

ABSTRACT

WILLIAMS, SHWANDA JONES. An Intrinsic Case Study Exploring Non-persistence of African American Students in Undergraduate Engineering at a Predominantly White Institution. (Under the direction of Dr. Aaron Clark and Dr. Cameron Denson).

African American persistence in STEM has consumed minds of politicians, college administrators and researchers for the past decade (Adams, Dancz, & Landis, 2015). Although several practices have been implemented and improvements have been made, African American persistence remains a national focus. According to Dika and D'Amico (2016) "representation of diverse groups in science, technology, engineering, and mathematics (STEM) fields is a persistent concern in the United States" (p. 368). Therefore, the purpose of this qualitative case study was to explore the experiences of African American undergraduates who did not persist in the College of Engineering at NC State University. Engineering is a prominent discipline and a subset of the science, technology, engineering and mathematics (STEM) discipline. African American students have been found to persist in engineering majors at a much lower rates than their peers. The self-worth achievement motivation theory developed by Covington (1984) was employed as a theoretical framework to guide the research and better understand the experiences of African American non-persistent engineers. The guiding research questions were: (1) What are the reasons some African American students do not persist in the College of Engineering at a predominantly White institution? (2) What are the particular factors within the College of Engineering that prompt non-persistence in African American students? The findings in this research study reveal emergent themes that bring to light reasons participants decided to not persist as engineering majors. Participants expressed experiencing difficulty understanding the content taught in the foundational engineering courses, becoming disinterested in the subject matter and expressing reluctance in seeking support from peers, instructors and minority

engineering programs. Eight of the nine participants expressed the most common reason for non-persistence was experiencing difficulty in science and mathematics courses. Participants reported that they began to lose self-worth and eventually gave up trying in the rigorous courses; thus they changed majors. This research also presents recommendations for future research and implications for practice that may help educators and administrators further understand this phenomenon and combat non-persistence among African American students pursuing engineering degrees at NC State University.

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An Intrinsic Case Study Exploring Non-persistence of African American Students in
Undergraduate Engineering at a Predominantly White Institution

by
Shwanda Jones Williams

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APPROVED BY:

Aaron Clark
Committee Co-Chair

Cameron Denson
Committee Co-Chair

Brian Matthews

Tameshia Baldwin

Kristin Hoffmann

BIOGRAPHY

Shwanda J. Williams is a wife, a mother, a daughter, and a sister. She is married to Patrick Williams and they currently have one son. They grew up in Bertie County, NC.

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CHAPTER 1

INTRODUCTION

Engineering is a discipline that seems to attract a diverse array of students from a myriad of backgrounds, ethnicities and socioeconomic backgrounds. These students lend themselves to be mathematicians, problem solvers and hands-on creators. Although these characteristics and skills accompany these students on their path to success in the world of engineering, there are often barriers that can be presented cognitively and socially in academic and environmental settings. In particular, African American students who pursue engineering have trouble persisting in the discipline. Brown, Morning and Watkins (2005) posited that research focusing on African American students continues to be appropriate because “they are the least successful engineering student group in terms of the proportion of enrolled students persisting to graduation” (p.264). Although there is quantitative research describing the reasons for persistence and non-persistence in African American engineers, there hasn’t been a plethora of qualitative research conducted to directly address the reasons African American students have trouble persisting in engineering and in particular in the College of Engineering at NC State University. The purpose of this qualitative case study was to understand the reasons African American students in the College of Engineering do not persist in engineering.

Statement of the Problem

Lorah, Samuelson, and Litzler (2014) stated in their research that African Americans continue to be underrepresented in the engineering field (p. 811). Upon reviewing enrollment statistics from NC State University’s Office of Institutional Research and Planning (2017), data showed that for the past seven years the enrollment of African American students in the College of Engineering fluctuates, each academic year showing a decrease from the previous academic

year in the fall semester. The problem an issue of non-persistence with African American students in the College of Engineering at NC State University. In addition to the lack of persistence in the College of Engineering at NC State University, the National Science Foundation (2017) produced a report showing that only 3.83% of bachelor's engineering degrees in the United States were earned by African American students.

Brown, Morning and Watkins (2005) stated the underrepresentation of African Americans along with other ethnic minorities as degree recipients in engineering is greater than their underrepresentation in enrollment due to their low degree completion rates. Data from NC State University's Office of Institutional Research and Planning (2017) also indicated the graduation numbers from year to year for African Americans in the College of Engineering has seen a decrease in the number of African American students in the last seven years. There is a shortage of African American students persisting in engineering which results in a lack of diversity for the discipline. The goal of this research was to investigate the reasons that African American students did not persist in engineering at NC State University. Without African American students gaining engineering degrees, the discipline will continue to lack the presence of African American engineers (Solorzano, 1995).

Background

“Engineering and society are interrelated; each one shapes the other. It is imperative to understand the influences of diverse human talents on society in order to encourage innovation, creativity, and global understanding to achieve a more equitable, inclusive, and prosperous world community. Creating a workforce diet that is capable of thinking and working across diverse perspectives is imperative to the future of engineering. To achieve this goal, we must characterize diversity, build communities that value diversity, and develop programs and

initiatives to leverage diversity” (Steering Committee of the National Engineering Education Research Colloquies, 2006, p. 261). “Underrepresented minorities are thought to have the ability to widen the diversity of thought that will ultimately strengthen the solutions that the workforce will be able to develop in response to today’s complex problems for a diverse society” (National Academy of Science et al., as cited in Yu, Crokin, and Martin, 2017, p. 68). Engineering is a field in which individuals have the opportunity to be change agents in the world through creativity, collaboration, problem solving and design. To exist in a world with a myriad of problems pertaining to diverse types of people it is imperative to have a broad range of perspectives and talents to tackle those problems. Without diverse perspectives, the world would be void of diverse and effective solutions (National Academy of Engineering, 2001).

Although African Americans have begun to pursue engineering, the lack of persistence continues to be an issue. The goal of the findings presented in this research is to help researchers and educators understand the reasons persistence is an issue, specifically within the College of Engineering. Cognitively and socially, achievement motivation can play a role in African American students’ lack of persistence, although “little is known about how academic confidence or achievement motivation affects engineering students and in particular African American undergraduate engineering students” (Lorah, Samuelson & Litzler, 2014, p. 825). Although little research has been conducted that links a lack of persistence to achievement motivation, researchers such as Seymour and Hewitt (1997) suggested students left engineering programs for many reasons, one dominant reason being because of a loss of academic self-confidence in a competitive environment.

Graham (1994) informed readers that questions surrounding the motivation of African Americans were of a great concern regarding the status of their academic achievements. The

researcher insisted that understanding how motivation was associated with achievement among African Americans was and is equally important as the popular focus on the cognitive process (p. 55). Motivation is suggested to be a key factor in any student's success. McGee et al. (2016) conducted research concerning African American post graduate engineers, albeit a slightly different demographic, the authors' argument that any solution aimed at addressing the lack of persistence of African American engineers through post graduate matriculation should begin with understanding how African American engineering students are motivated (p. 186).

Purpose of the Study

Achievement motivation influences can be linked to a lack of persistence in undergraduate engineering for African American students. In particular, the research explores reasons related to self-worth, an achievement motivation theory. "National concerns over the "STEM Pipeline" have led to additional funding at all levels to recruit and retain more students in STEM fields. Yet very few of these initiatives have significantly increased the number of underrepresented minorities, particularly African Americans, in STEM fields" (Kendricks & Arment, 2011, p. 2). In order to increase the number of African Americans in engineering by helping them persist, this research aims to showcase how some African American students lose their sense of self-worth within this academic environment, leading to non-persistence. Although very few studies have utilized self-worth achievement motivation theory to explain nonpersistence, Graham (1994) alluded to the need to explore this phenomenon in relation to achievement motivation in her research having stated "the study of motivation appears to be a key variable in understanding achievement strivings of minority populations" (p. 56).

The first purpose of this research study was to understand the reasons African American students did not persist in engineering. The second purpose of this study was to understand what

influences within the College of Engineering caused African American students to not persist in engineering. The goal of this research study was to discover reasons some African American students did not persist as engineering majors.

Need for Study

“Although there is existing literature on student persistence in undergraduate engineering programs, there is a lack of insight regarding the experiences of African Americans and other minorities. According to Beasley and Fischer (2012) there is limited research that addresses the high rates of minority and female non-persistence or dropouts in STEM disciplines such as engineering. In addition, there is a need to identify influences that affect African American students’ STEM confidence” (Lorah, Samuelson & Litzler, 2014, p. 817). In addition to sparse research on African Americans and non-persistence in engineering, little is known about the extent to which self-worth impacts the decisions of African American undergraduate engineering students (Lorah, Samuelson & Litzler, 2014, p. 825). This qualitative research study will help fill a gap in the literature regarding African American students’ lack of persistence in the College of Engineering and the influences of self-worth in achievement motivation in determining non-persistence in engineering amongst African American students.

In addition, it is proposed that this research will help promote reform in educational practices and will hopefully compel educators and administrators to work together to develop strategies surrounding visibility of support programs to help African American students persist in engineering.

Theoretical Framework

Elliot, Dweck, and Yeager (2017) stated “motivation is perhaps the indispensable element needed for school success” (p. 10). Cotten, Rikard, Coleman, Huang, and Ball (2016) found that changes in students’ intrinsic values and expectancies were statistically significant predictors of changes in students’ academic motivations. This led to researchers hypothesizing that by instilling intrinsic values, utility values, and expectancies for success, improvements can be made to the structural integrity of the STEM pipeline (Cotten, Rikard, Coleman, Huang & Ball, 2016, p. 633). These findings give way to positioning this research within the confines of the achievement motivation model, self-worth theory, which assumes students need to maintain their sense of worth or personal value by achieving success or avoiding failure in the classroom where intrinsic and extrinsic motivation is promoted (Covington, 1984).

While focusing on the mental and emotional motivational role of nonpersistence, researchers have developed models of motivational thinking. Elliot, Dweck, and Yeager’s (2017) five key elements of the competence motivation model are metacognitive skills, learning skills, thinking skills, knowledge, and motivation (p. 9). The basis for Covington’s self-worth theory is the achievement motivation model (learned-drive theory) developed by Atkinson and McClelland (McClelland, 1985; McClelland, Atkinson, Clark, & Lowell, 1976). People who are achievement motivation prone seek moderate challenges and risks. They are constantly trying to better themselves. Motivation also involves the individual’s motivation to enhance their intellectual skills (Dweck, 1999, 2002, 2007; Dweck & Elliot, 1983). These individuals believe intelligence is defined as rarely making mistakes or showing intellectual weakness (p. 10).

Within the achievement motivation models, Atkinson, McClelland, and their colleagues (Atkinson, 1957; McClelland, Atkinson, Clark, & Lowell, 1953) formalized the idea of

avoidance versions of the achievement motive, which is striving to avoid failure. The motive to avoid failure involved anticipatory shame caused by a competence-relevant situation. “The notion of anticipatory emotion represents a special case of future-oriented emotions” wherein those emotions may promote non-persistence (Baumgartner, Pieters, & Bagozzi, 2008). These similar tactics help form the basis of failure-avoiding students who assume a self-worth protective strategy to protect their perception of their competence as analyzed in the self-worth theory of achievement motivation.

The analysis of data in this research study was guided by the self-worth framework as presented by Covington (1984) as to explore participant voices when presenting the reasons African American students did not persist in engineering. Utilizing the self-worth framework regarding African American non-persistence and achievement motivation will assist in providing implications and solutions to combat to the phenomenon of non-persistent African American engineers in the College of Engineering.

Research Questions

The purpose of this qualitative case study was to explore and uncover the reasons African American students did not persist in engineering in the College of Engineering. The following questions guided the research:

1. What are the reasons some African American students do not persist in the College of Engineering at a predominantly White institution?
2. What are the particular factors within the College of Engineering that prompt non-persistence in African American undergraduate students?

Limitations and Delimitations of the Study

Upon deciding to explore the dilemma concerning the lack of African American students persisting in engineering, several recognizable limits to this research study became apparent. Utilizing the case study approach to explore the perspectives of a modest number of participants in one semester may not reflect the views of an entire population (Creswell, 2007). This research study examined nine participants from one University's engineering school. Although the thoughts and perceptions of multiple participants were explored, some participant responses may not be generalizable (Creswell, 1998). One participant also showed apprehension during the interview and exhibited signs of fear due to the researcher power imbalance. Although this was the case with one participant, the researcher was able to gather meaningful responses from the other participants. In addition, this research also sought to explore and describe the intrinsic experiences of the participants instead of providing evidence through statistical measures.

Key Terminology

Achievement Motivation: motivation that involves seeking moderate challenges to better one's self (Wigfield & Eccles, 2001).

Belonging: the feeling of being a part of an organization or being qualified to be a member of the organization or environment (Covington & Dray, 2002).

Engineering: a discipline that utilizes mathematical and scientific reasoning within a process to design, construct and build entities and find solutions to enhance living conditions (American Society for Engineering Education, 1985).

Failure-avoidant: individuals driven to avoid failure in order to eliminate a showing perceived incompetence (Covington & Dray, 2002).

Non-Persistence: the act of not continuing on a current course, such as a project, task, or academic pursuit (Yu, Corkin, & Martin, 2017).

Self-Worth: the attempt of students to protect their self-esteem, worth and personal value when their perceptions of their ability change. Please see Figure 1. They adopt strategies to keep their inability veiled (Covington and Beery, 1976).

STEM: the acronym STEM represents the following disciplines: science, technology, engineering and mathematics (McClain, 2014).

