:38:06] I wouldn't say that I feel different at all. As with a lot of interactions I have, I kind of think in the back of my head when I'm first getting to know someone ... how is this [going to] go? Are we [going to] become friends and then [are you going to] say something that [is] just [going to] make things uncomfortable? Things like that. I have thought in the back of my head...*

Having Role Models

Inspiration for underrepresented minority students to succeed in the CoE may come from understanding the achievements of their predecessors who paved the way for students to successfully embrace and succeed in science and engineering today. Having role models and understanding their accomplishments may serve as the catalyst for some students to pattern their academic careers. DeAndre [00:38:33] expresses, "*It helps you try to do just as they did. Be better, you know."*

Because some students may feel isolated, it may be more important to show role models. Knowing that others have succeeded, encourages these students to persist. This knowledge of their predecessors may create an inclusive atmosphere for some underrepresented students who otherwise might feel isolated and detached from the student body. Students' knowledge of their predecessor's contributions may further serve as the foundation upon which a sure footing is established for students to persist in their engineering curriculum. Julie supports inclusion of the achievements of underrepresented minorities across racial/ethnic groups as a reflection of the diversity of ethnicities in the CoE.

> *[**Julie**][0:31:19] ...because [the CoE has] a diverse student body to tailor to. And I think it's very important for that diverse student body to see what is achieved by people like them.*

When asked what impact would discussions of the contributions of different racial ethnic groups of scientists and engineers have on him, DeAndre asserts that knowledge of their accomplishments would serve as role models for him to emulate.

> *DeAndre [00:38:05] ..., you know, have role models, I guess, you know, like he did it I can do it too...*

Michael also believes that having knowledge of successful African American scientists and engineers would provide a level of comfort.

[Michael] [0:40:36] ... it's just like another level of like reassurance. In the sense that you see people who look like you, and who might even come from like the same background as you.

In the excerpt below, Michael is clearly interested in having instructors from minority groups with whom he can identify.

[Michael] [0:34:15] And so I´m seeing him up there ... give his lectures and ... seeing how he knows what he's talking about is very, ... motivating in the sense that... it [is] another person [from] a minority group. ...

Engagement with Faculty

CoE students may often need to solicit assistance from faculty. To do this, students have been proactive to build these relationships. Some of these relationships are related to academics and office hours and some are related to research. When students lack the confidence to initiate these relationships, they may have difficulty establishing meaningful relationships with faculty and can suffer academically. However, students in this study appeared to be at ease establishing faculty-student relationships. They seem to understand the importance of this aspect of social capital and vigorously pursued developing relationships with faculty.

Opportunities for Students to Initiate Conversations with Faculty

Transfer students may be accustomed to smaller class sizes at their community college. Communication in the CoE may be stifled in classes with large numbers of students. This perceived inability to talk to or meet with the instructor can be viewed as an obstacle to the transfer students' success. In comparison to the university environment, interactions with professors at the community colleges were facilitated because of the small class sizes. To ease communications, engineering professors permitted students to contact them directly via email. Professors were then able to respond to the students' queries without the students having to schedule office visits. This

method of communication is breaking down a perceived barrier to the transfer students' success in engineering.

> *DeAndre [00:17:14] So, as a [community college] transfer student [talking to my instructors was] something I was used to, and so transitioning into here and being able to still communicate with my professors, and stuff, that helps a lot. And plus the idea that the class is big and I cannot get a one on one with the professor. {Being able to email my professor} kind of, brought that [lack of communication] barrier down.*

Samuel demonstrates that he understood the importance that faculty-student relationships can have to his future career.

> *[Samuel] 354: I try and stop by there [instructor's office] as much as I can so she'll know my face so that when I need a letter of recommendation, she'll know enough about me to know that Samuel is serious about grad school and wants to be a good student. And I'm trying to work on that same relationship with my professors.*

Students with strong connections to faculty gain advantages. Faculty provide recruitment, industry network linkages, and help students improve study methods. Faculty also provide advice, support, and advocate on behalf of the CoE student to support their success in engineering.

> *DeAndre [00:48:18] Yeah, they're very helpful. Yeah, helped me with my studies. Help me, not just even in class but I could say getting contacts in the industry also helps. [The professor] has a few recruiter friends that he has, [and he] provided me a few email addresses,*

Matthew's experience with his engineering faculty reflect the continued support they provide.

> *[Matthew] ¶655: P….there have been plenty of times I would go to his office [engineering professor] and he would explain something to me. He's like, "Well, do you understand?" ...But I don't know, it just seemed something about him where I could say, "No, I don't understand. Please continue to you know help me." And that seems like that's been the vibe with all the [professors] I've had. Like, if I have questions, they'll do all they can to help me out.*

Julie perceived a difference in the level of support faculty provided after she was admitted into the CoE program. She describes taking courses as a non-engineering major but still in the CoE, where her interactions with faculty were pleasant but not necessarily inclusive. After she was officially admitted into the CoE, she perceived faculty to be more invested in her success.

> *[**Julie**][1:37:47]... Even when I was taking lower division engineering courses that I could get into without being an engineering major. It's like I was in those courses and interacting with the faculty and College of Engineering, and they were still pleasant interactions. But, I did not really feel, and was not made to feel a part of engineering, even though I was participating in engineering activities, and in the courses. And it wasn't really until officially "Julie's admitted to College of Engineering" did that start to happen, even though I was already participating in things happening in engineering.*

Engineering Faculty as Motivator

Bensimon (2007) underscored the unique position that faculty have to influence minority students' success. Students in this study corroborate Bensimon's finding that faculty who engage with students beyond the classroom can motivate student interest in and passion to pursue engineering. In the passage below, DeAndre expresses satisfaction with having the opportunity to freely speak with his instructors either outside of the classroom environment or via email.

> *DeAndre [00:26:51] I think {meeting with the instructor} outside of classroom, like I did. [Just] talking to him one on one, that helped...to motivate me, just the ability to talk to him on [a] one on one basis.... helped {to motivate} me because as opposed to feeling like I need to drop this class [when I made a poor grade on a test. … now, I can email [the instructor] anytime, which is pretty awesome. He's very good at like responding.*

Julie discusses the motivation that ensued after perceiving that her instructors actually had an interest in her success and achievement. Julie's passion for engineering is further kindled when she can sense the instructor's passion for teaching, interest in their students, and willingness to provide relevant homework assignments.

> *[**Julie**][0:15:33] [Discussions with faculty] motivated me because someone actually wanted ...to also make sure that I'm satisfied with what I'm achieving. I would say that having engineering faculty, who are investing in their students and*

> *they pay attention to each individual is very helpful.... Having faculty that are actually motivated by what they do. And they are ... clearly there to motivate the people that they're teaching. ... It motivates me because I'm very motivated and very much love engineering, but to see other people's passion really motivates me, it puts me on a mood to work...*

Michael desires that instructors share their experiences as college students in engineering. This is to allow current students to understand that the feelings they may be experiencing are not unique to them and to show the students that the instructors can identify with them and their current situation in a specific engineering course.

> *[Michael] [0:34:15] And I think having just another level of reassurance from the faculty that like, maybe hearing like their stories of how they were in college would be helpful because then that would give the students a perspective of like, wow I'm not always perfect but like so is like my [professor]. Like my [professor] didn't do all the things that they're necessarily telling me to do. But like they did do enough which is how they got here in the first place.*

Role of Faculty Research

Some African American transfer students expressed an understanding that the research their faculty conduct can provide students insight into new technical concepts. Faculty research can play an important role in enhancing the students' own understanding and learning about their disciplines. These students realize that this research can also influence their future as it aligns to their interests. They do not hesitate to approach faculty to learn more about their academic research. In the passage below, Michael shares his sentiments regarding a discussion with his professors about a topic of interest to him.

> *[Michael][1:06:49] I talked to a few of my professors [about] what they are researching in terms of [the technology] cause I think that's like a pretty cool concept. And so I'd like to see what they think about it.*

Students also report how conducting research with faculty teaches them concepts that are not generally learned in the class environment. Julie describes how the research she is doing with faculty not only equips her with valuable skills but also prepares her for graduate school.

> *[**Julie**][1:06:36] I'd say my research opportunities for going on three years now, I have done research with a professor in [discipline specific] engineering department.... I learned a lot that I would not have learned in class. And I think that it prepared me more for graduate school.*

The faculty-student research experience to which students may aspire is important to African American transfer students. When faculty and students are appropriately matched, this mentor-mentee relationship may be perceived as quite rewarding. When properly facilitated, faculty led research presents an opportunity for students to not only see a different dimension of their faculty but to also understand the far reaching impacts of the institution. Julie's case presents evidence of the importance of providing engineering transfer students with professional growth and development opportunities and matching the faculty with the student.

> *[**Julie**][1:09:04] I mostly got this opportunity and it was a benefit to me in the way that it was because the professor is actually dedicated to teaching students and improving his students... I did not realize that students even participate in research opportunities that connect them with institutions like NASA, and national and international companies.*

Research skills may be underutilized and unrealized with students who are unprepared academically or who are too early in their curriculum to have the academic skills for what a project needs. Consideration of the students' skills may serve to prevent instances of faculty-student mismatch. Samuel's comments are reflective of this misalignment between what his faculty offered and what he gained in his faculty-student research experience.

[Samuel] 528: I've had two undergraduate research experiences so far. One was in simulation. The learning curve of that one, being my sophomore year, the learning curve was so steep I could barely tell you what it was about or if I liked it or not.

Peer and Social Networks Amongst African American Students

Peer networks provide students with systems of support. For African American men, Sinanan (2012) found that their social adjustment can be attributed to relationships with other African American students. In this study, African American students are the supportive structures that provide other African American students encouragement. These relationships also provide a means by which students are enabled to hold one another accountable. This is to ensure that each student is doing that which is necessary to successfully complete the engineering courses. In the passage below, Matthew discusses his experience with fellow African American students and the implicit understanding that each holds the other accountable.

> *[Matthew] ¶241: P: ...Subconsciously we [are] kind of you know hanging out together, like "Hey, did you do this?" "No.' "You know we've got to get through this together, you know." Although it wasn't ever stated out loud to one another, I think that kind of was the consensus [among us].*

In an engineering learning environment, Stump et al. (2011) attest to the importance of peer-to-peer interactions via collaboration with increasing students' performance. Samuel discusses the experience he has with a friend who provides him encouragement and he likewise does the same.

> *[Samuel] 396: There's actually a guy that I went to high school with, in the same major. ... We traditionally have encouraged each other through the years.*

Peer networks of students who share the African American identity provide an inner circle of students who understand the shared issues they may encounter at a predominantly white institution. Julie describes the support she gets from such peer networks.

> *[**Julie**][1:39:45] I would say as an African American student, when you interact with other African American students you just feel like you really understand what each other is going through, and you understand each other, and you support each other. You just understand.*

African American women often express feeling isolated in predominately white institutions (MacPhee et al., 2013). Social networks which allow African American women to have a sense of community may mitigate these feelings of isolation. In the passage below, Jolene discusses her experience with developing social networks. A sense of community results from both knowing people who were friends of a family member and having a small group of people with whom she has developed relationships.