Success-oriented: individuals driven to achieve who have a positive achievement motivation perception (Covington & Dray, 2002). [see figure below]

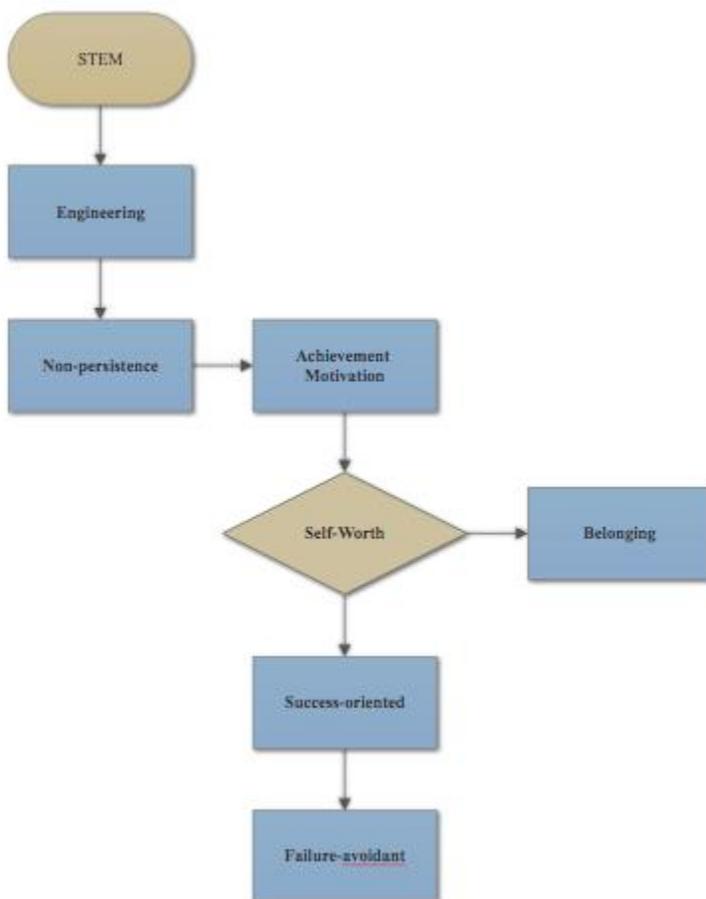


Figure 1: Self-Worth Theory in Non-Persistence

Chapter Summary

In recent years, there have been significant efforts by government, industry, universities, and philanthropic foundations to address the problem of underrepresentation of African Americans among engineering graduates (Brown, Morning, Watkins, 2005, p.263). There has been a focus to do so because STEM employers in the United States have affirmed the value of a diverse workforce in the drive for innovation (Newman, 2011, p. 194).

The self-worth theory of achievement motivation guided this research, which focused on exploring the reasons African American students did not persist in engineering at the undergraduate level in the College of Engineering at NC State University. The research presented explored students' perceptions about their own abilities and the influences that resulted in their non-persistence in the College of Engineering.

To continue to position itself as an economic powerhouse, the United States has to diversify the STEM workforce (Bidwell, 2015). In order to diversify the engineering pipeline, more African American students need to persist in the engineering discipline at the undergraduate level at NC State University.

CHAPTER 2

LITERATURE REVIEW

“Engineering is a discipline that can illustrate the features of student choice that affect field migration and attrition in very clear terms, and was chosen for this study because, however complex its story, all the variables affecting choice, persistence, and migration come into play” (Adelman, 1998, p. 14). The engineering discipline, a refined and celebrated extension from the traditional vocational education era, has seemingly attracted a diverse array of patrons at universities across the world. However, even in all its allure, the discipline doesn’t seem to retain its diverse array of patrons in its entirety, in particular African American undergraduate students. “A more recent study conducted by the Higher Education Research Institute (2010) found that 33% of White and 42% of Asian American students at a national sample of institutions completed their bachelor’s degrees in STEM within five years of entering college, compared to only 18% of African American and 22% of Latino students” (Chang, Sharkness, Hurtado, & Newman, 2014, p. 556). Although this phenomenon can be observed at a national level, this research study has specifically explored African American undergraduate students in the College of Engineering at NC State University. Throughout this chapter the researcher provides an exploration of literature that displays the history of the engineering discipline nationally and in the College of Engineering and its non-persistent counterparts, African American students (Office of Institutional Research and Planning, 2017). In addition, the literature has illustrated the need to explore the phenomenon of non-persistence of African American students in engineering within the self-worth achievement motivation theoretical framework using a case study method (Ohland et al., 2011). Thus, this chapter fills in the literature gap regarding African American students in terms of self-worth achievement motivation reasons for non-persistence in

the College of Engineering at NC State University (Wigfield and Eccles, 2001; Office of Institutional Research and Planning, 2017).

Engineering History

“Engineering is the study and implementation of the practical uses of science. The profession deals with the design and building of a wide range of machines, devices, systems, and structures” (JBHE, 1998, p. 32). According to the U.S. Department of Commerce (2011) STEM jobs were expected to grow 17 percent from 2008 to 2018; however, according to the U.S. Department of Education (2010) from 2007-2008, African Americans represented only 7 percent of engineering and biological sciences undergraduate degrees in the United States. Adams and Burgoyne (2017) suggested that engineering programs typically exhibited student retention rates of 60% after the first year. Although these statistics are representative of a national problem, a similar phenomenon is occurring within the College of Engineering. According to the Office of Institutional Research and Planning at NC State University, during the 2015-2016 academic year, the College of Engineering had only 40 African American students complete an engineering degree out of the 1370 who completed the program. African American students represented slightly less than three percent of those who completed engineering degrees in 2016.

During the 1970s, African American enrollment in engineering degrees at universities and colleges around the nation saw a 300 percent increase; however, by the early 1990s, the numbers began to decline. Since then, the problem of African American students persisting in engineering at universities and colleges around the nation has been an dilemma (JBHE, 1998). According to the Journal of Blacks in Higher Education (1998), African Americans historically have been absent in the field of engineering. It is reported that African Americans were thought to be incapable of comprehending complex subjects within the engineering curriculum. In

addition, engineering firms were reluctant to hire African Americans, therefore African Americans did not pursue the study of engineering.

Bowman (2015) conducted a research study that examined the degree trends for African American students. His study showed a more positive trend for African American males, although non-persistence for African American students remains a concern in the United States and in particular in the College of Engineering at NC State University. Bowman (2015) found that engineering bachelor of science degrees for African Americans declined from 5.1% to 4.3% over the course of nine years; however, the overall number of bachelor of science engineering degrees reported to ASEE increased by about 28%. The African American male engineering degree recipients grew from 2398 in 2005 to 2742 in 2013, an increase of approximately 14%. In contrast, the number of female African American recipients of engineering bachelor of science degrees declined 23%, from 1144 in 2005 to 875 in 2013. Although there has been a slight improvement in African American male engineering degree recipients from 2005 to 2013, the overall picture for African American engineering degree recipients remains bleak in comparison to their peers. The positive increases for African American male degree recipients establish that some efforts are working in some engineering disciplines such as electrical engineering; however, in some engineering disciplines there remains a decline for African American males as well as females. As shown in Figure 2 and 3, this research has explored the reasons for the overall non-persistence of African American students in the College of Engineering at NC State University.

Degrees & Certificates by Year (will change with selections)

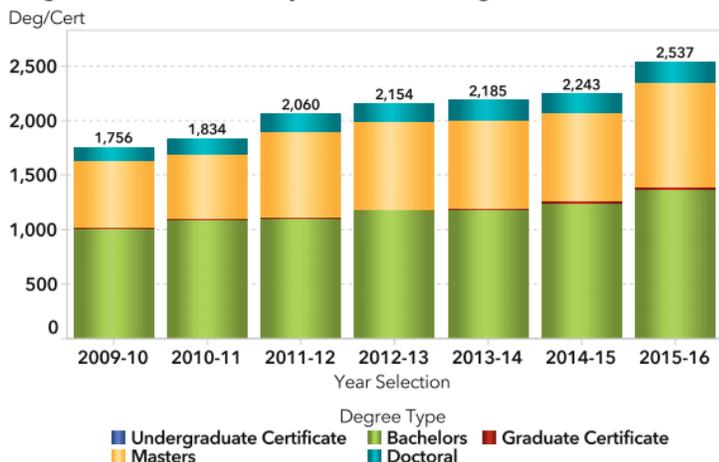


Figure 2: White/Caucasian Student Degree Completion in COE

Degrees & Certificates by Year (will change with selections)

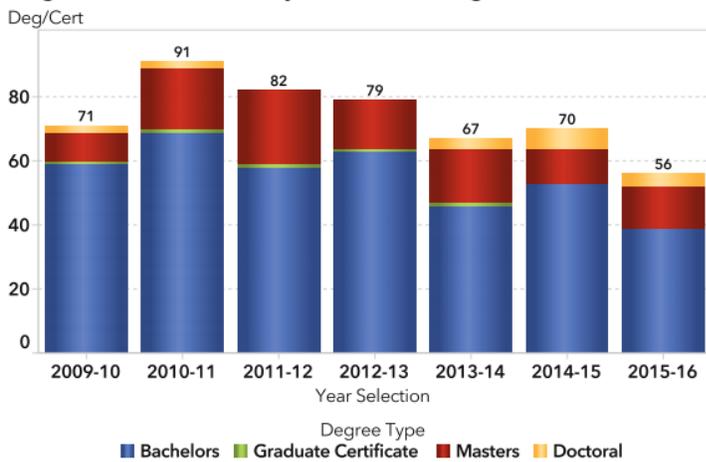


Figure 3: African American Student Degree Completion in COE

In 1960, the first African American student to have a degree conferred represented the College of Engineering (NCSU African Americans, 2017). Fifty-six years later, in 2016, only 40 African American students stood as graduates for the College of Engineering.

Upon searching the Electronic Theses and Dissertation database for manuscripts before and after the year 2002, only two manuscripts were found to date which showcased research regarding African Americans in engineering. Atwater (1980) conducted a quantitative study

examining the variables of success of Black undergraduates within the science and engineering discipline. Wall (1995) conducted a case study exploring African American undergraduate persistence in the department of industrial engineering.

Wall (1995) used a qualitative case study to investigate persistence amongst African American students within the College of Engineering. The researcher drew on a critical theory while using an interpretive framework to gather the perspectives of students, faculty members and administrators regarding the persistence of African American students in the industrial engineering department. Her respondents included six African American students and her primary method of data collection was in-depth interviews. At the time of Wall's research, African American students "made up about 10% of enrollment in both the college of engineering and the university" (1995, p. 101-102). In her narrative which blended many voices in an effort to describe the community of struggle amongst African American students surrounding persistence, several themes emerged.

Wall found that students within the industrial engineering department of the College of Engineering had issues with campus climate, the department setting, financial issues and overall institutional change. Although she exclusively researched persistence versus nonpersistence, many students were also found to not persist due to the same issues. In particular to non-persistence, students expressed having transferred out of engineering because of the demands of a challenging curriculum at a predominantly white institution (PWI), low expectations by peers in academic settings and a "cut-throat" attitude amongst peers (Wall, 1995). Research conducted by Wall (1995). Wall's research provided indications of several self-worth issues among African American students within the discipline. This research study has uncovered similar issues surrounding non-persistence for African American students today, twenty years later.

Outside of the university, no research studies were found to address the issue of non-persistence of African American students in the College of Engineering at NC State University. This lack of literature focusing on the College itself warranted a need for this research study.

Achievement Motivation

“The Latin root of the word “motivation” means “to move”; hence, in this basic sense the study of motivation is the study of action” (Wigfield & Eccles, 2002, p. 110). Within the last 30 years, theorists have presented a plethora of research on motivational beliefs, values, and goals and how they develop (Wigfield & Eccles, 2002, p. 1). The study of motivation provides a rich framework for addressing some of the most pressing issues facing our educational system today and often revolve around problem areas such as early withdrawal, retention, persistence and attrition, which have been disproportionately observed in ethnic minorities, particularly African American students (Wigfield & Eccles, 2002, p. 121). Although theorists have presented quite a bit of research on motivational beliefs and how motivation serves as a framework for addressing pertinent issues in society and the educational system, very little research has been conducted related to the motivational beliefs of African American students and the relationship of those beliefs to academic non-persistence (Wigfield & Eccles, 2002, p. 123). In this research study, the self-worth achievement motivation theory served as a framework for exploring the phenomenon of non-persistent African American students in the College of Engineering.

Within the fields of education and psychology, prominent scholars have contributed substantially to the achievement motivation literature. Early achievement motivation research dates back four decades to the work of Atkinson and McClelland (1960). Atkinson (1960) developed a theoretical model to explain how approaching success and avoiding failure influences a student’s motives to take risks and gauge performance levels. Atkinson (1960)

determined that motivation is strongest when a person's motive to achieve success outweighs their motive to avoid failure. However, when an individual has a stronger motive to avoid failure, achievement becomes "distant and unattractive" (p. 52).

In addition to the development of theoretical models, McClelland's (1969) Thematic Apperception Test (TAT) was one of the earliest achievement motivation instruments to be developed. The Mandler-Sarason Test Anxiety Questionnaire (TAQ) was often paired with McClelland's Thematic Apperception Test (TAT) to create a combined measure of achievement motivation (Hermans, 1970, p. 353). Other early instruments measuring achievement motivation include the Iowa Picture Interpretation Test (IPIT) and the French Test of Insight. The French Test of Insight was used to measure achievement regarding the strength of a motive to achieve and the TAQ instrument was used to indicate a student's strength in their motive to avoid failure (Mandler & Sarason, 1952; French, 1955). Criticism arose regarding the tests, suggesting they lacked internal consistency and test-retest reliability (Herman, 1970, p. 353) but findings indicated that success-oriented students would choose somewhat more difficult tasks, giving them an equal chance of achieving success. These students would also perform better than those who were prone to avoid failure, whom also avoided tasks at any level of difficulty.

In time, new instruments were constructed to measure achievement motivation. These instruments included the Achievement Motivation Profile (AMP), the Ray Motivation Achievement Scale, and the Contextual Achievement Motivation Survey (CAMS). The most recent, CAMS, which is grounded in McClelland's theory of achievement motivation, is considered suitable for use although recommendations have been made to continue to explore ways to measure the concept of achievement motivation (Smith, 2015). Such test are deemed suitable in research studies where participants' achievement motivation needs to be measured.

However, for this qualitative case study research, it was the researcher's intent to develop a more holistic picture of how self-worth achievement motivation plays a role in a participant's decision-making and the influence self-worth has on non-persistence in the College of Engineering.

Since these early developments, the achievement motivation theoretical approach has been developed and explored to formulate numerous models. Current models in the achievement motivation field include: self-efficacy theory, self-worth theory, expectancy-value theory, entity vs. incremental intelligence theory, self-determination theory, interest theory, goal orientation theory, and social goal theory (Wigfield & Eccles, 2002, p. 4). Although there is a vast array of achievement motivation models, literature from this research focuses on the self-worth theory of achievement motivation which is an extension of Atkinson's and McClelland's Expectancy Model.

Self-Worth Theory of Achievement Motivation

Conceptually, self-worth can be defined in terms of an individual's self-esteem, self-respect, and personal acceptance. As an individual takes an evaluative review of himself, self-worth is usually discovered. In terms of the evaluation of self-worth, most individuals strive to protect their sense of worth, especially if it is threatened. Individuals, particularly students, try to increase or protect their sense of worth by showcasing their successes and avoiding failure. Success drives their self-worth and failure diminishes their sense of self-worth (Covington and Beery, 1976). Beery (as cited in Covington and Beery, 1976) proposed that a threat may impress upon an individual's self-worth when there is an inability to perform which further limits the individual's perspective of success. A student may believe this dilemma exemplifies failure which in turn inhibits their reception or approval from society. These implications led to the

conception of the self-worth theory, which is a model within the achievement motivation theoretical umbrella. “The self-worth theory assumes that a central part of all classroom achievement is the need for students to protect their sense of worth or personal value.

Perceptions of ability are critical to this self-protective process, since for many students the mere possession of high ability signifies worthiness. Moreover, ability is widely perceived as a major cause of success, and success in turn reflects well on the individual” (Covington, 1984, p. 4).

Distinctly, the academic environment affords students the opportunity to evaluate their abilities, put forth effort and gain acceptance or approval as residuals for their abilities and efforts. Strangely enough, academic environments also pose an interesting dichotomy for students which sets the scene for implications and threats to an individual's self-worth (Covington and Beery, 1976). The classroom is a unique place for students to gauge their abilities; however, it is also the setting for students to approach failure. A student's sense of self-worth does not necessarily have a navigable boundary to differentiate a right or wrong place for its formation; it simply ascertains whether or not it is being threatened or maximized. Within this relationship, therein lies the birth for several pertinent concepts within the self-worth framework which include: ability, achievement, effort, failure and success.

Success and failure are viewed differently by interpretation. In this particular case, students who are older have tendencies to place a high demand on success in reference to their ability. Covington and Beery (1976) posit that in one instance, success serves as evidence of ability. If an individual has performed well historically in an area, the assumption is the individual will succeed again. However, if failure ensues, it is believed to be evidence of insufficient effort. This does not position failure as a threat for these students. Students who typically take this position believe failure is a part of the learning process and is in no wise an

indication of their idiosyncratic learning characteristics. This is an example of a success-oriented individual. Another type of individual appears and that is one who is failure-avoidant. For this individual, they harbor fear and often have self-doubts. He or she believes they lack ability, therefore they avoid putting forth an immense amount of effort in the attempt to avoid a threat to their self-worth. Their lack of effort which presumably results in low achievement is conceivably a strategy for the individual to protect their self-worth. Failure is a threat and it is perceived to be indicative of their inability to perform well. For success-oriented or failure avoidant individuals, these concepts play a large role in determining an individual's self-worth. The perception of one's ability serves as a dominant factor of achievement behavior. Success in the classroom or in life seems to lend rewards personally and socially. Individuals are driven to succeed to minimize indications of failure and assume a position of success and reap its benefits (Covington & Dray, 2002; Covington, 1984).

Extrinsic and Intrinsic Rewards for Motivation

Typically, achievement is a major focus in academic environments. Even before an individual frames their personal definitions of success or failure, they have aiding cues. Students in particular are usually motivated by extrinsic or intrinsic means. Extrinsic motivation occurs when students are motivated to achieve for the purpose of receiving praise or acknowledgment from others, typically peers and teachers. Intrinsic motivation occurs when students achieve because of personal enjoyment or knowledge acquisition. Success and failure look differently for individuals who achieve when extrinsically rewarded versus those who achieve for intrinsic rewards. Extrinsic and intrinsic motivation based on extrinsic and intrinsic rewards play a role in a student's sense of worth because they are residuals of a student's achievement, ability, or effort. Covington and Beery (1976) insisted that although academic environments, specifically

teachers, provide extrinsic rewards they prefer students to have intrinsic motivation as it assists in the learning process. In the world of academia students are praised for achievement or effort. This is particularly troublesome for both the success-oriented student and failure-avoidant student. For the success-oriented student, extrinsic rewards incite a fire that when quenched through academic inability or ensuing failure, they lose self-worth. For the failure-avoidant individual, extrinsic rewards do more harm than good, shedding light on the student's academic insecurities which leads to a loss of a sense of self-worth (Covington & Beery, 1976, p. 27-35).

Sustaining Self-Worth

Some individuals are equally striving for success and attempting to avoid failure. One individual can either be strongly failure-avoidant or heavily success-oriented while another may have tendencies that indicate they hold both characteristics. Covington and Beery (1976) coin two overall themes for avoiding failure. The initial theme for individuals who try to avoid failure “involves disowning the implication that failure holds for one's ability to achieve” (Covington and Beery, 1976, p. 43). This concept describes the individual labeled as an *underachiever*. A second concept for a failure-avoiding strategy includes “attempts to avoid failure and its implications by ensuring success” (Covington and Beery, 1976, p. 44). An individual who uses this strategy is described as an *overstriver*. Two main strategies presented for individuals who avoid failure to evade an implication of their ability to achieve are: nonparticipation, false effort, and impossibly high goals. Nonparticipation, false effort and impossibly high goals are failure avoiding tactics used by students when failure seems inevitable and they want to evade displaying having low ability. The two main strategies presented for individuals who want to ensure their success include: low goal-setting and academic cheating. When there is a fear of failure, low goal-setting and academic cheating ensure success.

An *underachiever* fears failure so they limit their effort academically to serve as a defense against that sense of failure. The underachiever associates their worth with their ability to achieve; however, they expect perfection (Covington & Beery, 1976, p. 51). To this student perfection becomes unattainable, so they use failure avoiding tactics such as procrastination and not trying. This in turn protects their sense of self-worth, although it produces negative results.

Overstrivers are similar to underachievers in that they believe their worth is tied to their accomplishments. Overstrivers differ in that they do perform well academically, however, their incessant effort to avoid failure through high achievements become burdensome. They extend quite a bit of effort and they showcase high ability. They are not procrastinators, they do try and they excel. Overstrivers experience threats to their worth even when they achieve because there is always the lingering thought of failure and when failure does happen, they lose a sense of worth. Overstrivers try to avoid failure by going above and beyond. This threat of failure increases in competitive environments.

Competitive environments such as in academic environments, are conducive to induce the development of the overstriver or underachiever mentality in students. In these stressful environments, self-worth can be defined by getting good grades. As alluded to earlier, success-oriented individuals often take on a challenge, however, they like the challenge to be within their means to achieve a guaranteed success. However, there are individuals, such as overstrivers, who tend to adopt a competitive mindset who have to be at the top and receive the best grades in order to eliminate any inclination of incompetence. These students often develop strategies to avoid failure. Learning becomes a means to obtain rewards. This in turn creates stress and fear when grades or extrinsic rewards are threatened (Covington & Dray, 2002, p. 33-36). Students with a self-worth behavior, such as overstrivers and underachievers, feel threatened when

accomplishment becomes obsolete in these competitive environments. Their identity and self-worth become threatened through loss of extrinsic rewards and achievement.

Self-worth theory states that in certain situations students stand to gain by not trying—by deliberately withholding effort. This is likely to occur when poor performance imposes a threat to self-esteem. One circumstance in which this occurs is following an experience of failure. Failure threatens self-estimates of ability and engenders self-doubt about the individual's capacity to perform well on a subsequent occasion. If subsequent performance turns out to be poor, then doubts concerning ability are confirmed. The self-worth theory states that one way to avoid threat to self-esteem is by withdrawing effort. Withdrawing effort allows failure to be attributed to lack of effort rather than to low ability. Thereby, threat to self-esteem is reduced (Thompson, Davidson, & Barber, 1995, p. 598).

Interestingly enough, Reisel and Brekke (2010) suggested that non-persistence in higher education amongst minorities may be a choice or forced behavior that is reflected by a lack of motivation or disinterest (p.694). The transition can present itself to be the effect of many causative reasons such as poor academic performance, economic distress, family obligations or other external factors (Reisel & Brekke, 2010, p. 694). There is a great body of literature that focuses on minorities' lack of persistence due to economic factors or external social factors; however, few literary sources attribute their lack of persistence, especially in engineering, due to achievement motivation factors.

Related Achievement Motivation Theories

There are two particular theories that Covington (1984) asserts directly influence or can be associated with the self-worth theory of achievement motivation. Those two theories are the learned-drive theory and the cognitive attribution theory.

Learned-drive Theory

Learned drives are considered to be psychological motives, such as the “need for approval, belongingness and achievement” (Covington, 1984, p. 6). Theorists, David McClelland and John Atkinson were responsible for developing the learned drive model in the 1950s. According to their model, the need for achievement is a results from an internal conflict to strive for success and to avoid failure (Covington, 1984). Whether an individual, or in this case a student, is success-oriented or failure-avoidant is said to be influenced partly by childhood experiences.

Success-oriented children, those who have a positive achievement orientation, have parents who permitted them exploration but established rules of conduct and set limits within those confines. They were rewarded for praiseworthy performance and in situations where performance fell short of expectations, parents remained neutral. Failure-avoidant students were punished by parents when they did not meet expectations and parents were considered guarded or vague in their vocalizations regarding the child’s success (Covington, 1984). It is also important to note that situational factors also played a role in which orientation the child was said to have taken. Self-worth, drawing from the learned-drive theory, focuses attention on the need to approach success and avoid failure. Furthermore, failure introduces a threat to self-worth.

Cognitive Attribution Theory

Weiner and his colleagues proposed what was considered a radical take on the learned-drive theory, prompting the attribution theory. The principle behind this theory states people's view of the causality of their success and failure influences the quality of their future achievement. "The basic emotional anticipation of hope for success and fear of failure (stressed in drive-theory formulations) was subordinated to cognitive attributions as the major determinants of achievement behavior" (Covington, 1984, p. 7).

In achievement situations, students attribute their successes or failures to 1) their ability, 2) their effort, 3) the difficulty or ease of a task, and 4) random chance (Covington and Beery, 1976, p. 67). Within the perceived causes of success and failure, students either believe there are internal (locus of control) or external influences determining the outcome. Internal outcomes, those controlled by the student, are based on ability and effort. External outcomes, those beyond the student's control, are task difficulty and random chance. Success-oriented students attribute success to ability and effort, and failure to a lack of effort. Failure-avoidant students attribute success to external factors such as an easy assignment or good guessing on an assignment. They ascribe failure to a lack of ability (Covington and Beery, 1976).

Relation to Self-Worth

Covington and Beery (1976) suggest self-worth theory of achievement motivation [see Figure 4] derives from the basic cognitive attribution position and shares with it the view that achievement behavior can be conceptualized in terms of perceptions of causality. However, unlike the attribution theory, there is a motivational component. Therefore, the relationship between the learned-drive theory and cognitive attribution theory coincide to form the basis of the self-worth theory.



Figure 4: Related Achievement Motivation Theories

In society, a person's worth is often measured by success and failure; therefore, incompetence poses a threat to worth. Ability is viewed as critical to success and inability is a component of failure. Self-worth stresses ability perceptions as a primary component of achievement behavior. There are three major components in determining students' self-worth, including ability, effort and performance. Older students, such as collegians, value ability over effort (Covington, 1984). Students who expend a tremendous amount of effort run the risk of showcasing incompetence in their ability which threatens self-worth. Therefore, they do not expend much effort and endure the guilt of a lack of trying which is preferred over the shame of low ability. This is a trait of failure-avoidant students. It is also important to note that with older students, simply the perception of high ability, which is heralded over effort, is beneficial to their self-worth. Since success-oriented students have a positive achievement motivation orientation, they are likely to accomplish future success while failure-avoidant students are likely to continue in failure. The self-worth theory assumes that much of student achievement behavior is best understood in terms of attempts to sustain a reputation of competence and worth. Students use protective strategies to avoid threats to self-worth (Covington, 1984). "The degree of certainty about one's ability status, as well as level of ability perceptions, appears to be a critical factor in resiliency to failure" (Covington, 1984, p. 12). This research study has utilized the self-worth

framework to determine if African American students showcase either success-oriented or failure-avoidant orientations based on their tendencies and what exact reasons pertaining to ability perceptions induce non-persistence in the College of Engineering.