> *[Jolene]:* 447: P: *And mostly like my sister's friends that are still like in grad school here. …* ¶*449: P So with them and then the few people that I know, I think I've found a good community.*

Michael has no family members with prior affiliations to this university. Unlike Jolene, Michael's experience with establishing community is one of trial and error. He seeks out relationships with people who share common interests.

> *[Michael][1:30:14] Community. ... I just try to make friends. Like in the general sense, I try to find people that like [want to] hang out and study together, and then [go] from there. If they [want to] hang out outside [of] school, then we just hang out.*

Samuel's experience with community is having a place where he can go without needing a reason for being there. The Multicultural Engineering Program is the place he feels comfort and community.

> *[Samuel] 170: Definitely the Multicultural Engineering Program. …Yes, it's been great as far ... a place... So it's like a place where you come in and everybody knows you....And you can sit and don't have to have a reason to be there. You don't have to schedule an appointment, you can just go talk to the director of the program... It's just really a place, you can say, "Hey I want to do something this summer. Can you find something for me to do?"... So it was basically the community feel that made it work.*

Extra-Curricular Activities

Students reflect positively on their involvement and experiences in extra-curricular activities. However, the value taken from these activities is very individualized. In the excerpt below, DeAndre describes how extracurricular activities provide a diversion from the routine of daily school work while discussing his involvement with a technical student organization.

> *DeAndre [00:10:54] ... [It] helped me a lot. Now I can at least focus on just not school, I have a life outside of school. Well, it's not really a life outside of school. ... But it's outside of the class.*

Students also report that extra-curricular activities help them to better understand their engineering disciplines by observing the applications used throughout industry and the underlying mechanics of these tools. Michael describes how participation in a [school event] supplements his in-classroom learning.

> *[Michael] [0:59:28]... [It] showed me a lot in like [getting] me familiar with like different tools that are out there for {professionals}. And like, just like seeing different ways of how to do like certain mechanics in {the profession}.*

Julie describes how extra-curricular activities allow her the opportunity to creatively explore her aspiration to unify and merge potentially disparate career fields into one.

> *[**Julie**][0:45:59] [Involvement in this organization] was an interest in creating things and being more focused on technology and engineering. I still have more of an interest in creating new technology. So it kind of just brought together all my interests and enabled me to actually pursue what I wanted to do and combine like building things with technology.*

Financial Issues

For some minority students, the biggest challenge to obtaining a college degree may be their inability to obtain financial resources (Palmer et al., 2009). Lack of financial support may also reduce retention of some African American students in STEM programs (Estrada et al., 2016). However, the students in this study did not appear to be burdened with unmet financial needs. They

described the different ways in which they were able to offset their financial responsibilities. DeAndre described having experience as a prior military service-member, which affords him access to federal resources for college expenses. Multiple students described working, scholarships, and federal financial aid.

Samuel represents a unique case with respect to financial support. His secondary education, as a graduate from a STEM preparatory high school, appeared to sufficiently prepare him for college such that he was able to obtain scholarships to off-set the cost of his post-secondary education.

> ***[Samuel]*** *Like, I don't have any student loans. I'm working very, very hard to not accumulate any at least through my undergrad while I continue school. So that means on top of keeping my GPA up and going the extra [distance] and giving tours for the [institutional] program which I'm getting more of a scholarship than an hourly wage, I got to do all my community services hours to keep some other scholarships. There [are] all [of] these things [that] I [have] to do {to keep my scholarship}.*

It is important for administrators to be mindful of the financial burdens placed upon students who struggle to secure financial support. These burdens may accrue as students pay the tuition and fees associated with college attendance. In particular, the fee structure for engineering courses may differ from the fees associated with the non-engineering courses. In the passage below, Michael expressed concerns about the fees in the various colleges. He was surprised to learn of the differences in fee structure within the same institution when transferring from College A to the CoE.

> *[Michael] [0:12:02] I was a little surprised, this might just be from my lack of understanding, [of] how the fees are different in [College A] in terms [of] like the fees [in] engineering … So engineering has ... a lot more fees because they have ... a lot more facilities. And if you're in a lab for engineering, that [is] also a fee that [is] tacked on to it.*

Students who are learning to manage money may require instruction on fiscal responsibility and how to plan to pay for college. McNeal (2016) reports that some universities have established financial advisors to assist students. In the passage below, Matthew discusses his experience with the feverish pace at which college debt can accumulate and its consequences.

> *[Matthew] ¶371: P: Uh, of course finances, especially after that freshman year, because you're staying in the dorms and that really accumulates, and I remember I couldn't enroll in my sophomore year classes because I still had a balance and then it went to collections and then it was just like, "Oh!" It was just, like, really hectic.*

When asked about the type of stress he has experienced while in college, Michael discusses his experiences worrying about his finances. He also addresses the potential consequence of having finances continuously at the fore front of his mind.

> *[Michael][1:34:00]...Financially, this isn't limited just to the College of Engineering, but like to [the] university as a whole. ... If you stop worrying about how you [are going to] pay for college, that's always like something that's in the back of your mind. ... it sort of detracts from like if you're trying to study.*

Careers

Internships are one avenue that students can use to prepare for their careers and work-force readiness. Some African American transfer students report that internships are widely promoted in the CoE. Matthew reports receiving emails about internships and exploring those opportunities on the Career Services website. He also reports having experienced multiple internships with his first one being as early as his freshman year in college.

> *[Matthew] ¶629: P: That [internship] was my third one. I had one right out of my freshman year…. Just got an email … I was on Career Services [website]… through Career Fair.*

However, students may need to be made aware that you can pursue an internship at any point during your academic career. Michael believed that one generally pursued an internship during their junior year in college.

> *[Michael] [1:10:06] I feel like I'm just like overall in like a weird position in terms of like trying to get internships. I know it is possible for sophomores to get internships in [discipline specific field], though it has been like pretty difficult. But this is the only time I started though... Because ..., I was under the impression that you usually do internships in like your junior year. But since like I am a junior, I figure... I might as well go ahead and try...*

DeAndre indicates that the instructor in the first-year engineering course was instrumental in apprising transfer students of career-related opportunities. Students may be unaware of these opportunities, however, if they are absent on a day when these discussions are held.

> *DeAndre [00:52:27] ... They [are] promoted a lot ... first-year engineering course ... They give you a lot of opportunities to uh, get involved in different co-ops, internships, and ... research opportunities here on campus.... one of the classes they have, alumni come speak to us about what they did as transfer students [in this university] going through the same process we're going through... [But] if you were an engineering student and you, say miss that particular class, you still will not know.*

Internships appear to be inextricably interwoven with Career Services as students acknowledge the role of career fairs in securing internships. Michael believes that leading up to the actual event these activities are heavily promoted but if students do not attend they are unable to learn of future internship opportunities.

> *[Michael][1:03:38]... I feel like [internships are] promoted in ...these big runs. So like ... a week or two [before] the career fair... it's promoted a lot... But then once the career fair is over, I think a lot of those opportunities, if you didn't go to the career fair, you would miss out on these opportunities and there is no way to like find out about those opportunities.*

Many of the students in this study reported knowing that there were internship opportunities available. DeAndre believes there is an email distributed regularly to CoE students. *DeAndre [00:48:36]... I think [CoE] email[s] ... a newsletter every Monday as well.* Michael also talks about using a software application to learn of these opportunities. *[Michael][1:04:40] I think [internships are] promoted decently well in terms of the career fair because they developed an app recently.*

Some of these students, however, perceive the promotional activities for professional opportunities (e.g., internships, research, co-ops, etc.) as lackluster. While students in this study identified how they believe the process works, this resulted in students acknowledging multiple venues from which the institution provides awareness of these activities. Students appear to have no comprehensive perspective on how information on professional opportunities is communicated to them. Lack of clarity on the method that professional opportunities are communicated is evident in DeAndre's response. DeAndre believes an awareness of these activities is based upon the student's presence on the day discussions occur in the first-year engineering course.

> *DeAndre [00:54:24] I don't think, they're being promoted enough. Because ... for someone who is not in the first-year engineering course [they] would never know.*

Other students believe there is still opportunity to do more to make sure everybody understands these internship opportunities exists. Julie believes that even with an awareness of the internship opportunities, for some students, this is not a sufficient motivator for them to take action. She believes this inaction is due more to the students' perception of lacking the preparation or the pre-requisites for their applications to Career Services' internship opportunities.

> *[**Julie**][1:18:26] I do see opportunities to prepare for say career fairs and other professional things. [But]I still feel like not enough students ... feel prepared for*

[internships, co-ops, research opportunities], or feel like they're available for them to actually apply for. ...

African American Transfer Students' Strategies for Engineering Success

The multiple strategies that African American transfer students use for success in engineering are as diverse as the composition of this transfer community. These strategies are woven together by a common interlocking fiber, reflected in DeAndre's comment, *"confidence is not gonna get me to be an engineer, but hard work will."* While the work of an engineering student requires discipline and fortitude, the strategies African American transfer students use to succeed fall into three main areas. These areas are student focused: self-direction, psychological adaptation, and actualization.

Self-direction in this study is one's intuitive ability to de-conflict external forces which could hinder their ability to progress. Students' recognize the importance of initiative, or being self-directed, to achieving success in engineering. In the excerpt below, Samuel recognizes what is needed and then takes action. He discusses the need for students to manage their time.

[Samuel] 118: I've understood how to do my Engineering course work. I've understood what work ethic is required, how much time, how much studying. ... I know I'm going to need a lot more time...

Matthew addresses being over committed and reducing involvement in the number of extra-curricular activities. He also discusses the need for self-direction through his advice about time management. He enacts the understanding of the need for time. *[Matthew]* ¶*615: P: This year I've really calmed down on my involvement.*

Julie discusses the role of self-direction in her progression through the engineering curriculum. She recognizes what she needs to do and then she puts in the action to do it.

*[**Julie**][1:42:32] You just have to... do the hard work ... So, I just had to calm down, figure out how to best approach everything, figure out what should be [started] first, what can I hold off on starting, and then everything was fine.*

The ability to direct oneself and the preference to take initiative may play equal roles in student success so too could one's mental health. Psychological adaptation in the context of this study is one's ability to confront emotional and mental obstacles at the onset of these obstacles and redirect one's course of action without succumbing to the pressure they exert. Matthew expresses psychological adaptation when he compares attending a predominately African American high school to attending a predominately white institution. He initially felt uncomfortable as an African American in the CoE environment.

[Matthew] ¶180: P... But then … you just get out there and make good friends ... get out of your comfort zone. That's basically….what you do.

Some African American transfer students question their identity as engineering students which is counterproductive to their success in engineering. These thoughts if not controlled may undermine the students' ability to assimilate into the academic environment, to focus on the curriculum, and also to maintain a healthy mindset. Julie discusses her understanding of how racial identity critically influences the college success of some students.

*[**Julie**][1:47:48] I'm just thinking of knowing that there are a lot of African American students who reach the point of getting into college, and they don't necessarily finish. .... And it is, directly attributed to their experiences as African Americans trying to get to college and get through college. ... Your personal experiences, if you had any issues or anything that are related to your racial identity or your appearance when you transfer to a new school. And that can have a huge impact on someone staying in college, and if they actually finish.*

Matthew and Michael are also extremely conscious of their racial identity and the underrepresentation of African American students in the engineering programs at this university.

[Matthew] ¶180: P… For four years [in high school] you're basically around people who look like you, you know. So then you come into this situation [CoE] where it's like, "Okay, I'm the odd one out."

[Michael] [1:27:28]... you don't see many other people like myself.

In the passage below, Michael discusses the change in his level of confidence to complete his degree as an African American student and how uncontrolled thoughts may lead to him questioning his ability to succeed in the program. He, therefore, purposefully strives to be cognizant of his mental state and elects to curtail those thoughts which run contrary to his goal to complete the engineering degree.

> *[Michael] [1:27:28]... I tell myself [that I have] got to know [that] I can do it. But then ... I always think, I look around and [wonder] where does everybody else sit? If they {other African American students} can't do it, maybe I can't do it [either]. I don't think that [way] too much ...I make a mental note [to] myself to make sure I don't think like that. ... But it definitely does like come into play when ... I walk into the class. And then there's ... no one else who looks like me.*

Actualization is the third strategy that African American transfer students' employ to achieve success in engineering. It manifests as a level of maturity for students who seek assistance and are transparent about their understanding of academic materials. Samuel's comments are an indication of this actualization.

> *[Samuel] 556: ... it was hard for me to ask for help. ...And so one thing that I would get stuck on it's not that I did [not] want to ask for help, but I would be so lost in the class or I waited so long, I would feel kind of rude asking someone to help me when I knew nothing about what was going on. They were going to be kind of like, "Okay, well let's start. Well, what's the first step?" "I don't know." "Well, what's this?" I [have] no idea. So I didn't want to go to [the] professors during [their] office hours, and say "I'm completely confused." ... but now I'm, like, I ... know how to avoid that from happening, but if I'm doing badly in class, I'd better do something or go find somebody who I can be honest with and say, "This is where I'm at. What can we do?"*

DeAndre uses actualization as he explains how one instructor equipped him with the tools to be successful in the professor's course.

> *DeAndre [00:13:19] [The professor] told me better ways to study. What I should be focused on. ... I learned better where to look for stuff, how to study for stuff...*

CHAPTER 5: SUMMARY OF RESULTS

The institutional support system which African American transfer students request can be configured into multiple categories. They include career advising, social supports, transfer logistics, finances, and role models. Of interest, some transfer students describe being unaware of the career advising services the CoE currently offers given the request for this service. Some local students also appear to be unaware of the career-related or internship opportunities available to them. Even with an awareness of these opportunities, Julie is concerned that for some students, this is not a sufficient motivator for them to take action. She believes this inaction is due more to the students' perception of lacking the preparation or the pre-requisites for their applications to Career Services' internship opportunities.

In addition to students' reluctance to pursue internship opportunities, these transfer students also appear to have some ambiguity about how to access the information. This is evident as students' ambivalence is pervasive throughout the discussion on internships and professional opportunities. At this university, however, internships are quite often coordinated via Career Services. Some students in this study express an awareness of the opportunities for internships offered through this venue. Julie's knowledge of the role of Career Services may have been predicated on the knowledge gained during the three years she attended the prior university. This could explain her familiarity with the professional services offered at this, her current, university. Familiarity with university environments would enable Julie to understand the process to access internship opportunities. Other students were unaware of Career Services' role and its software application available to assist students with learning of internship opportunities. Only one African American transfer student who participated in this research study acknowledged using Career Services' software application.

In addition to career advising, multiple African American engineering students, in this study, express concern with the lack of social supports, or the availability of structured opportunities to develop relationships with other African American engineering students. Michael expresses concern with the lack of community amongst African American engineering students and desires a venue for students to come together to get to know and support one another. For African American transfer students, building relationships can be difficult because as underrepresented racial minorities in the CoE, they may feel isolated and alone. Isolation is a common experience for many minority college students, Landry (2002). The African American engineering population at this predominately white institution is small. Students are spread across multiple engineering disciplines. This then limits their academic and/or social interactions. With few opportunities for African American engineering students to interact with other African American engineering students, they may experience a lack of community amongst their peers. This may be the crux of why students in this study request structured opportunities to socialize and to build these relationships.

As transfer students, the African American engineers require resources to enable successful transition into the CoE. These resources, or transfer logistics, are the processes where the CoE provides transfer students information and knowledge to facilitate their transition. In this research, students report not having knowledge of transfer logistics, such as the engineering degree flow sheets and the CoE's website. DeAndre believes that for community college transfer students, receiving these materials, (i.e., the engineering degree flow sheets) would equip them to be more proactive and less reactive. He believes that potential transfer students will then be better situated to make decisions which impact their futures. Lack of this information can result in the student making mistakes, such as taking classes that do not transfer into the CoE.

While several students discussed the need for transfer logistics support, multiple students also addressed financial concerns. Collectively, there was no consensus on the need for additional financial resources to pay for college expenses. Each student, however, had a uniquely different perspective on finances. For some students, credit cards are a mechanism to help absorb college and living expenses when they lack other resources. The ability to manage credit via credit cards was a major concern. Students also expressed concern with the dissimilar selection of textbooks and free online e-books by professors who taught the same course. Students perceived instructors lacked concern for the students' out-of-pocket costs to purchase these textbooks. The exorbitant costs for some textbooks could place undue hardships on students with limited financial means. This could set in motion a spiral of personal debt which could also result in students dropping out of the engineering program.

Students' success in engineering is dependent upon many things. Finances may be a major barrier to the success of some engineering students. Lack of social supports may be another barrier to engineering success. Students also talked about the lack of diversity education. As defined in this study, diversity education is the structured, programmatic initiatives that teach students respect of ethnic/racial diversity and tolerance of others' ideas, opinions, and personhood. Both Julie and Michael have a different stance and proposition for diversity initiatives. Julie expresses a concern that the CoE has no programs which address uniting the student body through the various facets of diversity. Michael's perspective extends to having role models. He and other students in this study acknowledge being motivated to excel in their engineering disciplines when they can see other African American professionals in their work environment or on a professional basis. Michael relates an instance of watching a YouTube video of an instructor teaching an advanced STEM class. When the camera panned over the

instructor, Michael was surprised to see someone who resembled him and with whom he could identify, an African American male.

5.1 Limitations of the Study

Two of the primary limitations to this study are the emphasis on a single race/ethnicity and the focus on one discipline. The concentration on the African American population is to the exclusion of the Hispanic and Native American students which are also underrepresented in engineering disciplines. I have chosen not to research those two populations as I can only focus on one of the racial/ethnic groups for this study. If we look more broadly to STEM, we see that the same underrepresentation occurs across STEM and not just in engineering. However, a third limitation to this study is the inability to stratify by gender. This self-imposed constraint is due to the small number of African American engineering transfer students.

5.2 Recommendations for Further Research

My work and educational experiences cannot overshadow the importance and relevance I believe the immigrant and international community have been on my perspective. Researchers who conduct similar studies should consider investigating these populations. In a sentence, the plight of the minority population has opened my eyes to the current political climate and upheaval at play in America. Without the immigrant and international communities' respective contributions, the words Emma Lazarus penned and immortally engraved onto the Statue of Liberty welcoming all people into the United States would represent a bygone era. This is not the domestic tranquility alluded to in the preamble to America's constitution. The synergies of immigrants and international students within the US educational systems enhance the academic, personal growth, and culture of wealth for all students. Originating in America's colleges and

universities, these interactions have had and will continue to have a positive impact on the establishment and prolongation of this United States democracy.

These interactions are particularly critical to our under-represented populations who may lack the socio-economic status to have the experiences that bring them into contact with global perspectives. Collectively, each population adds to diversity of ideas, intellectual pursuits, workforce skills, and community. America's institutions are at the forefront and leading edge of providing innocuous places for creative activity and expression, exploration of ideas, and meritorious instruction to occur. Academic instructors facilitate collaboration among people with dissimilar backgrounds, experiences, and opinions. These unique experiences build an inclusive culture and add to the fabric of society.

As I think broadly about this research, I understand the limitations in this study are the narrow focus on a single population of native born students. In the future, my plan is to expand the study population to begin to look at other underrepresented populations, as well as the growing number of international students and how they thrive in American colleges and universities.

CHAPTER 6: RECOMMENDATIONS

This research sought to understand the experiences of African American engineering transfer students in the College of Engineering and the institutional factors students attribute to their academic success. While there are multiple recommendations that I will make from this study, it is unclear how many of these are unique to African American students and it seems that most of the recommendations are more broadly beneficial. As purported in The Art of Student Retention, Swail (2004) reports student success is an outgrowth of an institution's ability to provide appropriate academic and social support to students during their college years. These supports form the basic foundation upon which student success is structured.

In the following sections, I will use Swail et al. (2003) Geometric Model of Student Persistence and Achievement (i.e., Geometric Model) to provide supporting evidence to substantiate and extend the model relative to African American community college engineering transfer students. The Geometric Model categorizes the student's experience into three constructs: Social, Cognitive, and Institutional factors. The social factor addresses the relational aspects of the student's experiences, such as family and peer influence, social coping skills, social lifestyle, etc. The cognitive factor addresses the performance and learning attributes affecting a student's academic ability, such as the student's aptitude, quality of learning, study skills, time management, etc. This research study is anchored in the institutional factors which Swail et al. (2003) attribute to student success.

Institutional factors are comprised of five critical components. They include Recruitment and Admissions, Academic Services, Students Services, Financial Aid, as well as Curriculum and Instruction. This research uses the student's stories to provide supporting evidence to substantiate each of these critical components or extend the model relative to African American

community college engineering transfer students. Recommendations are based on the concerns and challenges as voiced by community college engineering transfer students in this study. These recommendations can then be considered for implementation by the CoE.

Recruitment and Admissions. Student identification is an important component for recruitment and admissions in the Geometric Model. Unlike the formative stage of identity development, in Swail's research, the term *student identification* is synonymous with the phrase *finding prospects*. Within student identification, Swail et al. (2003) emphasizes collaborating with secondary schools to identify prospective students; monitoring students' participation in pre-college programs; developing recruitment teams which include work-study students and education majors; and using alumni associations to identify prospective recruits. Although Swail et al. (2003) describe student identification as it relates to pre-college applicants or high school students, this research addresses how to identify prospective African American community college students as potential engineering prospects. African American students in this study expressed feeling isolated in the CoE due to its lack of racial/ethnic diversity. This research extends Swail's discussion of student identification at secondary institutions to encompass recruiting African American students at community colleges.

Anderson-Rowland (2013) suggests that exploration into the inclination of community college students to transfer to a 4-year institution is perhaps important and relevant to 4-year colleges and universities. As such, understanding when students made this determination to transfer (i.e., in middle or high school, between high school and community college, while at community college, etc.) is essential. She found that 36% of the students decided to attend 4-year colleges and universities while they were attending the community college. This is up from 21% in 2010. Implications may be that 2- year schools are encouraging more students to strive for the

Bachelor's degree and 4-year institutions are conducting greater outreach efforts at community colleges. Further research is needed to understand African American students' motivation for attending community colleges, which is outside the scope of this research.