African American Students and Motivation

Graham (1994) selected 140 research studies where researchers examined the motivational factors related to African American students. Graham discovered three important misconceptions regarding African American motivation research. Although previously suggested by other researchers, Graham found African Americans to be no different than other ethnicities regarding personality traits that inhibit their motivation. It was also posited that there was insufficient evidence concerning African Americans having a lack of control when addressing motivational consequences. It was also supported that African Americans in general have an expectancy for future success, although African Americans have been found to overestimate their future success in light of their current abilities and performance. A more recent study examining persistence and non-persistence suggested that underrepresented minorities, inclusive of African American students, who pursue majors in STEM, such as engineering, are affected by environmental and internal psychological factors (Chang, Sharkness, Hurtado, & Newman, 2014).

When addressing motivational performance in African Americans, certain considerations should take place, especially in settings such as academic environments. Understanding the motivational psychology for African Americans should concern the self, such as self-worth (associated with self-esteem) and self-perceived ability. When analyzing African American student motivation researchers should be sensitive to failure, acknowledge the complexities of

race and social class within society, and incorporate a range of affective determinants of behavior (Graham, 1994).

Grounded within the self-worth theory, this research has viewed the non-persistence of African American students in the College of Engineering based on similar and additional factors. The case study has presented a wealth of data that will inform future research and posit helpful recommendations within the engineering discipline regarding African American students. It will also shed light on the role self-worth plays in the overall departure of African American students in the College of Engineering at NC State University. It is through understanding their voices and exploring the data presented in this research that researchers and administrators should ascertain pertinent information that will help reshape the population of African Americans in the College of Engineering.

Non-Persistence among African American Students in Engineering

Retaining underrepresented minorities such as African Americans in STEM disciplines like engineering seem to be a national priority, however, the trends exhibiting persistence are bleak (Hernandez, Woodcock, Schultz, Estrada, & Chance, 2013, p. 90). Students are admitted to engineering programs within many institutions, however evidence stemming from engineering education literature illustrates a problem with non-persistence among women and minorities.

Ohland et al. (2011) conducted a research study that examined participants at nine different institutions exploring success in engineering education. The researchers found that although some African American students did persist at high levels, persistence of African American students in general exhibited more variation than any other race. In addition to non-persistence within the discipline, historical equity issues present unfavorable situations and circumstances (Adelman, 1998).

According to Adelman (1998) NC State University has been considered a flagship engineering school in the North Carolina higher education system, and its engineering programs are considered to be selective. Albeit an engineering powerhouse, it showcases similar issues along with institutions within the United States - the continual non-persistence of African American engineering students. According to the Office of Institutional Research and Planning (2017), for the past seven years, the College of Engineering has averaged a loss of more than 25 African American engineers between the end of the fall semester and the beginning of the spring academic semester, year-to-year. Although 25 may seem to be a small number, it has a large implication when the number of African American engineering students make up less than five percent of the College of Engineering. One of the proposed research questions in this study aimed to pinpoint the reasons African American students did not persist in engineering. Espinosa (2011) even suggested that negative effects to persistence sometimes include attending a highly selective institution.

Stafford (1966) completed a research study regarding the factors associated with the achievement and attrition of freshmen engineering students in the College of Engineering at NC State University. Since that time, few research studies of similar magnitude have been conducted to address this phenomenon within the College of Engineering. Stafford (1966) conducted a quantitative study examining the relationship between the student's Scholastic Aptitude Test (SAT) scores, the occupational level of the father, parents educational level, high school rank, GPA in the first semester within the College of Engineering, and student attrition. The study involved separating students into three groups: *suspension*, *transfer*, and *withdrawal*. A correlation statistical test was conducted to find that two of the variables, SAT mathematics

scores and high school rank were statistically significant in differentiating whether students experienced attrition or persisted.

Although this research study is valid, it does not address non-persistence within the College of Engineering among African American students. Neither does the research study provide depth and richness regarding student reasons for non-persistence. Aside from Stafford's (1966) research, a more recent research study examining persistence amongst first-generation college students in STEM majors also posited that first-semester GPA for "diverse groups" was a deciding factor in persistence; however, the research did not exclusively discuss African American non-persistence or the role of motivation within an academic setting (Dika & D'Amico, 2016). However in Stafford's (1966) research, he provided evidence from researcher Marsh's (1966) literary work which correlates with Atkinson's (1960) early research that achievement motivation within the academic environment is a useful factor when examining students' non-persistence.

Although quantitative studies have been conducted examining factors associated with non-persistence and the academic ability of engineering students, this research study had a concrete goal to explore personal and narrative depictions of non-persistence. The question of non-persistence can certainly be informed through statistical measures weighing in on competence and motivation; however, a qualitative perspective of firsthand accounts that corroborate the various reasons for non-persistence from those who did not persist presented to be beneficial.

Reasons for Non-persistence

Renowned persistence researcher Tinto (as cited in Rodgers, 2017) suggested that persistence is influenced by the students ability to separate from previous academic and social

associations, transition and become acclimated to the academic and social communities of their institution or academic program. Tinto believe that if students were socially and academically integrated into their program, persistence was more likely to occur (p. 38). Although this is a highly respected theory, for African American students especially those attending predominantly white institutions (PWIs), academic and social integration takes on a different form, thereby negatively affecting their persistence and thus producing non-persistence amongst these students in STEM programs like engineering. The “students’ perceptions of the accessibility of faculty and other students, the comfort of the culture of their STEM program, and the overall sense of feeling welcomed by the program and fellow students all combine to influence students’ motivation, which in turn influences their academic and social integration” which in turn functions as reasons for their persistence or non-persistence (Rodgers, 2017, p. 38-39).

Rodgers (2017) defined persistence as a “students’ tendency or decision to continue or not continue along their current course” (p. 38). Students described as non-persistent can be considered as those who made a decision to discontinue their current academic course, in this instance, the discipline of engineering. If persistence is considered a student-controlled variable, then there must be reasons for students to make the decision to not persist (Rodgers, 2017). After reviewing the literature, several reasons for non-persistence were presented by multiple authors, the most frequent themes were discussed in this chapter and served as a guide to this research study.

Academic Environment

Seymour and Hewitt (1997) conducted research illustrating that students left science or engineering programs because of a loss of academic self-confidence in the competitive environment. Although Seymour and Hewitt’s work (1997) did not exclusively consolidate their

reasoning to African American students, they did however find that “white, masculinist experiences and expectations permeated courses in science, mathematics and engineering” which could have thereby influenced African American students to be non-persistent in such an environment. Furthermore, if the climate of the institution’s engineering program presents to be unwelcoming assisting in African American students’ feelings of a lack of belonging, it could have presented to be detrimental to their persistence in those programs (Marra, Rodgers, Shen, & Bogue, 2012). Strayhorn et al. (2014) suggested that studies have shown that historically underrepresented racial/ethnic minorities (URMs [such as African Americans]) face several obstacles at predominantly White institutions (PWIs) that impede their engagement including negative, unsupportive faculty members and very few same-race peers upon whom they can rely for support and friendship. Some of these same reasons for the non-persistence of African American engineers was also variably presented in this research.

This reason can be further asserted by taking an opposing view. Palmer, Davis and Hilton (as cited in Burrell, Fleming, Fredericks, & Moore, 2015) suggested that at historically black colleges or universities, also referred to as HBCUs, non-persistence has little to do with institutional characteristics such as academic environment, but with socioeconomic issues such as a lack of financial support. This further asserts that at predominantly white institutions, also known as PWIs, African American students may encounter motivational barriers within their academic environment. Barr, Gonzalez, and Wanat (2008) concluded that many underrepresented minority students when confronted with academic challenges did not know how to persevere.

Extending beyond a concept of belonging and community, problems within the academic environment related to ability and achievement were found to be prominent. Literature suggested

that non-persistence has stemmed from African American students not knowing how to cope with academic inadequacies. Meyer and Marx (2014) provided qualitative evidence supporting students' academic reasons for non-persistence. The authors reported in their research that "the most common institutional factor mentioned by participants and supported by the attrition and retention literature was the participants' feeling of unpreparedness for the rigors of the engineering program" (p. 541). Researchers Seymour and Hewitt (1997) found that barriers to persistence in engineering among African Americans revolved around faculty guidance. In addition, Castaneda, Cabrera, Hengstler and Nora (1992) also found depleted motivation to be a factor linking similar inhibitors such as an institutions' academic characteristics (p. 144).

Seymour and Hewitt (1997) suggested that students in general felt a lack of or poor personal support in engineering programs. Marra, Rodgers, Shen, and Bogue (2012) found that poor teaching and advising were reasons for non-persistence. Lovecchio and Dundes (as cited in Tucker & Winsor, 2013) also indicated that one of the reasons for Black students' decreased persistence in a STEM major were academic challenges, faculty advising, climate issues, and motivation. Perceptions of racism and discrimination amongst African American students in an academic environment could have a negative impact on a student's focus or motivation, which, in turn, could ultimately hinder his or her achievement. Moreover, if students perceive racism and discrimination in the academic environment they could possibly adopt a victim mindset, which is damaging to academic success (Brown, Morning, & Watkins, 2005, p. 269). Tinto (as cited in Freeman, Alston, and Winborne, 2008), presented research showing that students' motivation and attitudes were enhanced and not inhibited when learning communities were established, which was especially beneficial for African American students.

Overall, African American students reported in several research studies that the biggest barriers to maintaining motivation in engineering concerned the academic environment whether in the classroom or within the departmental climate amongst peers and faculty. These reasons, amongst others discussed in this section, prompted this research study in an effort to showcase that some of these reasons, as illustrated by the data, continued to play a role in non-persistence of African American students.

Overcoming Stereotypes

Steele (as cited in Hope, Chavous, Jagers, and Sellers, 2013) “posited that Black students, particularly those who identify strongly with academics, are concerned with confirming stereotypes of academic incompetence and racial inferiority in academic settings—stereotype threat” (p.1125). Steele (as cited in Hope, Chavous, Jagers, and Sellers, 2013) also “suggests that in response to repeated experiences of stereotype threat, students may disidentify with the academic domain as a means of protecting their self-concept from the threat associated with negative race-based academic stereotypes” (p. 1125). This experience of negative stereotyping may lead to a lack of academic effort or achievement. Wigfield and Eccles (2001) believed that minority males, more than other adolescents, had to cope with the stressors of academic challenge and negative stereotypes about their group, and that those stressors could undermine the endorsement of achievement values. African American males and females both have encountered negative experiences from the broader society. Beasley and Fischer (2012) confirmed that African American women and men may suffer from stereotype threat, although it is unclear if men or women are more vulnerable to negative stereotyping. Even though stereotypes seem to have a negative effect, some researchers have found that in certain cases these experiences tend to cement a tempered or controlled Blackness which allowed them to

focus on meaningful activities (Reid, 2013, p. 78). Thus, the stereotype threat empowered African American students to persevere in certain cases.

Stereotypes can often be masked by racial microaggressions in the academic environment. These are subtle, nonverbal implications that often affect African American students in negative ways. Rodgers (2017) suggested that students can receive messages, whether hidden or apparent, about their own academic competence from their peers, faculty members and society in general. Stereotypes could play a role in sending negative messages about competence and ability. Yu, Corkin and Martin (2017) also proffer that stereotypes can serve as another barrier which negatively impact underrepresented students' motivation and achievement. Hurtado et al. (as cited in Chang, Sharkness, Hurtado, & Newman, 2014) found that "perceptions of hostile racial climates were negatively associated with the sense of belonging of all students, whereas such climates hindered the academic adjustment" of only underrepresented minorities (p. 557-558).

Although none of the participants in this research cited stereotypes as being a reason for their non-persistence, an interview participant and focus group participant did express experiencing racial undertones. Understanding that African American students are inhibited by the use of negative stereotypes can help researchers develop new theories as to why certain African American students are non-persistent in the engineering discipline at the undergraduate level.

High Aptitudes in Science and Mathematics

Participation in advanced courses and strong preparation in high school became a major influence for African Americans pursuing STEM at the undergraduate level (Dancy, Palmer, & Maramba, 2001, p. 498). Specific groups of African American students showcased strong

aptitudes in science and mathematics according to researchers. Astin and Astin (1992) found that students who persisted in engineering majors entered college with adequate mathematical and academic preparation. In particular, for African American students who did not take rigorous courses in disciplines such as mathematics, the classes at the undergraduate level presented themselves as major barriers for those students, as well as for other minorities. It was posited that those students were inhibited by institutional structures that limited opportunities for rigorous academic preparation (Oakes, 1990).

Interestingly enough, according to NC State University's College Admissions website, the College of Engineering reported admitting students whose academic history boasted rigorous courses and relatively high composite test scores. It is uncertain of the level of rigor experienced by each student at their respective secondary schools. Although students who do not perform well in science and mathematics at the secondary level experience persistence issues within the engineering discipline, African American students within the College of Engineering were selected because of this secondary experience. These characteristically high performing students could very well have been ill-prepared. A similar theme, experiencing academic difficulty, especially in mathematics and science, was indeed presented as a assister of on non-persistence.