Before any student can be recruited into an engineering degree program, they first must be exposed to or have an interest in or knowledge of engineering. That is not a different finding for African American community college students. This research found a seemingly untapped opportunity to expand recruitment efforts is at community colleges. In DeAndre's experience at the community college, he was unaware of recruitment efforts. *[DeAndre] [00:02:46] ...finding ...someone from the College of Engineering, is very rare. I've never seen one. And I think if they had someone [at the community college] to help out directly, that [would] greatly help*. DeAndre recognized the opportunity for the CoE to introduce its programs and initiate recruitment efforts at community colleges. Swail (2004) discusses using alumni clubs and college students as cost-effective ways to serve in the capacity as high school recruiters. These are the college students on staff, or in work-study programs, or in graduate assistantship programs. As an extension of that idea, the CoE should utilize its African American engineering community college transfer students who are members of the Transfer Student Association (TSA). They can serve in the capacity as recruiters for 2-year academic institutions and conduct transfer discussions with students in community college classes.

In this study, evidence indicates that it is impactful to show students that completing an engineering degree can be accomplished. Michael suggests students need firsthand accounts of their peer's experiences in engineering and an awareness of the rewards of having an engineering career. *[Michael] [0:04:50]... I think showing students that it's not as hard as it may seem and also how rewarding it is. ...* Additionally, Michael acknowledges that it is also important to talk

to students about the respect the profession commands. *[Michael] [0:04:50]..... there [is] a lot of respect in the field. ... When you say you're an engineer, people look at you like, wow you must be really smart.* From an institutional perspective, the message recruiters and the TSA must convey is that it is possible, you can do this.

It is standard practice and generally known that recruiting is most effective when it is conducted in person. However, potential budgetary constraints, resource limitations, and personnel fatigue can make face-to-face interactions infeasible and impractical. To enhance recruitment efforts across a broad network, institutions can adapt Swail's recommendation for recruiting at high schools. In the Geometric Model, Swail et al. (2003) discuss collaborating with secondary schools to identify prospective students. For students enrolled in pre-college programs, Swail et al. (2003) recommend to monitor their participation. The CoE can adapt Swail's recommendation by working with the TSA to collaborate with community colleges to identify potential engineering students. This could be through specific course enrollment and/or through academic advising, while working with the transfer student association. Once those students are identified, their academic progress can be monitored. These students can then be placed on a path to attend the institution.

For situations where students are not identified as prospects or staff resources are limited, recruitment efforts can be extended through digital messaging. This can be done through active and passive marketing campaigns. Using existing technological solutions, the CoE can implement active marketing campaigns that feed users information by using search engine optimization protocols and online advertising as well as social media marketing, such as Instagram, YouTube, etc. The CoE can implement a passive marketing campaign for users who are seeking more information by enhancing its online presence to develop a choreographed and

well-designed digital presence. A potentially more effective technique is use artificial intelligence (AI) to develop a customized digital experience for community college students, discover their academic needs, and redirect them appropriately.

The CoE can also extend recruitment efforts by developing a transfer site. This is an experiential mechanism to provide support to students prior to and during the transfer process. Michael suggests the CoE can increase African American transfer student enrollment in engineering by helping community college students to understand the transition process into CoE. *[Michael] [0:08:40]...like showing them what the process looks like.* Using a digital presence to facilitate the transfer process, the CoE can have peer testimonies on that site talking about how the process was for them and the key points to which a transfer student needs to be aware and to pay attention. The CoE can have African American engineering students in the TSA to share their stories. As Michael suggests, they will provide firsthand accounts of what the transfer process was like for them, the resources they used, the departments they visited, the financial packages they received, etc. *[Michael] [0:04:50] ... bringing students that are already in the field to ... discuss how their [experiences have] been and ... their transition.* This online presence accomplishes more efficiently this idea of bringing students together and could improve communications between the CoE and community college students.

For students interested in engineering but unsure of what branch to pursue, the CoE can provide a personalized assistant that leverages AI to help the individual. The assistant will provide an interest and skills inventory assessment to direct potential transfer students to the appropriate personnel to provide academic and professional career counseling support. This assistant will begin to facilitate the transfer process by responding to frequently asked questions and directing students to personnel who can provide further assistance. For students unsure of

which courses to take, the assistant will provide an opportunity for students to input their unofficial transcript of the courses they have taken and grades they have received at their current institution. They can then take an online assessment to determine in which course, among a sequence of courses, they are academically prepared to enroll. Students' transcripts will also be automatically evaluated to determine the courses they will need to take and the prerequisites for those courses. Additionally, the personal assistant will assess the student's selection of courses to evaluate their selection in comparison to the demands generally associated with the courses and advise students of the amount of time studying that students have historically needed to excel in these courses. For each of the recommended courses, a cost estimate is compiled that provides in-state and out-of-state students the tuition costs, fees, miscellaneous costs associated with each course, and a total cost for the semester. Based upon the information the student provides, the assistant will also make recommendations for scholarships, grants, and work-study opportunities that may be of interest to the student.

Academic Services. In Swail's Geometric Model, academic advising, supplementary instruction, assessment/ tutoring/mentoring, and research opportunities are critical components. Swail (2004) emphasizes providing students consistent and organized academic advising/ counseling in academic advising; encourages forming peer study groups in supplementary instruction; encourages recruiting underrepresented minority faculty, staff, and students as mentors in assessment/tutoring/mentoring; and encourages developing research opportunities with industry partnerships in research opportunities. All of these components of academic services rely on effective communications.

In this study, there were several gaps in that flow of information between the CoE and community college transfer students. Students discussed the lack of flow of communication as a

prevalent theme. Whether this entailed students discussing their lack of information on recruitment, scholarships, degree flow sheets, advising, etc., utilizing the CoE's digital presence as a solution provides a means to improve the flow of communication and complements existing efforts to recruit students. This lack of communication flow could also have been mitigated with the assistance of a pre-engineering academic advisor or counselor. This concept and recommendation to have a dedicated person who provides regular and structured academic and counseling services to pre-engineering students is an extension to Swail's recommendation to have an academic advisor. One student in particular had difficulties transferring because of the lack of awareness of information. His experience transferring from the community college to the university offers insights for improving academic services. Other participants in this study lacked the necessary academic assistance to ensure they received the proper information prior to transitioning into their engineering disciplines. The CoE should have a dedicated pre-engineering academic advisor who works with community college students to prevent students from enrolling in non-transferable courses; incurring costs for courses that do not apply towards their engineering majors; and wasting time from taking courses that do not transfer. The added expense and time has resulted in students taking additional classes at the university. For students desiring to transfer to CoE, a pre-engineering academic advisor could potentially eliminate the issue of wasting money and valuable time.

While academic advising is important to transfer students, so too is providing transfer students supplemental instruction, such as Michael recommends to [*Michael] [1:37:20 ... build that support group together...* One approach that Michael offers is to develop structured study groups for transfer students. *[Michael][1:00:27]... Study groups would be a good start.* Unlike freshman engineering students, who are assigned peer advisors or mentors during their first

semester through targeted mentorship programs, engineering transfer students are left without mentors. This is particularly problematic for African American engineering transfer students given the very low numbers of African American transfer students. They have neither peer advisors nor mentors to assist them with making these connections. Participants, in this study, substantiate Swail's recommendation to form peer study groups. Matthew recommends assigning peer advisors to African American engineering transfer students. *[Matthew] ¶701: P: Definitely…doing that peer advising.* This formation of peer advising and study groups is the supportive structure that provides African American engineering transfer students the academic support needed. It also provides students the opportunity to develop relationships with others who can assist with providing supplemental instruction.

In the Geometric Model, Swail et al. (2003) discuss the position faculty have as role models in the context of students' social and academic integration. They further acknowledge the underrepresentation of minority role models and the significance role models have with underrepresented minority students in the university settings. In the tutoring/mentoring section of academic services in the Geometric Model, Swail et al. (2003) discuss the necessity of recruiting a diverse group of minority faculty, staff, and students who can serve as mentors. In this institution, there are very few African American engineering faculty members. Diverse engineering faculty would serve as role models for African American transfer students in this study and provide them with a sense of inspiration as Julie indicates. *[**Julie**][0:34:00] It's inspiring to me to see people like me achieving things like that.* Diversity would also create a sense of inclusivity so students are not overwhelmed with feelings of dis-ease or discomfort. DeAndre posits *[37:47] because it creates an environment of inclusion... and diversity as well*.

Given that this institution has little diverse faculty, the CoE can look to diverse engineering professionals as other sources of positive academic role models and mentors. Michael suggests bringing in diverse engineering professionals to discuss their current profession and their college experience. *[Michael] [0:37:41]... I think, if you're a student, and you want to see yourself doing something.... it's important to have like a model... I'd like to see it, specifically more in person. I get that that's not always a possibility.* Given the lack of African American PhD faculty, the CoE can look for more diverse engineers from industry to teach some of the professional engineering courses, such as engineering leadership, professional development, etc. These individuals can also assist African American engineering transfer students by bringing the students into research labs to work with African American engineering professionals. Diverse industry personnel can provide job shadowing opportunities. The CoE can also bridge the deficit of African American engineering faculty role models by hosting faculty from partnering institutions, such as Historically Black Colleges & Universities or those institutions that have more diverse faculty for summer and/or year-long guest programs. Guest faculty can work with the CoE's faculty in research labs, teaching, and/or collaborating on solicitations (i.e., request for proposals).

Student Services. Campus climate and counseling are critical components for student services in Swail's Geometric Model. Within campus climate, Swail (2004) emphasizes building community by planning social activities among campus organizations. Within counseling, he emphasizes enhancing students' coping strategies by using health services, such as counseling and psychological services. Swail (2004) further stresses that institutions should be aware of the cultural and racial issues facing underrepresented minority students as institutions offer counseling services.

This university offers several programs to assist African American students with connecting with their peers and developing relationships, such as the National Society of Black Engineers (NSBE) and an active Diversity and Inclusion (D&I) Office. However, the students in this study feel that they want something different. A recommendation DeAndre makes for building community among African American engineering community college transfer students is to host a Transfer Student Association (TSA). This could connect community college students to the university prior to their transfer. DeAndre believes the TSA caters to existing transfer students as opposed to incoming transfer students. *DeAndre [00:04:20]...I think [the Transfer Student Association is] more geared to people who are already transferred.* This TSA could also help engineering transfer students develop social networks with other engineering students. Julie suggests *[0:18:57] I would say, if they had like a networking or socializing event for transfer students.*

Perhaps students in this study emphasized the need for additional academic and social supports because as transfer students, they still experience a sense of isolation. They come into programs that have established leadership and defined cohorts of students, some of whom have been with the programs since their freshman years. While the transfer students identify and connect racially and/or ethnically with other program participants, initially, they are still outsiders and are not part of any of the existing cohorts. This underscores why it is imperative for the CoE to keep the transfer student at the center of its programming. It is important to adopt initiatives that assist African American engineering transfer students with developing a sense of community and to think about how to incorporate African American transfer students into existing programs. This substantiates an aspect of the Geometric Model by developing "social activities that build community among all campus constituencies" (Swail, 2004, p.108). This

will provide the institution opportunities to address African American engineering transfer students' social needs of coming into the middle of established communities.

Financial Aid. Financial aid counseling/training as well as grants and scholarships are critical components for financial aid in Swail's Geometric Model. Within financial aid counseling/training, Swail et al. (2003) emphasize institutions do the following for parents and students: improve the flow and ease of financial information disseminated; provide financial aid and other college information early; offer financial management seminars in collaboration with financial institutions; provide cultural diversity/sensitivity training to financial aid counselors. In the grants and scholarship sector, Swail et al. (2003) recommend institutions utilize the private arena to create additional aid in the form of grants and scholarships.

The financial systems at this institution have been set up to support our freshman students. As early as a student's freshman year at this institution, a financial advisor is assigned to assist students with developing skills to manage money. This advisor also provides on-campus financial education workshops. The CoE offers an orientation course that provides transfer students instruction on financial planning and money management to address their lack of knowledge about current financial programs and/or packages. The CoE also offers several scholarships to assist students financially. These include scholarships for transfer students, minority students, current students, departmental awards, etc. Some transfer students in this study, however, were unaware of this financial support structure. Michael expressed needing to *[1:22:46] ... educate people who are in the [CoE] about different finances...* This research extends the discussion of financial aid counseling/training to encompass transfer students from community colleges.

However, there is an issue with communicating the availability of existing scholarships as Michael states. *[Michael] [1:21:59] I think having more scholarships available [would] be helpful. And that could be specifically for people who [have] transferred or for people who are in the minority...* Here it appears that this information was never communicated effectively to Michael. Communicating such information can be accomplished in several ways, such as using the pre-engineering advisors, TSA discussions with community college students, the CoE's enhanced online presence, and the AI personalized assistant. DeAndre recognized the gap in communication as he noted that apprising students of the availability of scholarships is important. *DeAndre [01:09:02] Now making the students aware of the scholarships is very important.* Students should not inadvertently nor fortuitously stumble upon scholarships as did DeAndre. *DeAndre [01:09:02] I didn't know [the diversity scholarship] existed until I was filling out [the general scholarship application].* The CoE should make sure that transfer students understand the availability of scholarships. The University should also assign a financial advisor to all incoming CoE transfer students as they enroll in the university. This will ensure that all students receive instruction on financial planning.

Open educational resources are becoming readily available. Leveraging open educational resources can minimize students' out-of-pocket costs for educational materials. The CoE offers open educational resources and incentivizes faculty to use these free online tools to develop resources for their classes. Faculty also have the option of using online eBooks to defray the students' cost to purchase textbooks. However, all faculty do not take advantage of these resources. Julie sees this disparity in the cost of textbooks and the selection of materials used for the same course. She recommends the CoE evaluate the faculty's selection of textbooks. *[**Julie**][1:31:04] I will say one thing that could help is if CoE actually evaluates how textbooks*

for courses are selected... I would say even in the same course depending on which professor you have. One may want a text book that's six hundred dollars, one may say "Use this online e-book, that's free". The implementation of Julie's recommendation and the increased utilization of open educational resources would reduce students' cost of curriculum and materials in the courses in which these resources are used.

Curriculum and Instruction. Curriculum review and revision as well as instructional strategies are important components in the Geometric Model. Within curriculum review and revision, Swail discusses using students, consultants, and faculty to continuously review the curriculum. He also stresses developing student and faculty relationships by making "teaching and learning a relationship process" (Swail, 2004, p.31). Within instructional strategies, he emphasizes "exploratory instructional practices" (Swail, 2004, p. 31). Swail (2004) further suggests complementing academic instruction by using educational technologies and integrating supplemental instruction.

As an extension to Swail's approach to use students and faculty to review the curriculum, a secondary recommendation to encourage faculty to develop and adopt OERs is to allow graduate students to support development of course content. This is a creative way to make open educational resources more appealing to faculty and serves as part of an educational mentoring program for graduate students. Broadening faculty adoption of eBooks and open educational resources will help relieve students of some of the costs for higher education a key concern for the students in this study.

A recommendation for the CoE to consider is to develop opportunities for students to engage more directly with faculty. This will facilitate students' success in engineering. Michael suggests *[1:29:26] I think that if there were programs [to provide] hands on experience ... a*

program where like for a week you and the professor are like partnering up and then you like try to solve ... some type of problem. ... I think that'd be like a really powerful like teaching moment. These relationship building opportunities are an extension to Swail's recommendation to support teaching and learning through building relationships. Examples of these faculty-student interactive activities that faculty can adapt include small group class projects with faculty mentoring each group (e.g., active learning). Industry partners would defray costs by supplying equipment for projects. Graduate students would minimize the instructors' time to prepare by assisting the instructor to adapt the project into the current course and modify its content. Homework help sessions held during class, labs with small groups, and undergraduate research opportunities are other ways to enhance faculty-student interactions. In these instances the professor and teaching assistant would work individually with students as needed and provide opportunities for more direct faculty-student engagements.

Rewarding faculty advisors for actively engaging in student organizations could also motivate faculty and strengthen faculty-student relationships. Collectively, the strategies identified help all students but differentially may help African American community college transfer students as faculty begin to get to know these students and develop relationships with them. They also substantiate the Geometric Model as these work relationships "integrate Supplemental Instruction into the curriculum" and "incorporate interactive, relevant, hands on, exploratory instructional practices" (Swail, 2004, p.31). The opportunity to work directly with CoE faculty also adds to students' intellectual accrual of academic knowledge. Further, it augments the manifestation of a student's level of confidence. Enhanced psychosocial interrelationships between faculty and students and the amplified opportunities to work directly with students are the tangible methods that engineering professors can provide their students.

Emerged Recommendations. Swail et al. (2003) remind us of how important positive role models are as they provide guidance and direction from which students can learn and emulate. Role models are the embodiment of dreams and possibilities. They may be historical figures or living persons who provide motivation, inspiration, and tangible actions for students to emulate. For underrepresented minority students, role models can serve as the crucial link between their present situation and a future they have yet to imagine. While current engineering students may have yet to think of themselves as role models, they recognize the need for STEM outreach and perceive it as their social responsibility. Students in this study talked about their desire for social opportunities to effect change and impact communities. They share a sense of collective responsibility towards the future generation of African American youth.

Students in this study offered ideas and solutions to increase African American students' representation and participation in engineering degree programs. While this research addressed engineering community college transfer students, Michael believes institutions must focus concerted recruitment efforts much earlier than the community college level. He believes student outreach needs to start at secondary inner-city/urban schools. Michael contends that college recruiters failed to come to his inner city high school to recruit potential engineering candidates. *[Michael][1:32:35] I think having more recruitment from like inner city schools ... would play a big part in bringing more diversity.*

Interestingly, recruitment initiatives can be the catalyst for students to begin exploring the possibilities of becoming engineers and provide the inspiration for their future success. DeAndre maintains that the tie back to student success begins much earlier than secondary schools. DeAndre's community service experience with African American youth impressed upon him the need to conduct these types of activities early in a child's life. DeAndre believes that presenting

African American engineering role models to children is foundational to helping children imagine achieving more than their circumstances might dictate. Rather than approaching students only in secondary schools, DeAndre reflects on his community outreach efforts to students who are in the primary grade level. He presents a multi-faceted description of his experiences at the Boys and Girls Club to explain why it is important for students to see successful people with whom they can racially and ethnically identify. DeAndre retells the story of one African American child who could initially only envision DeAndre through the experiences of his own family life. This experience deeply impacted DeAndre and the emotional connection he felt is evident as he re-counts the experience.

> *DeAndre [00:24:06] ... I volunteered for the Boys and Girls Club ... these are kids from really low income communities ... typically ... [there usually will] be a percentage of African-American. And they see me when I get there, the first time I got there ... one of the kids asked me if I've been to jail. Huh... "Okay, what makes you think I've been to jail?" And the answer, it really got me, like he said, "Oh [because] you [are] like my dad." And then [I'm] like, oh, okay. You know?*

DeAndre connects the perceptions of the young African American child to the potential impact that role models, and specifically engineering role models, can have to help change the perceptions and futures for such children.

> *... It's important to show African-Americans, at least, even from a young age that you don't have to be Black to go to jail, or whatever. You don't have to be White to succeed, you know. You can be who you are. You can succeed, prosper without, you know, regardless of the color of your skin. And I think [this university's] Engineering Program can impact other, I guess, from the Community College, or even younger than that. Even from high school, um, uh, just show them a picture of a Black person succeeding. I mean, we just had a Black President then, but that's a different story [LAUGH] you know? They should be able to see that. And they should be able to see that someone is within their community, that is actually being successful in say, engineering for instance, you know.*
>
> *Interviewer [00:26:00] So, what could the College of Engineering do? What would you like to see them doing?*
>
> *DeAndre [00:26:08] Hey, take us for example, to ... [high school], you know, talk to the students, in especially [those who are from] a rough background, whatever.*

We're trying to [make them better], but [they just see road] blocks, just because they are African-Americans, you know. To ... help them bring down the barrier. Help them see that they can succeed regardless of who they are.

Michael and DeAndre understand that to increase the number of African American students in colleges of engineering, youth must be engaged during their formative years. Institutions could aid this by extending STEM outreach activities to younger audiences of students and broadening recruitment initiatives to include inner city high schools.

Providing engineering students with social supports is a tangible service that may lie well within the CoE's sphere of influence. This may also extend to the students' well-being as generally people perceive the engineering discipline as quite demanding. Some of these demands are with respect to the curriculum, work load, and time management, which can then lead to stressful situations for some students. Other demands can be mental and psychological. Swail et al. (2003) emphasize providing psychological services to increase students' abilities to cope. The need for these types of services is reflected in Julie's interview as she recommends the CoE provide counseling services. *[**Julie**][1:33:57] I'd like [CoE] to have more support services specific to mental health.* At some point, you must recognize that everyone comes from different places and with different life experiences. Although Julie did talk a lot about the need for mental health types of services, the psychological support is beyond the type of student services that the CoE provides. However, the CoE can assist students by identifying campus resources and making sure they have access to these resources.

Implementing Students' Recommendations. Table 4 depicts the reconciliation of data from multiple student participants transformed into relevant, timely, and actionable insights. These data are a compilation of students' recommendations and provide a framework to facilitate African American community college transfer students' engineering success. This framework

represents a consolidation of the two phases of a student's transition into a 4-year engineering degree program: recruitment and retention. The organization holding the primary influence over the recommendation is indicated as well as recommendations spanning multiple organizations. Recruitment is sub-divided into pre-transfer and transfer experiences. Pre-transfer experiences include activities, such as identifying prospective students and social marketing campaigns. The transfer experience includes transition logistics, such as the information, knowledge, resources and materials to facilitate students transferring to the university. Retention is the second phase of the student's transition and is separated into finance, community, and role models. Finance entails activities, such as assigning financial advisors and developing industry partnership. Community and role models help students feel welcome. Retention also includes career enhancing opportunities and opportunities for students to serve as role models for youth in the community.