Assessing Women and Men in Engineering (AWE) Students Leaving Engineering (SLE)

Instrument

“The AWE Students Leaving Engineering (SLE) instrument is designed to meet the need for a quantitative instrument to collect data on the reasons engineering students decide to transfer out of engineering” (Marra et al., 2007, p. 4). Marra, Bogue, Shen and Rodgers (2007) developed an instrument that gathered basic demographic data and asked questions to determine participant reasons for non-persistence. Questions from the instrument gathered responses regarding

students': "pursuing an engineering major, high school preparation, intended transfer destination (e.g. which college, work, military), career plans, participation in college extracurricular activities, and factors that impacted respondents' decision to leave engineering and included a rating of the significance of each contributing factor" (p. 4).

Based on results from the 47 open-ended question instrument, the following factors were said to have influenced students' non-persistence: teaching/climate, workload/grades, advising, advice, finances, and belonging. Teaching and climate boasted the highest average as reported by students in their reasoning for leaving engineering. Interesting enough, the grade-point averages (GPAs) of these students ranged from 1.82 to 4.0. Students who reported themselves as high performers reported leaving due to not having a sense of belonging in the major, which held the lowest influence for students leaving the discipline. This cross-institutional study provided insight to reasons why students left engineering. Although the instrument provided viable data, the lack of African American student perspectives presented within the research left a gap regarding reasons specific to African American students. In addition, the instrument indeed provided some qualitative data sharing participant voices; however, African American respondents failed to be presented in great majority.

Non-Dominant Reasons for Non-persistence

Within this chapter, the most frequent and dominant reasons for non-persistence amongst African American students within engineering were presented. Most of those themes presented in the literature correlated with the themes presented in this research study regarding reasons are specific to the College of Engineering at NC State University. Non-persistence for African American students at Historically Black Colleges (HBCUs) and some Predominantly White Institutions (PWIs) suggested some students switch out of engineering due to financial reasons

(Marra, Bogue, Shen, & Rodgers, 2007, p. 4; Burrell, Fleming, Fredericks, & Moore, 2015).

Although the reason was posited by students through qualitative and quantitative data, the overall feedback regarding financial hardship affecting student decisions was not overwhelming.

Marra, Bogue, Shen, & Rodgers (2007) reported student learning styles as influencing factors for leaving the discipline. The traditional lecture style format seemed to disconnect students from the content. The researchers found that traditional pedagogical practices were incompatible with students' personal learning styles and preferences. Berry et al. (2007) completed a research study working with African American students in engineering and they also proffered that students expressed a desire for professors to have the ability to teach students with different learning styles and levels of ability. Participants within the research study were noted as having expressed the need for professors to make conscious efforts to reach every student and gauge their understanding. This factor can also be connected to the academic environment theme.

Lastly, Marra, Bogue, Shen, & Rodgers (2007) showcased in their instrument that some students expressed having family or community influence regarding their pursuit to engineering. In addition, Azmitia and Cooper (as cited in Rodgers, 2017) discussed the importance of friendship and family-like connections described as "identity agents." Within STEM disciplines like engineering, identity agents are important because they help students maintain cultural identity and facilitate adjustment into the university culture. Prior to enrolling and deciding to persist or not persist, several authors point to family and community influences. Charleston posited (2012) that African Americans who pursued computing science degrees, an engineering major within the College of Engineering, at the undergraduate level were found to have parents

who invested in their learning during their primary years and encouraged their engagement with STEM disciplines.

Community or university-sponsored programs such as pre-college programs and minority engineering programs were found to have an impact on persistence. Pre-college programs can also be correlated with academic preparation for course rigor. Dancy, Palmer and Maramba (2011) suggested that the intensive pre-college programs gave students exposure to collegiate academic concepts and skills while at the secondary level prior to undergraduate enrollment. Allowing African American students an opportunity to be exposed to engineering content, as showcased in engineering-focused pre-college programs prior to postsecondary helped bring students up to speed with the material, which was posited by respondents as a reason they left engineering in some instances due to disconnect with the material. In addition, pre-college programs can be particularly important for underrepresented minority and STEM students (Stolle-McAllister, 2011). A recent research study conducted by Eris et al. (2010) showed that persistent students and non-persistent students did not differ on most factors regarding persistence in engineering. Their research also showcased non-persistent students detailing information regarding pre-college preparation, parental influences and confidence in math and science skills.

Chapter Summary

“The role of motivation and collaboration in STEM learning and performance is paramount” (Freeman, Alston, Winborne, 2008). Although this research does not review STEM subjects collectively, the *E* in *STEM* is engineering. In every aspect of achievement motivation discussed, most students attempt to avoid failure or err on the side of caution when showcasing academic incompetence. Meyer and Marx (2014) suggested that academic failure led to students’

diminished confidence in their abilities to succeed, as well as non-persistence. Participants in Meyer and Marx's (2014) research study mentioned feeling unprepared for the commitments expected of them to succeed in the engineering program and expressed dealing with confidence issues all while being faced with academic challenges such as difficult coursework and poor advising. All these reasons presented to be barriers to the students motivation. Furthermore, Moore, Madison-Colmore, and Smith (2003) found that negative experiences, attitudes and perceptions impeded their students' academic performance and drive.

In an exploration of the themes in the literature, the common reasons that posed a motivational barrier revolved around self-worth. As stated, students in highly competitive environments exhibited a tendency to lose their identity when their academic prowess did not measure up as expected. Their worth is defined by their achievement so when their level of achievement decreases, so does their worth. Marra, Rodgers, Shen and Bogue (2012) suggested that the difficulty in engineering curriculum, and a lack of belonging prompted non-persistence. Students questioned their belonging or fit in engineering as a result of academic factors. African American students, experiencing adversity and stereotypes, (Moore, Madison-Colmore & Smith, 2003) were found to lose steam if even what they were once motivated to do became difficult to attain because of an overwhelming pressure to perform and that tension inhibited them from measuring up to their personal standards.

Many African American students, as stated earlier, experienced stereotypes at PWIs. Beasley and Fischer (2012) reported that African American participants in their research "believed that most Whites assumed they were the recipients of preferential treatment and incapable of being accepted on their own academic merits." *Failure avoidant* students do not like the idea of looking incompetent. With the weight of stereotypes, an overly competitive

environment and a lack of belonging, all this can weigh on the African American student prompting non-persistence. “This self-worth analysis suggests that the functional relationship between intrinsic valuing and extrinsic payoffs depends in part on the motivational disposition of the students. For some students these processes appear to be antagonistic, as in the case of failure-avoiding students; for others conflicting, as in the case of overstrivers” (Covington & Dray, 2002, p. 38). These sentiments assisted in setting the tone for this research’s exploration of various reasons African American student’s perception of self-worth presented to be a reason for non-persistence in the College of Engineering.

This chapter explored the various theoretical models of achievement motivation and honed in on one model in particular, the self-worth theory, and how this theoretical framework as presented in the literature served as a theory deemed as appropriate to position the basis of this research. In addition, the issue of non-persistence with African American undergraduates in the College of Engineering was discussed as the main problem this research has addressed and therefore presented recommendations for future research.

CHAPTER 3

METHODOLOGY

The purpose of this research was to explore the reasons African American students do not persist in the College of Engineering at NC State University and to explore the reasons and influences, albeit internal or external, that prompt non-persistence with those students. At NC State University, non-persistence amongst African American students seemed to be a continuous trend for College for seven years. The trend was for African American students seemed prevalent more so than their counterparts due to the already small population of African Americans within the College (Office of Institutional Research and Planning, 2017). In an effort to guide the research, two questions of importance were posed: 1) What are the reasons African American students do not persist in engineering and 2) What are the particular influences within the College of Engineering that prompt non-persistence in African American students?

This research study utilized an intrinsic qualitative case study approach to highlight the case itself. Case study research is a qualitative approach in which the research explores a real-life, bounded system through detailed data collection that involves multiple sources of information, and reports a case description and case themes (Creswell, 2013). This qualitative case was composed to illustrate a unique case regarding a high caliber engineering department with an unusual trend of continued non-persistence in African American students (Creswell, 2013). In conjunction with the suggestions of Creswell (2013), the case study approach was selected in an effort to provide an in-depth understanding of a specific case regarding African American students' non-persistence in the College of Engineering at NC State University. A qualitative approach was selected to provide a rich and in-depth perspective to help the reader understand the participant's situation versus showcasing the research through the researcher's

perspective as in quantitative research (Hancock & Algozzine, 2017, p. 8). The objective of the research was to share the candid and reform-shaping voices of the participants which provided insight into their thoughts and experiences for this specific case.

STEM and Case Study Research Literature

Case study research seemed most fitting to tell the story of the participants for this unique, intrinsic case. According to the Office of Institutional Planning and Research (2017), as the trend for engineering persistence among their White peers went up, African American student persistence went down. Previous case studies were explored to provide guidance and support regarding feasibility and use of the case study approach to share the details of this phenomenon.

Perna, Lundy-Wagner and Drezner et al. (2009) conducted a case study exploring the role of Historically Black Colleges in the production of African American females in STEM. Although the case study focused solely on African American females in a HBCU setting, the chosen methodology provided an opportunity to elicit fruitful responses in an effort to examine a particular situation in which the phenomenon examined was unique, or intrinsic. In these instances, the case study methodology is recommended according to Wilson (as cited in Perna, Lundy-Wagner & Drezna et al., 2009). The researchers established a data collection protocol using multiple sources of data including institutional documents, focus group interviews and observations. In their research, four themes emerged, one of which directly correlates to the theory guiding the research of this study which was the development that participants in the study acknowledged academic, psychological and financial barriers as having a negative impact on the persistence of Black women in STEM fields, like engineering (Perna, Lundy-Wagner & Drezna et al., 2009).

Similar to the purpose of this research study, Lancaster and Xu (2017) captured the

experiences of African American STEM majors using the qualitative case study approach. The researchers gathered data by conducting ninety minute focus group interviews. The researchers found the case study approach fitting because of its focus on a specific program (STEM) within a bounded organization (the four-year institution) as cited by Lancaster and Xu (in Creswell, 1998). The institution was 35% African American and 53% White. Although considered racially diverse, the institution boasted an 80% attrition rate among African American students who declared STEM majors. This research presented several themes also addressed by other prominent research literature including students having weak faculty relationships, frustration with academic advising and students having inadequate preparation for challenging classes.

As presented in similar settings in prior research studies, this research has also focused to provide a holistic picture of the particular experiences of non-persistent African American undergraduates in engineering while situating the case within the self-worth achievement motivation framework to understand the reasons for non-persistence while in the College of Engineering. It is the intent of the researcher to have provided a complete picture of the participant experiences from the data by utilizing the case study approach.

Wall (1995) conducted a case study with the College of Engineering which explored the topic of African American undergraduate persistence in the department of industrial engineering where she uncovered discrepancies amongst African American students and their approval of institutional and environmental support while pursuing an engineering degree.

McClain (2014) conducted a case study at another public southeastern research university examining the educational experiences of African American undergraduates pursuing STEM. McClain's (2014) research uncovered a wealth of data detailing similar sentiments posited in this paper's literature review such as African American students lacking a sense of belonging and

experiencing stereotypes while pursuing a STEM degree. Lee and Matusovich (2016) used a multi-case study approach by using several qualitative methods to develop a co-curricular support model of engineering support centers in an effort to increase retention of African American students. In each of these studies, the researchers sought to understand contextual conditions and examine specific phenomena in an attempt to offer insights and illuminate meaning to expand the reader's experience of a particular case (Perna, L., Lundy-Wagner, V., Drezner, N.D. et al., 2009). Thus, this research maintained the same objective unique to identifying reasons for non-persistence amongst African American undergraduates in the College of Engineering.

Case Study

As stated in Creswell (2013) some suggest that a case study is not necessarily a *method*, but it is considered a *focus* for the researcher; however, Creswell considers it dually a methodology and a focus. It is quite different from other methodologies in that it is narrative in nature, but it can also be very scientific. A case study is intended to define a problem and gather all sources of evidence to explore or explain a phenomenon within a context with limits (Wall, 1995). The researcher must present a specific focus in its entirety while maintaining its complexity. A case study can be presented as a container, a situation or an argument, but most importantly it must be presented as a rich picture with boundaries (Thomas, 2016).

This research study explored a specific situation or the unique case of non-persistence in the College of Engineering. According to Creswell (1998), a case study explores a single case or multiple cases in a *bounded system* over a period of time through detailed data collection which involves multiple sources of information. The *bounded system* can be defined as the set time and place the case (an event, activity or individuals) is being studied. Typically, the multiple sources

of information can come in the form of observations, interviews, documents, archival records, and/or audio-visual materials (Creswell, 1998, p. 61-62). Using a variety of data sources ensures the particular issue being explored is probed and analyzed through a variety of lenses “which allows for multiple facets of the phenomenon to be revealed and understood” (Baxter & Jack, 2008, 544).

Case studies are situations within its pre-formed setting which can be physical, social, historical or economic. According to Yin (as cited in Baxter & Jack, 2008) the case study design should be considered when:

- 1) The focus of the study is to answer “how” and “why” questions;
- 2) You cannot manipulate the behavior of those involved in the study;
- 3) You want to cover contextual conditions because you believe they are relevant to the phenomenon under study; or
- 4) The boundaries are not clear between the phenomenon and context (p. 545).