Table 4. Recommendations for African American Transfer Students' Engineering Success

	RECRUITMENT	The University	The College of Engineering (COE)	Engineering Peer Group
	Pre-Transfer Experiences			
1	Recruit in-person at Community Colleges (CC).	X	X	X
2	Collaborate with CCs to identify prospective engineering students.	X	X	
3	Develop social marketing campaigns at the discipline level using artificial intelligence (AI).	X	X	
	Transfer Experiences			
4	Develop a discipline specific online transfer site for prospective students.	X	X	
5	Distribute discipline specific advising materials at CCs and/or to prospective students.		X	X
6	Assign a pre-engineering CC academic advisor.		X	
RETENTION				
	Finance			
7	Assign financial advisors to incoming transfer students.	X		
8	Utilize multiple organizations to make CC transfer students aware of discipline specific scholarships, fellowships, internships, grants, etc.	X	X	X
9	Utilize open educational resources to reduce students' cost to purchase academic materials.		X	
10	Develop partnerships with industry to provide paid opportunities for undergraduate student employment.	X	X	
	Community			
11	Assign peer advisors to incoming transfer students.			X
12	Develop structured academic support mechanisms to assist transfer students with developing a sense of community in the COE.		X	
13	Develop structured social support mechanisms to assist transfer students with building community amongst their peers in the COE.		X	X
	Role Models			
14	Leverage diverse African American professionals for guest lectures by collaborating with industry, HBCUs, and other institutions.		X	X
15	Develop government and industry partnerships with African American engineering professionals for undergraduate research opportunities, fellowships, and internships.	X	X	
16	Provide academic opportunities for students to develop relationships with faculty through direct, structured, and purposeful engagements.		X	X
17	Engage in STEM outreach to provide role models for the community.			X

The framework in Table 4 represents the primary areas of authority for each functional unit within the organization that can influence the success of African American community college engineering transfer students. These are the organization itself (e.g., the university), the college of engineering, and the engineering peer group (e.g., the existing community of African American community college engineering transfer students). Each functional unit of the organization has responsibilities towards promoting and building a more diverse student body. Universities are engaged in recruitment but this study found that universities need to make sure they are intentionally engaged in recruitment of community college students. Universities have a role in retention as well; particularly, as relates to the functions of financial support for students. Assigning financial advisors is the one recommendation whose responsibility lies solely with the university. The CoE has responsibilities across these same areas but also has responsibility for building community and identifying appropriate role models. The engineering peer group also has significant impact on building community amongst African American engineering students because they identify ethnically/racially with the students they are serving. They also can serve as role models for other prospective engineering students and youth.

The functional units have overlapping roles and areas of emphases in this framework. The university and the CoE share recruiting and outreach initiatives. These initiatives extend the universities' recruitment efforts to encompass community colleges and create opportunities for colleges of engineering (CoEs) to collaborate with community colleges to identify prospective engineering students. The CoE and engineering peer group share areas of influence with respect to orienting community college engineering transfer students to the university environment and to the CoE. The CoE and engineering peer group collaborate to create community among African

American students and transfer students. They develop social supports and foster opportunities for African American engineering transfer students to engage in personal growth and development.

The engineering peer group's role is shared with the other functional units with regards to finance. It is important, however, that each functional unit assists transfer students with increasing their knowledge of potential financial resources for reducing indebtedness due to pursuits of higher education. Addressing these recommendations through the representative functional units will enhance African American community college engineering transfer students' outcomes at universities and ultimate academic success in their engineering disciplines.

Structural Mechanisms

This section addresses the holistic aspects of the engineering transfer student's experience in the CoE as administrators work together with students. It addresses the structural mechanisms for collectively implementing the CoE's and the student's recommendations. The structural solutions proposed are specifically housed in the CoE. This is because transfer students who enter the CoE do so mid-curriculum and are not members of the established freshman cohort of students. In addition, organizations, such as the National Society of Black Engineers and the Black Student Association, do not generally address the unique challenges for the community college engineering transfer student. To better support transfer students, the CoE should establish two programs to support community college transfer students' needs. They are the Transfer Student Association (TSA) and the Transfer Orientation Course (TOC). Through these two programs, the CoE serves as the liaison between engineering transfer students and the university at large.

The Transfer Student Association (TSA). The first approach to address the students' recommendations is through a transfer student association (TSA). This structural mechanism is a combination of the CoE, the engineering transfer students, and their peer groups. The engineering transfer student association can be the foundation upon which to build the cohort for transfer students in general and African American community college engineering students in particular. Although other student organizations exists, which address the needs of certain demographics, there is not one which addresses the needs of the transfer and discipline specific status of the student. The TSA should be distinctively situated as its own organization because its members understand and recognize the unique aspect of transfer students' experiences, such as coming into the middle of established cohorts.

Transfer students experiences are not relevant to the general engineering student populations that are established as freshmen. Julie explains the lack of opportunities for transfer students to socialize. *[Julie][0:09:49] I feel like for students who come in as freshmen, there are many opportunities organized by the university for you to socialize. And you kind of gain an interest in each other seeing "Oh we're in the same classes. Oh we're very similar to each other" and you kind of socialize and get to know each other that way and end up networking, and working on academics.... But as a transfer student [there are not] too many things set up to really socialize you with everyone else in College of Engineering*. This student association can serve as the vehicle through which the connections between the university's CoE and prospective African American community college engineering transfer students are sustained and maintained.

The TSA represents a vital component of the CoE's support of this student demographic. It is one of the two primary mechanisms to support this community of transfer students. The

TSA receives funding from the CoE, is beholden to the requirements the institution places on student orgs, and serves under the supervision of an institutional faculty/staff advisor. The TSA's identity is therefore subsumed into the role of the institution. This differs from Swails' model where the peer support is considered under social factors. Swail et al. (2003) describe peer support as the societal factors that may impinge upon a student's well-being in various social situations and impact students' academic persistence and subsequent performance. By embedding the TSA student organization as an institutional responsibility, it has the potential to have more formalized impact/sustainability.

The TSA can also serve to build community between the African American community college engineering transfer student and existing African American engineering students. It is the TSA that can develop and foster peer relationships amongst African American engineering students. Julie recommends providing opportunities for transfer students to socialize with other engineering students. *[**Julie**][0:18:57] I would say, if they had like a networking or socializing event for transfer students with other students in College of Engineering that'd be good.* This can be accomplished as the TSA assigns peer advisors to incoming African American community college transfer students. Peer advisors can also serve to assist students with identifying various social support and campus activities that may be of interest to incoming students. These actions could positively impact African American community college transfer students' retention in engineering degree programs.

Students in this research spoke about the importance role models have for themselves as well as for youth. The TSA can present role models for its membership by working with the CoE to identify African American professionals as guest lecturers. When asked what impact would understanding the contributions of African American scientists and engineers have on him,

Michael spoke of how seeing the success of others would be helpful. *[Michael] [0:40:05] I think seeing how people who look like me have done things that, like I [want to do], would be helpful.* The TSA membership could also serve as role models and assist the CoE with increasing African American students' awareness and interest in engineering disciplines by incorporating STEM outreach into its mission. Michael and DeAndre both suggested engaging youth. Through the TSA's membership conducting STEM outreach, African American youth can begin to envision the possibilities of becoming engineers as they engage with African American engineering transfer students. Julie knows the impact role models can have on the community. *[Julie] [0:34:00] I think it's very important for me to give back and also be a role model.... I also see the impact that [African American scientists and engineers] have on the African American community as an inspiration...* The TSA could create these connections between engineering students and pre-college aged youth and their families and could ultimately assist to build a pipeline between the African American community and the CoE's engineering disciplines.

The Transfer Orientation Course (TOC). The second approach to address the students' recommendations is through a transfer orientation course (TOC). This structural mechanism is the primary component through which the CoE can holistically implement the students' recommendations and support African American community college transfer students' engineering success. This particular CoE has a transfer engineering course to try to orient transfer students to engineering. In this course, they have tried to solve some of the problems students discussed in this research. Evidence from this study indicates that African American transfer students find the first-year engineering course beneficial. There are elements of the course in which students expressed interest, such as financial planning and career advising. The course serves students to direct their focus towards degree completion and debt reduction. The course instructors do this by

having students to develop and map out individual protocols inclusive of coursework required to complete their engineering degrees. The course instructors also apprise students of campus resources.

Administrators, staff, and faculty of orientation courses must be cognizant of how to help students understand finances whether it is buying textbooks, developing a financial plan, or using a money coach. Those are key components for an orientation course. Julie talks about how this orientation course helped her to gain better insight into financial planning. *[**Julie**][1:29:40] [The first-year engineering course] was helpful because that was the first time I had actually written all that out on paper. I knew what I was going to do and I had a way to practically pay for school ... And, I saw ways that I could optimize my plan after I actually had it all written out, so.* Poor financial management is a risk factor for student retention (McNeal, 2016). Course instruction also included increasing Julie's awareness of how to reduce debt, helping her to develop strategies to pay for college, and assisting her to develop a cohesive money management plan.

Role models are key to successful orientation programs for African American transfer students. These role models can also serve as potential mentors. Matthew talks about how the orientation course at this institution provided a mentor who helped him to understand how to map out which classes to take to complete his engineering degree. *[Matthew] ¶313: P: So I remember from my… first-year engineering course, we have like a mentor, and she told us to ... map out [the classes] ... [that we are] going to take each semester [to include] if we want to go to summer school or [not].*

Another aspect of an orientation course that is important to African American students is awareness, availability, and knowledge of research opportunities. DeAndre talks about how this orientation course increased his knowledge and awareness of research opportunities available.

DeAndre [00:54:24] [Speaking about the opportunities presented in the first-year engineering course] I would [not] have known that there [were] research opportunities on campus that you can get involved in as a student you know.... Research experiences are central to underrepresented minority students' persistence in professions that are concentrated in scientific research (Schultz et al., 2011). This orientation course also exposed DeAndre to various engineering careers. *DeAndre [00:54:24] [The first-year engineering course explores] different careers in the engineering field....* The course provided industry recruiters with whom he could speak. *DeAndre [00:54:24] [The first-year engineering course] also helps during the career fair because we [were able to talk] with the recruiters prior to going to the career fair.* Limited knowledge of career options is one area that under-represented minority students may contend (Enriquez, 2015).

Kim et al. (2011) found that role models foster women's confidence and continued interest in engineering. This is an important aspect for program administrators of orientation courses to consider when identifying potential speakers for guest series lectures. The orientation course at this institution was instrumental in introducing African American women role models during the orientation course. *[Jolene] ¶493: The speakers are influential to me because, like, it's somebody that's been through it, or they just… they're speaking, not just like a professor just teaching you some stuff, it's just like they are speaking from their own experience and this may be, like, something you are going to experience....* It is also important for orientation courses to help students to get involved in academic and/or social activities. Jolene talks about how the orientation course provided her an avenue to get involved *[Jolene] ¶493: P: Yes. ... [The first-year engineering course] makes you get out and go to meetings and ... get involved.*

CHAPTER 7. CONCLUSIONS

An Extension to the Geometric Model. This research sought to identify the institutional factors African American community college engineering transfer students attribute to their success. Data that examines students' community college enrollment by future major/interest in relationship to their success was unavailable. All we seem to know are Associates of Arts or Associates of Science type of degree information but the intent of actual completion of 4-year Bachelors of Arts/Bachelors of Science by major appears to be unknown. In this study, students' individual and collective experiences form the basis for the recommendations. Insights gained during this study provided for 17 actionable recommendations. They address multiple ways to improve the success of African American community college engineering transfer students.

Swail's Geometric Model captures the cognitive, social, and institutional aspects of students' experiences in his framework for implementing support programs to aid student success. Swail places students at the epicenter of the model. Everything revolves around these students even though they have no actionable role in this framework. The cognitive dimension addresses the student's intellectual acumen accumulated before advancing to higher education (Swail et al., 2003). The social dimension addresses family and peer relationships and the student's career aspirations and situational coping skills as factors impacting the student's success. The institutional dimension considers students as the central figures upon which actions are directed to enable their success. Students are not agents in their own success according to this model. Their roles are to bring their academic histories, decision-making skills, cultural backgrounds, intra-personal skills, etc. to the institution. The institution then assesses these

students either individually and/or collectively to design and develop academic and social support programs that facilitate their success (Swail el al, 2003).

The recommendations I propose focus on, support, and align with the institutional factor from Swail's Geometric Model. Swail's framework decentralizes responsibilities under the institutional factor into 5 components: *recruitment and admissions, financial aid, student services, academic services, and curriculum and instruction.* This decentralization is apparent as Swail discusses these components from the perspective of the department in the university that has authority over each function. Similar to Swail, I found that in this study each of those five departments is important for African American community college engineering transfer students. However, my research reframes and re-conceptualizes the institutional components to develop a more holistic approach to the role of the institution to support student success.

The five decentralized responsibilities under Swail's institutional factor collectively align with three major functional units that have ownership and accountability for the factors: the University, the CoE, and the students themselves. My recommendations are framed around the functional unit that best supports the success of African American community college engineering transfer students. Some of the recommendations are specific to a given functional unit, while others span across boundaries. My research re-conceptualizes and reconfigures the elements of Swail's institutional factor in a manner that creates a more holistic approach to building African American community college transfer students' engineering success. This holistic approach recognizes the student as a multifaceted individual and attempts to address all of these facets collectively.

From a functional perspective, this research proposes a new reorganized framework for the institutional component of Swail's model. The reorganization is necessary to directly and

effectively address the recommendations for community college engineering transfer students from a more holistic perspective. The reorganized framework is hierarchical and is constructed based on the operations of the institution and its functional units, and further acknowledges that the responsibilities of a functional unit can be accomplished in multiple ways at a university. For maximum impact on this population of students, recommendations that have the most critical and direct connection to the CoE should be centralized under its control. This centralization of specific functions under the CoE is an important extension of Swails' model specifically to support the success of engineering transfer students.

Another adaptation to the institutional component in Swail's Geometric Model addresses the failure of the model to include the contributions that students can make to their own success as well as to the success of others. Little attention is given to the role students have in understanding their own academic and social capabilities or in their abilities to detect, rectify, and curate individualized solutions. This research identifies the engineering transfer student as a core member of the CoE's team to support African American community college engineering transfer students' success. It identifies students as pro-active participants in their success and their peers' success. It identifies the role that current students have in developing positive peer relationships and building a sense of community amongst incoming transfer students. This research proposes that the CoE will incorporate the students and their functions via the transfer student association and thereby institutionalize student engagement.

Given this study's exploratory nature and with data from only six African American community college engineering transfer students, this study was limited in breadth and scope. With this limitation, it is unclear how many of the African American community college engineering transfer students' experiences are unique to African American students. However,

this research confirms the relevance of Swail's model for this particular student population even though his model is built around a larger sample. It appears that most of the recommendations derived from this study are more broadly beneficial to the community college engineering transfer students in particular, and to transfer students overall, regardless of students' race/ethnicity or the type of sending institution. For example, students in this study cited the lack of flow of information and/or communication as a prevalent theme throughout this research. This issue was not contingent on the type of transfer student (e.g., internal transfer, a transfer from another 4-year university, or a transfer from a regional community college). They all expressed the difficulty of coming into this institution at the mid-point of their academic cycle and not knowing enough information nor having it communicated to them.

However, there was an important factor identified that is unique to the intersectionality of the identities of this student population. Isolation is a factor that comes from being an African American engineering student and being a transfer student. Transfer students come in to established cohorts in the CoE. In the general engineering population, there are few African American engineering students. There is even less representation of African American students in these small engineering transfer groups of students. Isolation presents a particular challenge for the African American engineering transfer student and conceivably this finding is transferrable to other underrepresented minority groups who transfer in to PWIs.

Impact on Student Success. The goal of this research is to increase the success of African American community college transfer students in engineering degree programs by improving the pathway from the regional community college to the 4-year university. Two key findings surfaced related to this goal: poor communication and the need for social networks. Communication is an issue that challenges all transfer students regardless of prior academic

experience, race, or program discipline. Eight of the 17 recommendations are related to improving the communication of information to transfer students during recruitment to and while at the university. Institutions must continue to strive to ensure all students, inclusive of community college transfer students, receive information pertinent to their transition to the university. The second key finding that can help support African American community college engineering transfer student success is the need for social networks. Nine of the 17 recommendations focus on the relational aspect of students' experiences and address improving their retention by providing encouragement, motivation, and support once students have arrived on campus. These students enter the university later than typical first-time full-time students and thus struggle to find communities that understand the unique needs of African American community college engineering transfer students. Students want the social networks on campus but they also want to be part of the social consciousness and collective development of the next generation of African American youth.

Institutions must employ a holistic approach to assisting African American community college engineering transfer students with successfully completing their degrees. This group of students struggled with challenges of communication and issues with social networking. I am proposing that the college of engineering and the transfer student association have the responsibility and capability to address those challenges. These groups can expand academic and social support programs to develop an all-inclusive approach to engineering education for African American community college transfer students. And to gain further insight, opportunities for future research should include broadening the study by looking at the overall community college transfer student population. This will solve the problem of the small sample size by providing a larger student body from which to recruit participants and to potentially gain greater

coverage of race/ethnicity, and gender. Given a large enough sample, the research data could be disaggregated by race/ethnicity and/or gender to understand how students' experiences differ along these dimensions.

It is generally known and accepted that the United States has a need for an expanded STEM workforce and that underrepresented minority students lag behind other racial/ethnic groups in STEM degree completion. My research identified ways to engage more African American community college transfer students in completion of four year engineering degrees. This research identified structural mechanism that could be utilized to support institutionalizing student engagement. This research expanded the CoE's responsibilities and subsumed specific departmental functions for the engineering transfer student. Furthermore, this study highlights the important role that institutions have in the success of African American community college engineering transfer students. If organizations can help with instituting the transformative initiatives that came forth from this research, we will broaden participation of people in STEM who don't always recognize it as a possibility. Retention of existing African American community college engineering transfer students will increase. More importantly, this study could be a solution to helping African American community college transfer students achieve success in engineering.

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APPENDIX A: Interview Protocol

CONFIDENTIALITY

To maintain confidentiality of the research participants' identity during the interview, I will conduct the interview in a secluded room. To mask the student's identity, I will assign each student a unique alphanumeric code. This code will represent the total credits completed at the community college (i.e., Partial – P or Associates Degree – A), gender (i.e., Male – M or Female - F), their enrollment status (i.e., Part-time – PT or Full-time - FT), and a three digit sequential number. I will place this alphanumeric code on the student's informed consent, survey, and interview protocol. Students will sign the informed consent; they will annotate using their initials adjacent to their acceptance of participating in a recorded interview and next to their agreement of me taking field notes.

I will pilot test a student completing the informed consent, the survey and the interview to condense the participant's time to no more than 45 minutes in total. Every day after I conduct the last interview, I will securely store and lock the informed consent forms in a file cabinet. The forms will remain locked and secured for a period of one year after the conclusion of the study, at which time, I will shred the informed consent, the survey and field notes, and delete the audio recordings of the interview data. At no time will I divulge the name or any personally identifiable information about the study participants.

ANONYMITY

To maintain anonymity and facilitate the interview process, I will store the interview schedule on a password protected computer in a password protected folder as an encrypted file. This schedule will contain the participant's name, telephone number, email address, the date, day and time for the interview.

STUDENT PARTICIPATION

I will visit with the transfer class instructor to solicit their assistance with encouraging African American community college engineering transfer students to sign up to participate in the research study. I will ask the instructor to post an electronic announcement on canvas and to email the students enrolled in the class for the current semester and to the students who were enrolled in the transfer class during the prior three semesters to request their participation.

I will visit with the Director of Communications for the Gallogly College of Engineering to request their assistance with encouraging African American transfer students to participate in the study. I will ask the director to post an advertisement in the college's newsletter to request student participation.

I will visit with the Assistant Director for Diversity & Inclusion for the Gallogly College of Engineering to request their assistance with encouraging African American transfer students to participate in the study. I will solicit their assistance with distributing a recruitment email and flyer to African American engineering transfer students who are enrolled in the Diversity & Inclusion program.

I will visit with the Assistant Dean for the Gallogly College of Engineering to request their assistance with helping me to coordinate with the Engr 2002 Professional Development

course instructors. I will solicit their assistance with distributing a recruitment email and flyer to African American engineering transfer students who are enrolled in their course.

Students can then text, email, or call to schedule their interview regardless of the method by which they were notified of the research study.

HOW RESULTS WILL BE USED

I will use thematic analysis from aggregated data and only extract small excerpts of their narrative to explain the research findings. Quotes used in publications will be descriptively identified using a single salient parameter from the study identification code. I will remove any personally identifiable information during the transcription of the interviews.

PREAMBLE

Thank you for coming in and taking the time to speak with me today. I am really interested in how it was for you as a transfer student, what challenges you faced, and what things helped. In particular, I would like to talk to you about the things the College of Engineering did to help you transfer. I also am interested in the College of Engineering's policies, processes, programs, and resources which you have utilized. I am hopeful that by your account and the account of other African American community college engineering transfer students that I can then offer possible solutions that the College of Engineering can take to increase the success of transfer students in engineering. I can also explore how to translate and apply these best practices to future incoming African American community college engineering transfer students.

PURPOSE

This research will focus on the experiences of these transfer students at a public 4-year predominately White research institution (PWRI). The study will identify the College of Engineering's programs, policies, resources, and processes, hereafter referred to as *institutional mechanisms,* specifically available to enable transfer students' success in engineering. The research will strive to understand the experiences transfer students may encounter that influence their success in the College of Engineering and seek to understand the extent to which they utilize the available institutional mechanisms. This research has three objectives:

1) What are the institutional mechanisms specifically available to this transfer population to enable their engineering success;
2) What are the experiences of transfer students as they enter the College of Engineering; and
3) What are the strategies African American community college engineering transfer students employ to be successful.

BACKGROUND

1. What is your gender? What is your race? How old are you? What is your classification? How many credits are you taking this semester? Which semester is this for you? Have you included the summer term in your count? How many summer terms have you attended? What was your classification when you first came in to this university? What semester and year do you plan to graduate with your engineering degree?

2. Have you considered enrolling in graduate school after graduating? What would motivate you to consider it?

Prior academic experience

3. Have you taken any courses at a 2-year institution and / or another 4-year university prior to starting classes at this university? What type of institution? How long did you attend the college? Why did you choose to attend an institution prior to coming to this university? What type of curriculum have you completed?

4. Tell me about your coursework at the previous institution? Did you complete your general education courses and then transfer to the university, Which math and statistics courses did you complete, What other degree seeking courses did you transferred in, and**.** How many total credits did you transfer in to the university? Describe how prepared you were for the College of Engineering?

Experience Transitioning to the University and the College of Engineering

5. Tell me about your transfer experience, how did the process go? Tell me about what made that an easy/hard or good/bad transition process? What surprises did you encounter during the transition to this **university** that could have been explained during your first week on campus? What surprises, unexpected events, or situations did you experience during the transition into the **COE** that could also have been explained during your first week on campus?