Upon considering the case study approach for one’s research, the research must then proceed through an analytical process unique to case study design. Creswell (1998) outlines (5) inherent focuses of the researcher for case study design:

- 1) The researcher must identify his or her case, in particular which bounded system to study ascertaining a certain individual or issue to illustrate a worthy case.
- 2) Next, the researcher must decide whether to study a single case or multiple cases.
This research will focus on a single case.
- 3) Afterwards, the researcher must establish a rationale for his or her purposeful sampling strategy in terms of gathering information about the case.
- 4) The researcher then must collect enough information to present an in-depth view of

the case being studied.

- 5) Lastly, the researcher must decide or constrain the boundaries of the case which involves the terms of time, events, and processes (p. 63-64).

Researcher and author Creswell (2013) posited that a case study should be the methodology of choice when a topic situated in a system that seeks to provide an in-depth understanding by a researcher through sources of information, themes and descriptions that seek to explore a real-life case. In case studies, it is always important for the researcher to identify the specific case, whether it be a small group or an organization. In addition, focusing on a current and real-life issue is important to case study research (Creswell, 2013). Using the case study approach to conduct this research allowed the researcher to provide an in-depth understanding of the situation regarding self-worth and non-persistence in African American students formerly studying in the College of Engineering at NC State University (Hancock & Algozzine, 2017, p. 10). As stated by Thomas (2016) “a case study is about seeing something in its completeness, looking at it from many angles” (p. 23). Using the case study design in this research has allowed room for discovering cause-and-effect relationships, such as the reasons students did not persist in engineering and what self-worth concepts played a role in the lack of persistence (Hancock & Algozzine, 2017, p. 39). Harper (2007) critiqued the research of several researchers and concluded that their findings concerning how college affected students, in particular Black students, was interesting but “neglected to meaningfully explore additional aspects of Black students and other students’ experiences” (p. 55). Harper (2007) went on to state:

“In many ways, quantitative methods can reveal what works—but not how it works, who and what made it work, the facilitators and obstacles that were encountered along the way, and the meanings students ascribe to the experience. We cannot begin to fully

understand and foster conditions to replicate effective educational practices in the absence of voice and sense making among students who actually experienced them. One-sided methodological approaches to assessing the end product (outcomes) continue to furnish insufficiently narrow insights into how those outcomes were accrued. Furthermore, efforts to support students, especially during difficult periods, could be guided by qualitative data” (p. 56).

Upon reviewing the definitions presented by researchers and considering the insights provided by the literature, selecting the case study approach to conduct research presented itself to be applicable and well suited for this particular case within the specific College of Engineering as the primary focus.

Types of Case Study

According to Yin (2009), case studies can present inductive or explanatory findings. He further posits that there are three types of case studies: exploratory, descriptive and explanatory. Exploratory case studies often ask what or how questions. When the research aims to describe an occurrence or continuing occurrence of a phenomenon, exploratory case studies are best. Explanatory case studies ask how and why. This type could be based upon historical case studies. They're investigating causal relationships. Descriptive case studies are heavy laden in theory building and attempt to heavily describe a particular phenomenon in a somewhat microscopic way in its setting and context.

According to Stake (1995), case studies can be intrinsic, instrumental, or collective. Intrinsic cases are usually studied because of the unique element of the phenomenon. An instrumental case will take a particular case to showcase a broader view of an issue or phenomenon. Studying more than one case simultaneously or sequentially is considered a

collective case study (Creswell, 1998; Stake, 1995; Crowe et al., 2011). Stake (1995) provides a comparison between intrinsic, instrumental, and collective case studies. “Intrinsic case studies only aim at acquiring better understanding of the particular case of interest. Thus, such case studies are not used for theory building. Instrumental case studies provide insights into an issue or are used to refine a theory, and collective case studies comprise several instrumental case studies. However, Stake also argues that studies seldom fit neatly into such categories, and that researchers have to make a strategic choice in deciding on the scope of the case study, since everything cannot and need not be understood” (p. 39) .

Stake (1995) suggests that it is difficult to situate a case in one particular category. Although the goal is to explore, the goal isn't to build new theory, however, it is to gain an understanding and form a picture of this particular case. Intrinsic and exploratory studies are similar in context (Stake, 1995). The aim is to take a closer look at this phenomenon for the sake of exploration and its special context. The researcher selected an existing framework to position this research. The development of a new theoretical framework was not undertaken; however, the self-worth theory of achievement motivation was utilized as a guide to understand and describe non-persistence among African American undergraduates in the College of Engineering.

Although there seemed to be a lack of research regarding African American students and non-persistence in engineering, the theory has been woven throughout the research study and the data presented has been analyzed within the context of self-worth. Therefore an intrinsic approach was used to explore this case. The nature of the case does not totally lend itself exclusively to the exploratory or intrinsic category, nonetheless, its most similar counterpart, the intrinsic case, was most fitting due to the theoretical and case underpinning.

Sample and Population

According to Collingridge and Gantt (2008), participant selection should have a clear rationale and fulfill a specific purpose related to the research question, which is why qualitative methods are commonly described as ‘purposive’. Therefore, the participants in this study were undergraduate students at NC State University who did not persist in the College of Engineering. All undergraduate students selected were African American students. In addition to using purposive sampling, the researcher also utilized snowball sampling and *gatekeepers* in the African American community at the University. Gatekeepers are known as authority figures who were privy to potential participants (Creswell, 2005). They were utilized to recruit more participants because a few of the proposed methods of recruitment, including visiting student organization and posting flyers in prominent locations around campus, failed to yield a participant interest (Mack, Woodson, MacQueen, Guest & Namey, 2005, p. 6). Research began in the spring semester and came to completion in the spring semester of the academic calendar.

Sampling

“The adequacy of participant numbers involves thoughtful decision-making; too few may risk adequate depth and breadth, but too many may produce superficial or unwieldy volumes of data” (Sandelowski 1995, p. 179). It is suggested qualitative research studies, the research objectives and characteristics of the study’s population help determine the number of participants to select (Mack, Woodson, MacQueen, Guest & Namey, 2005, p. 5). Curtis et al. 2000, Tuckett 2004, Walsh and Downe 2006, (as cited in Cleary, Horsfall, & Hayter, 2014) suggested utilizing the purposive sampling strategy to recruit participants for the study. Creswell (2013) described purposeful sampling as when the researcher or inquirer selects individuals and sites for a research study because those selections ‘purposefully’ inform an understanding of the central

phenomenon. Purposeful sampling is also one the most common sampling strategies. Snowball sampling, a type of purposeful sampling according to Creswell (2005) was also utilized.

“Qualitative snowball sampling is a form of purposeful sampling that typically proceeds after a study begins and occurs when the researcher asks participants to recommend other individuals to study” (Creswell, 2005, p. 206). Utilizing these sampling strategies gave way for participant selection to be based on criteria relevant to the research questions. With purposeful sampling, sampling sizes can depend on time and resources available, in addition to the research study’s objectives. One general guideline regarding sample size in qualitative case study research suggested studying a few individuals and collecting detail about each individual (Creswell, 2013). Also upon reaching saturation, suggesting the data collection no longer brings additional insights to the research questions, sampling can be determined appropriate (Mack, Woodsong, MacQueen, Guest & Namey, 2005). Four participants were selected to gather documents and complete interviews. They served as the primary participants of the research study while an additional five participants were selected to participate in the focus group interview. The four primary participants were non-persistent students from the College of Engineering and the focus group participants contained persistent engineering students and students who had engineering interests but did not complete coursework.

Recruitment of participants took place in their everyday environments as well as in the university community. The researcher visited two African American student organizations which were, the Afrikan American Student Advisory Council and the National Society of Black Engineers at NC State University to recruit participants and coordinated with the president of the African Student Union to inform student members of the research study. The researcher also distributed approved research flyers in locations at the university in the Fountain, Clark, and

Case University Dining Halls. Originally, flyers were to be placed in the Talley Student Union, however, the researcher was informed that placing recruitment materials in the student union was prohibited. Recruitment of the participants [see Figure 5] was focused to find participants whose personal experiences and relationship with the research topic were related. The data collected from the nine participants has been analyzed and presented in this research study.

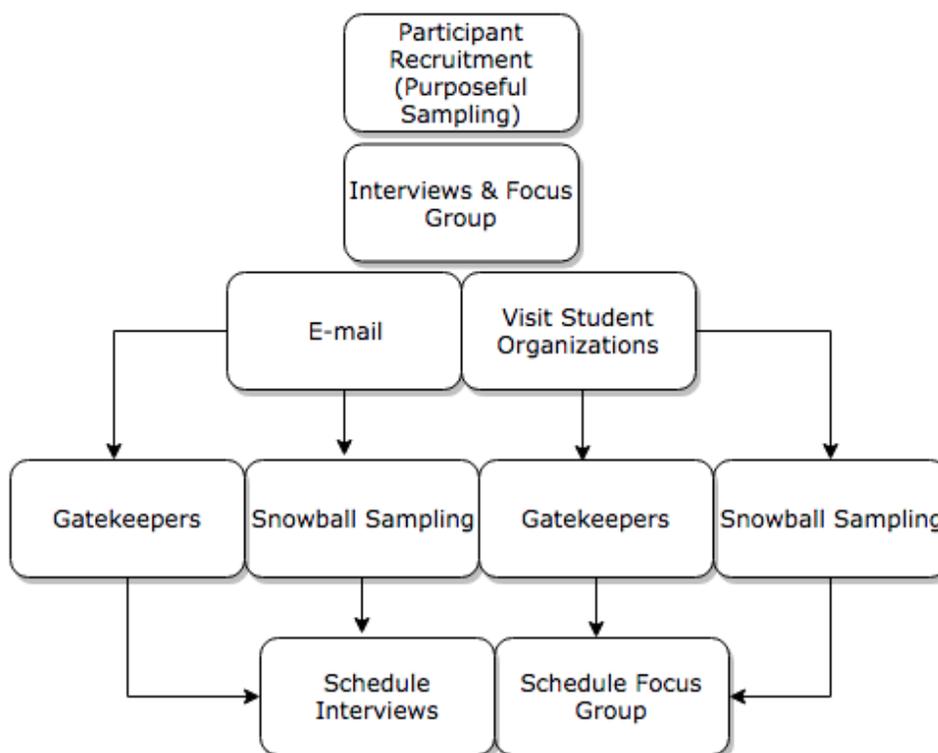


Figure 5: Sampling Procedure

Data Collection Procedures

Methods used to gather data included conducting one-on-one interviews, focus group interviews, and gathering purposeful documents such as class assignments, reflective journal responses, and unofficial transcripts. Eight participants participated in one-on-one interviews, data from four participants were used for this study. In McClain's (2014) study at the University

of Virginia, he recruited eight African American undergraduate students in an effort to examine their experiences in STEM. In the qualitative study, the researcher utilized one-one-one interviews, focus group interviews, a review of transcripts and autobiographies as methods of data collection. Data collection methods were used to assist in answering the guided research questions: 1) what are the reasons some African American students do not persist in the College of Engineering at a predominantly White institution, and 2) what are the particular factors within the College of Engineering that prompt non-persistence in African American students?

Class assignments helped the researcher assess the student's academic performance and assisted in triangulated the data provided in the interviews regarding performance in engineering courses. Originally, personal emails were supposed shed light on personal motivations, frustrations, thoughts, and concerns of engineering majors and relationships with peers and faculty. None of the nine participants were able to locate personal e-mails sent or received during their time as engineering majors. Transcripts provided an overall picture of participant's performance while in the College of Engineering and the University. Hughes, Shehab and Walden (2011) also analyzed academic transcripts from their participants. The researchers conducted a qualitative study of African American engineering undergraduates asking the question "what is success to you?" The study utilized semi-structured interviews and academic transcript data. Interviews and focus groups served as dynamic ways to observe participant interactions amongst one another and listen to participant views and perspectives.



Figure 6: Creswell's (2013) Data Collection Procedure

Interviews and Focus Groups

This research study identified key participants whose opinions and attitudes provided important insights regarding the guided research questions. Furthermore, these participants were interviewed individually and as a group. The one-on-one individual interviews yielded a considerable amount of information pertaining to the interviewee's personal perspective. The focus group also capitalized on the sharing of opinions and perspectives and even provided the researcher with interaction and additional information that did not occur in every individual interview (Hancock & Algozzine, 2017, p. 46). To gain depth and richness from each interview and focus group interview, only seven interview questions were asked. It is suggested that interview and focus group questions be concise and brief to maintain the attention of the participant, gather rich and relevant data, and save time (Jacob & Furgerson, 2012, p. 5).

As stated by Hancock and Algozzine (2017) in their research regarding case study research, when gathering information for interviews and focus groups (in addition to what has already been discussed), the researcher should complete the following steps to ensure success:

- 1) Develop an interview protocol, or guide.
- 2) Attain consent of the interviewee.
- 3) Consider an interview setting: a private, neutral, and distraction-free location
- 4) Review with the interviewee the purpose of the interview.
- 5) Develop a means for recording the interview data.
- 6) Adhere to legal and ethical requirements for all research involving people.
- 7) Listen to the interviewee. (p. 46-49).

The suggested protocol developed by Algozzine (2017) were implemented in this study when administering and participating in individual interviews.

Interviews

“An interview is a process in which a researcher and a participant engage in a conversation focused on questions related to a research study” (DeMarrais, 2015, p. 54).

DeMarrais (2015) suggested that qualitative interviews move beyond typical conversations had in everyday settings. The researcher shifts focus with the intent to gather data which takes higher importance than simply dialogue. Upon determining the purpose and the design of the research study, the researcher sets out to fulfill the purpose of the study through interviewing the participants. The goal becomes to focus on the participant experiences and views, while uncovering wealthy data (DeMarrais, 2015, p. 54). Also posited by Creswell (2013), “the research interview should not be regarded as a completely open and free dialogue between egalitarian partners. In this dynamic, the interview is “ruled” by the interviewer. The interview is dialogue that is conducted one-way, provides information for the researcher, is based on the researcher’s agenda, leads to the researcher’s interpretations” (p. 173).