6. What would you tell future African American engineering students about preparing for the College of Engineering at this university?

7. Describe your engineering support system at this university. How did you develop your support system? Why did you think it was necessary to have a support system?

8. When I mention institutional practices, what comes to your mind? Tell me how you have used specific practices to enable your success in engineering. Tell me what **motivated** you to use these in support of your engineering program.

9. As an African American student; tell me what more can be done to help African American students succeed in engineering?

10. Did you ever go talk to your advisor over at Williams? Tell me about your interaction with your Advisor. Tell me what campus events do you attend regularly? Tell me what other events have you attended while you were here? Why did you choose those that you attended regularly? Why did you choose not to continue attending these? As an African

American student, tell me how were you received at these events? What can be done to improve how African American students are received?

11. In general, how do you feel about being an African American student in engineering at this university?

12. Share with me how the COE is helping you to develop confidence in yourself as an engineering student and future engineer? What have you personally done to help you develop confidence as an engineering student or the confidence to become an engineer?

13. Tell me how the COE is helping you to develop your identity as engineer? What have you personally done to develop your engineering identity?

14. Aside from classes, tell me what other things are there for which you are responsible? *To enable you to manage these responsibilities,* does it require that you reside at home such that you see yourself as a commuter student?

15. How are you financing your education? Do you work full or part-time?" Are you a full or part-time student? Tell me how you are managing both a work and school course load. What type of impact do these additional responsibilities have on you both academically and your ability to participate in COE social / academic activities? Are there specific COE events that you would like to have attended but were unable to because of your responsibilities? *With these responsibilities,* what, if anything, do you think the College of Engineering can do to provide some type of support?

Engineering Curriculum

Now we are going to talk about the engineering curriculum. Thinking about the COE's engineering curriculum, programs offered, and competitive teams can you answer these questions and tell me about it from your experiences. The first set of questions that I am going to talk to you about is how the engineering faculty motivates you in the classroom. So, can you talk to me for a few minutes about what they do in the classroom to motivate you as a student?

16. **What** do engineering faculty do in the classroom to motivate your engagement in the engineering program?

1.1 Do the faculty give you any real-world applications, problems, and/or class examples to motivate your engagement? *(Prompt)*

1.1.1 **How** do these work for you? Do they resonate with you personally?

1.1.2 **Would** something else motivate you more effectively in the classroom?

1.1.3 Do you think these applications, problems, and/or class examples are equally effective for all groups of students?

1.1.3.1 Do you think these affect others differently and who?

1.1.3.2 **Why** do you think these work for the other racial/ethnic groups?

1.2 Are these real-world applications, problems, and/or class examples helping to build upon your knowledge of engineering?

1.2.1 How do these examples build upon your prior knowledge of engineering?

1.2.2 Would some other type of activity motivate you more effectively in your engineering classes from an African American student's perspective?

1.2.3 Do you think these activities need to change to motivate the African American student's engagement in the engineering program?

1.2.3.1 Why would these need to differ to motivate the African American student's engagement in the engineering program?

Classroom and/or Homework Exercises

The next set of questions that I am going to talk to you about asks you to think about the type of classroom exercises or homework problems assigned by your engineering faculty. Think in

general terms about how you might categorize these problems or about how you would explain them to an African American high school student who is thinking about majoring in engineering.

2 What type of classroom or homework exercises do your engineering faculty assign?

2.1 Do the faculty assign classroom or homework exercises that come from the textbook and/or from real-world problems in the local industry? *(Prompt)*

2.1.1 **How** do these exercises work for you?

2.1.1.1 Can you relate these exercises to the type of work you will do as an engineer? *(Prompt)*

2.1.1.2 How would these exercises change if they were to relate to your idea of the work you will be doing as an engineer after graduating?

2.1.1.3 Would some other type of class exercise or homework assignment motivate you more effectively in your courses?

2.1.2 Do you think these exercises are equally effective for all groups of students?

2.1.2.1 Do you think these exercises affect others differently and who?

2.1.2.2 **Why** do you think these applications affect them differently?

2.1.3 Do you think these exercises are effective for African American engineering students in general?

2.1.3.1 What type of exercises would appeal to African American engineering students?

2.1.3.2 Why would these types of exercises be suited for African American engineering students?

2.2 Do the faculty discuss the relevance of the classroom or homework exercises to innovations in technology, the local economy, industry, or to problems engineers are encountering in the real-world? *(Prompt)*

2.2.1 Do these exercises resonate with you personally?

2.2.2 Are there engineering applications or academic content that you would like to see covered in your engineering classes?

2.2.2.1 How would this impact the learning environment for other African American students?

2.2.2.2 Why do you think the application or content would have that impact?

Teaming Projects

Now let's talk about another aspect of the engineering curriculum, team projects and/or extra-curricular engineering activities. Teams are generally formed inside the classroom but the actual projects may happen outside of the classroom, while engineering activities may or may not require you to work with your peers from class. This next set of questions asks you to think about the type of engineering team projects and activities in which you have participated.

3 What engineering projects are you involved that have allowed you to work on a team?

3.1 Have you participated in any engineering competitive teams, on teams with students from non-engineering disciplines, or why have you not? *(Prompt)*

3.1.1 How were you selected to participate on the team?

3.1.1.1 Did the selection of other team members generally create a diverse teaming experience?

3.2 What was your experience like on this team?

3.2.1 Can you describe your role as a team member? *(Prompt)*

3.2.1.1 Why did you take this role?

3.2.2 How did your experience on the team impact you academically in your engineering courses?

3.2.2.1 How did your experience on the team help you with understanding your engineering courses? *(Prompt)*

3.2.2.2 How did this experience help you to develop relationships with other students in the class? *(Prompt)*

3.2.2.3 Why do you think your experience on the team had these effects on you?

3.2.2.4 How did this experience on the team prepare you to be an engineer?

3.2.2.4.1 How did your role on the team provide you the opportunity to assume a leadership position? *(Prompt)*

3.2.2.4.2 What other leadership roles have you experienced in the COE?

3.2.3 How did your participation on this team impact your ability to work with people who are different from you?

3.2.3.1 What can others learn from your experience?

3.2.3.2 What impact did your race/ethnicity as an African American have on the way team members interacted with you?

3.2.3.2.1 How does this make you feel?

3.2.3.2.2 Why do you think your race/ethnicity had this impact on the way your team members interacted with you?

3.2.4 What impact has your race/ethnicity had on your interactions with others in the COE?

3.2.4.1 What can the COE do to assist African American transfer students with race relations?

3.2.4.2 What can the COE do to promote a supportive learning environment among all students?

4 Should discussions of diversity in engineering be a part of the engineering curriculum?

4.1 What impact would discussions about diversity in engineering have on you?

4.1.1 How would understanding the contributions of diverse people to advancements in engineering motivate you? *(Prompt)*

4.1.2 How could the COE incorporate discussions of diversity?

4.1.2.1 Why should the COE address the topic of diversity?

5 Similar to considerations of ethical behavior on a job, when you think about cultural sensitivity and its relationship to engineering education, from the perspective of being an African American, what comes to mind?

5.1 From a historical perspective, how could the roles African Americans have had in the United States be taken into consideration when COE faculty select the type of competitive teams and team projects to sponsor? *(Prompt)*

5.1.1 Why should cultural sensitivity be a consideration for the type of competitive teams and team projects that are supported in the COE?

5.1.1.1 Why should discussions of cultural sensitivity be a part of the engineering curriculum?

5.1.1.2 What impact would discussions about cultural sensitivity have on you?

5.1.1.3 How would these discussions make you feel?

5.1.1.4 What do you think the impact would be on your fellow classmates if the COE discussed cultural sensitivity?

5.1.1.5 Why should the COE include cultural sensitivity in the curriculum?

6 Have you participated in any engineering faculty research, internships, co-ops or why have you not? *(Prompt)*

6.1.1 What was your experience like?

6.1.2 How did this experience impact you in your engineering classes?

6.1.2.1 Were you able to relate the knowledge gained from this experience to lessons taught in the classroom? *(Prompt)*

6.1.3 Why do you think the experience had this effect?

7 What does the COE, the faculty, or other programs and activities do, out-of-class, to motivate your engagement in the engineering program?

7.1 Are you given any real-world applications, problems, and/or out-of-class examples to motivate your engagement? *(Prompt)*

7.1.1 **How** do these applications work for you? Do they resonate with you personally?

7.1.2 Do you think these applications are equally effective for all groups of students?

7.1.3 Do you think these applications affect others differently and who?

7.1.4 How do you think these applications work for the other racial/ethnic groups?

7.2 Are these engineering applications, problems, and/or out-of-class examples helping to build upon your knowledge of engineering?

7.2.1 How do these engineering applications, problems and/or out-of-class examples build upon your prior knowledge of engineering from an African American student's perspective?

7.2.2 Do you think these out-of-class applications, problems and/or class examples need to change to motivate the African American student's engagement in the engineering program?

7.2.3 Why would these out-of-class applications, problems and/or class examples need to differ to motivate the African American student's engagement in the engineering program?

7.2.4 Would some other type of out-of-class activity motivate you more effectively in your engineering classes?

8 Is there something else that I have not asked about that you need to tell me?

APPENDIX B: BACKGROUND / DEMOGRAPHIC SURVEY

BACKGROUND / DEMOGRAPHIC SURVEY

Before we begin the interview, please complete the following survey. OU Student ID# _____

1. How do you identify your gender? ☐ Female ☐ Male ☐ Prefer not to report

2. How do you describe your race/ethnicity? *(Please check all that apply)*

   ☐ American Indian or Alaska Native ☐ Asian

   ☐Black or African American ☐ Hispanic or Latino

   ☐ Native Hawaiian or Other Pacific Islander ☐ White

3. How old are you? ☐ ≤ 19 ☐ 20 - 24 ☐ 25 - 29 ☐ 30 - 34 ☐ ≥ 35

4. What is your engineering major? _____
   (Major)

5. When did you start at OU? _____
   (Semester & Year)

   5.1 How were you enrolled for most of your time at OU? ☐ Full-time ☐ Part-time

   5.2 What is your expected date of graduation?

   Semester: ☐ Fall ☐ Spring ☐ Summer

   Year:

☐ 2019	☐ 2021	☐ 2023	☐ 2025	☐ 2027
☐ 2020	☐ 2022	☐ 2024	☐ 2026	☐ 2028

   5.3 What level of degree will you earn at graduation? ☐ BS ☐ MS ☐ PhD

6. What are your plans after you graduate? _____

6.1 At some point, do you plan to earn a graduate degree; why or why not?_____

_____

7. Have you taken any courses at another institution prior to entering OU?

☐ Community College ☐ 4-Year College or University ☐ Both ☐ N/A

7.1 How many credits did you transfer into your engineering program at OU?

☐ ≤ 8 ☐ 9 – 15 ☐ 16 – 24 ☐ 25 - 30 ☐ ≥ 31

7.2 Why did you choose to attend that institution before entering OU? _____

_____

7.2.1 What degree, if any, did you complete at that institution?_____

_____

Thank you for completing this survey. We will now begin the interview.