The researcher utilized one-on-one interviews in an attempt to accommodate participant

schedules and as an opportunity to build initial rapport with participants before involving them in a group dynamic. Although the researcher followed an interview protocol [see Appendix B], the semi-structured interview approach was taken in that the pre-determined questions were utilized but several of the questions allowed for exploration and allowed the interviewer to pursue an interviewee's response in detail. This tactic permitted the researcher with flexibility (Gill, Stewart, Treasure, & Chadwick, 2008). This assisted the researcher and participant in uncovering aspects of the particular case being studied and discuss in detail (DeMarrais, 2004, p. 53). Per the literature from the research, the interviews became a unique discourse where the researcher learned about participant experiences, perspectives, and views. The researcher took an emic role (only incorporating the views of the participants), and personally tracked to bracket her own theoretical perspectives and beliefs so they would not influence the way in which the interview was given (DeMarrais, 2015, p. 55). From a self-worth theoretical perspective, unique to this research study, issues of motivation, belonging, performance, ability and effort will be central to the design of the interview questions (DeMarrais, 2015, p. 55). Given the size of the population of potential participants at the University, four participants were selected to be interviewed in the study. As suggested by DeMarrais (2015), quality and depth in the interviews was reached within this small participant sample. One participant elected to complete his one-on-one interview via the telephone. Due to the participants schedule, he was not able to meet in person. According to Creswell (2005), this method of interviewing is deemed viable. The one-on-one interviews were the most time consuming to conduct, with each interview extending beyond forty-five minutes (Creswell, 2005).

Focus Groups

“A focus group interview is the process of collecting data through interviews with a

group of people, typically four to six” (Creswell, 2005, p. 215). Creswell suggested focus groups as a primary method of data collection for qualitative research. Per Creswell’s suggestion, this research study utilized the focus group method to collect data concerning a shared understanding from several individuals. In this research study, the majority of the participants interacted with one another and provided shared experiences, however, two of the participants were reserved at times. In these instances, the researcher encouraged all the participants to talk and provide their perspectives (Creswell, 2005).

The researcher not only decided to conduct a focus group to find similar data, but to have a guided discussion where collective views could be heard (Gill et al., 2008). A focus group protocol was created to assist in guiding the discussion [see Appendix C]. According to Gill et al. (2008), the composition of a focus group provides for a quality discussion. In addition, interaction amongst participants is key to a successful focus group. In this research study, participants were initially quiet, however, the research promoted a comfortable atmosphere and assured confidentiality of the discussion. Participants began to interact and divulge meaningful information. The researcher continuously paid attention to group dynamics and observed interaction amongst the participants (Brown, 2015, p. 87).

Although focus groups can present themselves to be complex in nature, they serve as an efficient way to collect data and they save the researcher time in comparison to interviews (Brown, 2015). Brown (2015) also suggested conducting focus groups in naturally occurring settings, such as those comfortable and appropriate for the participants. The researcher focused to moderate the focus group effectively and efficiently, allowing for fruitful conversation and guided discussion (Gill et al., 2008).

The researcher conducted one focus group. Gill et al. (2008) suggested that focus groups

can work successfully with as few as three participants and as many as 14 participants. The focus group interviews were recorded and transcribed for data analysis.

Documents and Reflective Journals

“A valuable source of information in qualitative research can be documents. Documents consist of public and private records that qualitative researchers obtain about a site or participants in a study” (Creswell, 2005, p. 219). Creswell (2005) also proposed that documents represent a good source for word data by providing the advantage of being in the language of the participants, however, documents can be difficult to locate and obtain. According to Elizabeth (2008) utilizing participant writing as a method of inquiry is beneficial. The participants become involved in the research. Participant writing, such as journaling, can benefit both the participant and the researcher while providing rich qualitative data. In this particular research study, the researcher originally intended to collect private documents such as personal e-mails, however, none of the participants were able to provide such documents.

When determining the documents to collect, the research used the following guidelines suggested by Creswell (2005):

- 1) Identify the types of documents that can provide useful information to answer your qualitative research questions.
- 2) Consider both public and private documents as sources of information for your research (no public documents were collected in this research).
- 3) Provide instructions to the participants regarding keeping a journal.
- 4) Examine the documents for accuracy, completeness, and usefulness in answering the research questions in your study.
- 5) Record information from the documents (p. 220).

The documents examined were extracted from the participants' private records (Hancock & Algozzine, 2017, p. 57). Documents from the participants' private records included unofficial transcripts and class assignments. Documents from the participants' private records also included their reflective journal responses, which provided insight into their attitudes, behaviors and perceptions. Creswell (2013) suggested that "journaling is a popular data collection process in case studies and narrative research" (p.174). Participants were asked to write reflective statements using Microsoft Word or by traditional means of pen and paper. In addition, when combined with information from one-on-one interviews and focus group interviews, the information gleaned from documents provided the researcher with important information from multiple data sources that were summarized and interpreted to address the central research questions (Hancock & Algozzine, 2017, p. 58).

Data Sources and Analysis

"Data analysis in qualitative research consists of preparing and organizing the data for analysis, then reducing the data into themes through a process of coding and condensing the codes, and finally representing the data in figures, tables, or a discussion (Creswell, 2013, p. 180). A case study approach was utilized as the goal was to uncover an in-depth understanding of the lived experiences of individual participants (Creswell, 2013; Thomas, 2016). Student data was collected by means of one-on-one interviews, focus group interviews, reflective journal responses, and purposeful documents. The researcher analyzed the data using abstraction, wherein the data was diluted and summarized several times. The researcher analyzed the data to search for emerging themes and afterwards grouped the data into larger themes to layer the data analysis (Creswell, 2007, p. 46). The researcher developed themes, as a result of coding. Thematic outcomes transpired from the coding process, through categorization and analytic

reflection from the researcher (Saldana, 2009). The researcher followed a similar process suggested by Creswell (2013) when analyzing data shown in the Figure 7 below:

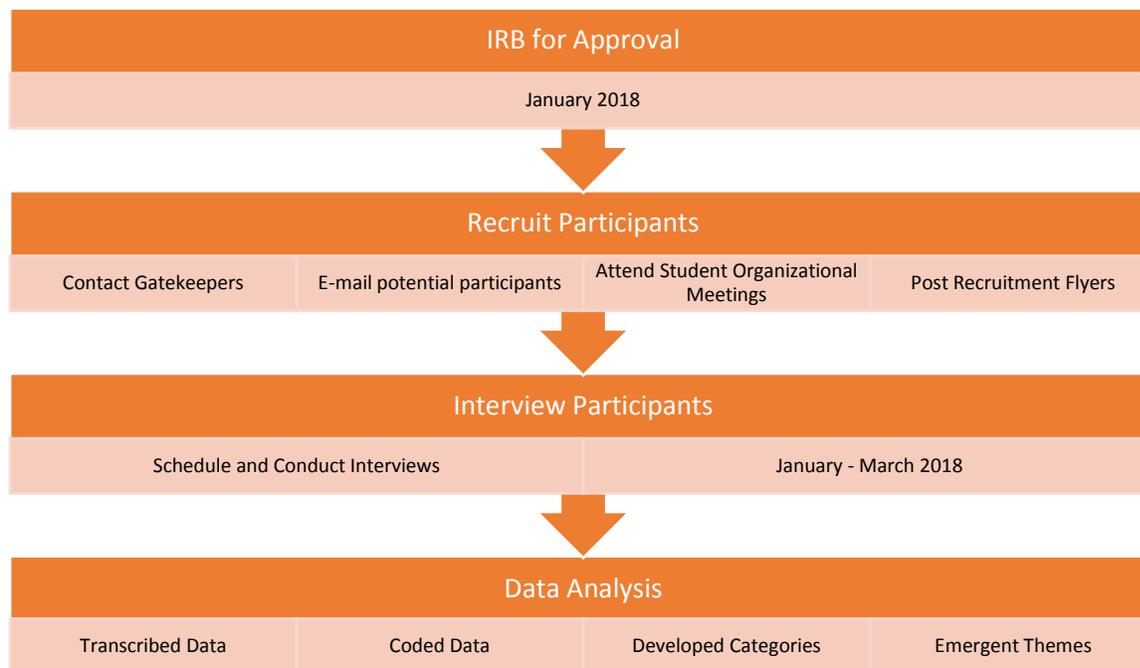


Figure 7: Data Analysis Timeline

According to Creswell (2013), a categorical aggregation approach can be taken with case study research. This involves the researcher seeking a collection of instances from the data in hopes that “issue-relevant meanings emerge”, such as with this research study (p. 199). Upon organizing the data, the analysis continued for the researcher. As the researcher immersed herself in the data, the transcripts were read and memos were created thereby giving the researcher a sense of the whole database (Creswell, 2013).

Codifying

Forming codes, sometimes called categories, “represents the heart of the qualitative data analysis (Creswell, 2013, p. 184). This step involves describing, classifying and interpreting the data. “A code in qualitative inquiry is most often a word or short phrase that symbolically

assigns a summative, salient, essence-capturing, and/or evocative attribute for a portion of language-based or visual data” (Saldana, 2009 , p.3). According to Saldana (2009), codifying helps the researcher to arrange data systematically, or categorize. Creswell (2013) also suggests that “the process of coding involves aggregating the text into small categories of information, seeking evidence for the code from different databases being used in a study, and then assigning a label to the code (p. 184). Data was coded to look for repetitive patterns and themes. The researcher established patterns to find correspondence between two or more categories. Developing 25-30 categories of information and combining them into themes provides feasibility to reduce the picture and present the themes in the research. In qualitative research, themes consist of several codes composited to form a common idea (Creswell, 2013).

The researcher utilized open coding in the data analysis, versus a priori codes, preexisting codes (Creswell, 2013). In this research, the codes represented:

- 1) information that the researcher expected to find; and
- 2) surprising information (p. 186).

The researcher paid attention to any outlying or nonconforming evidence that was overlooked through the first iteration of the coding process to confirm accuracy of the established codes. The codes were useful in summarizing and condensing datum and establishing themes. The researcher’s interpretation of the data is presented in this research which involves her making sense of the data. The researcher’s interpretation was dually held within the theoretical framework in conjunction with her own personal views; however, the researcher’s interpretations were linked to the research literature as shown in Figure 8 (Creswell, 2013).

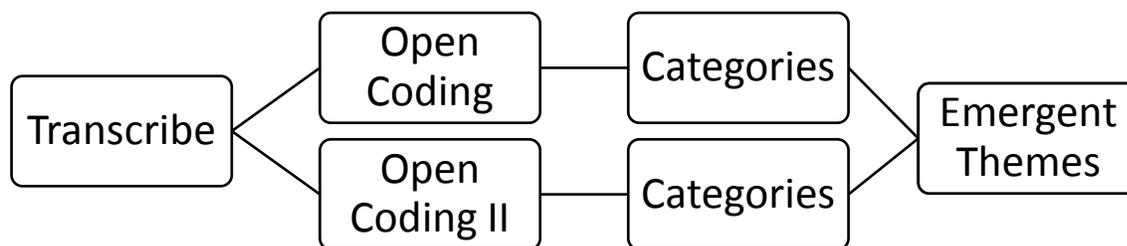


Figure 8: Coding Process

Validity

Creswell (2013) suggests that in relation to the researcher, substantive validation deals with understanding one's topic, the literature from other sources, and documented process of the research study. He further posits that from his perspective, validation emphasizes a process. In terms of validity or credibility, as referenced by some qualitative researchers, the researcher in this study utilized several methods of documentation and combined several strategies in the collection and analysis of the data. One pertinent validation strategy used was triangulation.

“Triangulation involves the careful reviewing of data collected through different methods in order to achieve a more accurate and valid estimate of qualitative results for a particular construct” (Oliver-Hoyo & Allen, 2005, p. 1). In this comparative method, the researcher searched for validation and support. Triangulation was achieved by using multiple methods to gather data, including interviews and collecting documents, to ensure the researcher shared all perspectives (Thomas, 2016). Verbal data, from the interview transcripts and visual data, including researcher observations during the interviews constituted for data triangulation as an effort to hone in on complementary perspectives from the data (Flick, 2004). This process of corroborating evidence from the various sources helped shed light on the specific themes in the research. The researcher used three triangulation methods.

Upon collecting the data from the one-on-one interviews and focus group interviews, the

researcher contacted each participant to perform member checks. Member checking occurred when the participants were given the opportunity to review their interviews for accuracy to solidify the accuracy and credibility of the researcher's findings and interpretation (Creswell, 2013).

In addition to member checking, the researcher collaborated with a faculty member to peer debrief. Peer debriefing, also referred to as peer reviewing, is a way of having an external checkpoint for the research by an unbiased, impartial party who discusses the research with the intent to help the researcher maintain validity or credibility (Creswell, 2013). The researcher and the faculty member held a peer debriefing session where the faculty member asked pertinent questions that led to the recoding of data and the development of a new emerging theme. The peer involved in the debriefing session also allowed the researcher to take notes and bracket personal biases that may have been present.

According to Creswell (as cited in Merriam, 1988), "clarifying researcher bias from the outset of the study is important so that the reader understands the researcher's position and any biases or assumptions that impact the inquiry" (p. 251). In this research study, the researcher kept a personal journal where she documented experiences after each interview, her process throughout the study and any personal assumptions or biases that required subsection to ensure they had no role in shaping the interpretation of the study.

"Therefore, the standards for validity or credibility in qualitative research include the following criteria: intensive time spent with those being interviewed, talking little and listening a lot; accurate and full recording and reporting of data; aspiration to balance; and desire for feedback on the credibility of the interpretive categories being applied" (Wall, 1995, p. 79).

Trustworthiness

It was the goal to establish trustworthiness in this research study through managing subjectivity and achieving triangulation. In order to manage subjectivity in the research study, the researcher maintained a personal journal, utilized several triangulation strategies (i.e. peer debriefing) and offered a reflexivity statement at the end the paper (Lijadi, 2015, p. 72). Although the reflexivity statement is offered at the end of the paper, the researcher's intention was to be reflexive throughout the process of the research study by bracketing personal biases' and attempting to solely share the experiences of the participants. Triangulation was also achieved because the researcher offered rich descriptions in the study which hopefully allow the reader to make decisions regarding transferability (Creswell, 2013).

In this research study, the researcher ensured the confidentiality of the participants. The researcher received approval from the University's Institutional Review Board (IRB) to conduct the study. At the beginning of the study, participants were given consent forms which included the purpose of the study, benefits of the study, information about confidentiality, ethical procedures and the researcher's contact information (Thomas, 2016, pp. 83-84). Participants were also informed of their option for opting out of the study during any point in the research study. Participant names were replaced with pseudonyms which ensured confidentiality. No personal identifiers were recorded in the study. All data was secured by encrypting documents and anonymizing data.

Chapter Summary

The intended case study allowed the researcher to talk to the participants throughout the course of one academic semester. The objective was to gather data that informed the reasons undergraduate African American students do not persist in the College of Engineering using a

self-worth achievement motivation theoretical lens. In addition to supporting the research questions, this case study was intended to share the experiences of the participants and give a voice to a specific case that will inform research and practice by assisting administrators and faculty in their work to motivate African American students to persist in engineering.

CHAPTER 4

ANALYSIS OF FINDINGS

The purpose of this chapter is to provide a detailed presentation of the findings from the research. The primary focus of this research was to explore the phenomenon of non-persistence among African American undergraduate students in the College of Engineering at NC State University. An intrinsic single case study methodological approach was chosen considering the desire to focus on understanding a specific phenomenon bounded in a particular system (Sargeant, 2012) positioned within an established theoretical framework. Participants in this research study were asked questions framed with a self-worth theoretical perspective which allowed participants to recount candid and personal experiences regarding self-worth while pursuing engineering majors. Participants also provided documents that would assist in understanding the phenomenon of non-persistence of African American students in engineering majors. Four participants served as the primary participants of the research study, participating in the one-on-one interviews and providing purposeful documents. A secondary set of five participants were selected to participate only in the focus group interviews. The research was unable to coordinate a synchronous time for the primary participants due to scheduling conflicts.

Two central research questions informed this research study:

1. What are the reasons some African American students do not persist in the College of Engineering at a predominantly White institution?
2. What are the particular factors within the College of Engineering that prompt non-persistence in African American students?

Several data collection procedures were utilized in this research study, including one-on-one interviews, focus group interviews, and the collection of purposeful documents. The findings

reported in this chapter are a result of the analysis of the data collected using a thematic analysis which consists of utilizing the open coding approach, developing categories and analyzing for emerging themes. A deductive approach was utilized to dissect categories and to solidify the emerging themes (Creswell, 2013). Three themes, each with three subthemes, were uncovered based on the analysis of data as guided by the two central research questions and the self-worth theory.

Data Collection Methods

The Institutional Review Board for the Protection of Human Subjects in Research (IRB) at NC State University provided approval to conduct this research study [see Appendix A]. All participants were given consent forms and were selected to participate in the study based on their voluntary consent and return of the signed consent forms. Participants were recruited using purposeful and snowball sampling. University gatekeepers were also utilized to recruit participants. Gatekeepers are members in a community of individuals, in this particular case, NC State University faculty and staff, who operate in a power role and have access to participants (Creswell, 2013).

Participants were contacted to take part in the research study through university e-mail. Other recruitment measures were utilized to recruit participants, however, only e-mail yielded participant response. An analysis of the findings in this study were gathered from nine of the thirteen participants who participated in this research study; four participant interviews and five participant interviews for the focus group. As mentioned, four participant interviews did not yield relevant data regarding non-persistence in engineering and one participant did not classify as African American. For the sake of this study those participant responses will not be disclosed.

All data discussed in this chapter will refer to the nine participants wherein relevant data was yielded from the specific data collection methods.

Originally, eight participants were targeted to participate in the focus group interview, however, due to a lack of response, five participants were willing to participate. One-on-one interviews were transcribed and coded by the researcher. The audio from the recorded focus group interview was transcribed and coded by the researcher. Purposeful documents including unofficial college transcripts, class assignments and reflective journals were transcribed and coded by the researcher.

Setting

NC State University was selected as the setting of this study. According to ASEE (2015), from 2006-2015, NC State held its place within the top 10 of the universities in the United States as one of the top producers of engineers with bachelor degrees. NC State University produced 14,769 engineers with bachelor degrees from 2009-2016 (Institutional Research and Planning Office, 2017). Of the 14,769 engineers produced by the University, from 2009-2016, 516 were African American, roughly three percent of NC State University's undergraduate engineering graduates. The University was selected because it is a top producer of engineers and also because of the non-persistence rate of some African American engineering students. In the next section, the research opens with a vignette of the setting for the case, as suggested by Creswell (2013).

Opening Vignette

A vibrant campus flowing with students of promise and ambition. Walking through the various parts of campus there are traces of the College of Engineering's prominence and importance. It is indeed considered one of the prominent and heralded majors at the University and yet not everyone who desires a place at the table gets an opportunity to sit and eat. Only a

select few find their spot in the College of Engineering and even a narrower population persist. For those who find a place in prominence, there is a moment to relish in the position. However, every semester presents itself to be somewhat of a hurdle. Who persists year after year, semester after semester? The College boasts more than 10,000 students (NCSU Engineering, 2018). Some will change the landscape of the engineering world, others will quietly find their way through and some will fight to hold on to dreams deferred.

Participants

The participants in this research study were all African American undergraduates who were formerly engineering majors. A total of thirteen students served as participants in the research study; however, only data from nine participants were utilized. Three of the students were not former engineering majors and one of the thirteen students did not classify as African American. Therefore, only data from nine of the thirteen participants was used in the presentation of the data in this chapter. All classification levels were represented by the participants with students having classification status' ranging from freshmen to senior.

Table 1 displays the information pertaining to each participant.

Table 1: Participant Data

Participant	Gender	Classification	Data Collection
Pseudonym			Method
Courtney	Female	Senior	Interview
Brandon	Male	Senior	Interview
Lamont	Male	Junior	Interview
Kandace	Female	Sophomore	Interview
James	Male	Freshman	Focus Group
Samantha	Female	Freshman	Focus Group
Tony	Male	Freshman	Focus Group
Mark	Male	Sophomore	Focus Group
Jessica	Female	Sophomore	Focus Group

Courtney

Courtney was the first participant interviewed. Although seemingly reserved and shy initially, as rapport was developed she became increasingly transparent and vocal. She gave a rich and detailed interview. Throughout the conversation she was never hesitant or appeared to search for answers. The passion of her convictions seemed to flow through in every response. This interview was an opportunity to be heard for Courtney and she seemed to take full advantage of the opportunity. Her participant voice bellowed through with truth and class without reservation.

Courtney, a senior from rural North Carolina, always had dreams of becoming an engineer. Having a strong relationship with her father, she proclaimed that he continuously encouraged her to be anything she wanted to be, including an engineer. She had several family

members who were engineers, so it seemed to be a genetic inclination. She excelled in mathematics and science and was a decorated high school graduate, coming in to the University with 68 credit hours. She described herself as “diligent and organized.” She seemed to be most qualified and certainly prepared. She was on trajectory to become a great engineer, however, upon taking her first few foundational engineering courses as a freshman, things changed.

Brandon

Brandon is the youngest of two siblings from rural North Carolina and a former computer science major. Growing up in one of the poorest counties in the state, success could certainly be subjective but it wasn't optional. His parents set a standard and so did his siblings. They attended some of the most prestigious universities in the state and went on to have success in their careers. Brandon was next. He was confident, he was sure, he was motivated and he was determined. After interviewing with Courtney, there was an expectation that every interview would have the same automatic flow of discourse. Upon speaking with Brandon, it became apparent that may not be so.

Brandon's interview was one of the most difficult. He was very reserved and somewhat guarded. When attempting to build rapport and attempt to facilitate comfort in order to help Brandon adjust, he remained distant. In addition, Brandon was the only participant who refused to provide any purposeful documents, other than the reflective journal responses. Although Brandon seemed uncomfortable during the interview, he did answer all the interview questions about his experience while majoring in engineering. Whereas Courtney was unashamed of her new major and newfound academic journey, Brandon seemed to offer filtered answers at times in order to brand himself as put together, confident and in control. Although Brandon offered specific reasons he decided to change majors, without supporting documents to juxtapose his

interview and reflection answers, there remains concern if indeed there was some participant bias.

Lamont

Lamont, having referred to himself as a shy individual, provided a candid and yet quaint interview. Although he seemed nervous at times during the interview, noticeably glancing around and dropping his head, his answers were unfiltered, straightforward and seemingly honest. The shy participant from a populous urban region in North Carolina was one of the easiest to interview. He seemed to find some comfort as rapport was developed. He recounted his experiences in engineering with smooth recollection and revealed a great deal about his own efforts and abilities while pursuing an engineering degree.

Lamont was very similar to Courtney in that he seemed to enjoy the opportunity to share his story. Whenever Lamont was asked a question, he revealed intimate insight to his personal opinions and even his own idiosyncrasies which seemed to serve as a segway to his exit from engineering. He also seemed to know exactly what he wanted to do but his start was rocky. Although he shadowed an engineering student prior to enrolling at NC State University and took one engineering course in high school, the summer transitioning into his freshman year presented to be difficult, academically. His family was on board, supporting his pursuit and he seemed academically adept so he appeared to be on the road to becoming an engineer. Lamont would have a few roadblocks that proved hard to overcome.

Kandace

Kandace, a quirky 21-year old sophomore, served as the last interview participant. Her interview was the longest interview, lasting almost ninety minutes. Kandace seemed to be very outgoing and enjoyed the interview discussion. During her interview, she initiated building

rapport and seemed very comfortable. Although it was her first experience with the researcher, the conversation seemed to flow quite naturally. One interesting thing about Kandace, she seemed to be scattered at times which was often reflect in her verbose responses.

Kandace gave a very rich and detailed interview. Her answers were lengthy and thorough. She would elaborate without coercion from the researcher and provide detail without oblige. Of the participants, Brandon and Kandace came in with the least amount of engineering exposure. They had no affiliation with engineers, as family or acquaintances; and they had never taken any engineering courses in high school. When recounting her engineering experiences, Kandace was very transparent and also shared details about her personal life and how those events played a role in her halt to becoming an engineer.

Themes

Upon completing the interviews and retrieving the documents, the researcher began the coding process develop categories and watch emerging themes unfold. The purpose of this research was to discover the reasons African American students were non-persistent in engineering majors. Three themes emerged and several subthemes which address the two research questions. The themes were: 1) Academic Difficulty 2) Lack of Enjoyment for Engineering Content; and 3) Apprehension of Support Systems. Theme 1, *academic difficulty*, had two subthemes, which were a) difficulty understanding engineering concepts and b) poor performance in mathematics and science prerequisites. Theme 2, *lack of enjoyment for engineering content*, had two subthemes, which were a) bored in class and b) lack of hands-on application. Theme 3, *apprehension of support systems*, had two subthemes, which were a) fear of reaching out for help and b) personal retreat. Each theme presented will answer the two central research questions.

The research study was guided by the self-worth theory of achievement motivation. The self-worth theory of achievement motivation adapted by Wigfield and Eccles (2000) and introduced by Covington (1984), states that learners measure their worth by their ability. To protect their worth, students will avoid any inclination of a lack of ability. Students are either considered success-oriented or failure-avoidant in terms of their ability to achieve success. Throughout the themes, self-worth concepts are intertwined and expressed in the participant voices where they lacked self-worth and felt incapable of continuing in the major due to their inability to perform at a high level, of which they were accustomed.

The themes and subthemes will be addressed in this chapter and participant voices will be categorized by those who participated in the one-on-one interviews and those who participated in the focus group [see Table 2]. The purposeful documents will also be presented in this chapter.

Table 2: Themes and Subthemes

Research Question	Themes and Subthemes
RQ1: What are the reasons some African American students do not persist in the College of Engineering at a predominantly White institution?	<ol style="list-style-type: none"> 1. Academic Difficulty <ol style="list-style-type: none"> a. Difficulty understanding engineering concepts b. Poor performance in mathematics and science prerequisites 2. Lack of Enjoyment for Engineering Content <ol style="list-style-type: none"> a. Bored in class b. Lack of hands-on application
RQ2: What are the particular factors within the College of Engineering that prompt non-persistence in African American students?	<ol style="list-style-type: none"> 1. Apprehension of Support Systems <ol style="list-style-type: none"> a. Fear of reaching out for help b. Personal retreat

Theme 1: Academic Difficulty

Subthemes: Difficulty understanding engineering concepts and poor performance in mathematics and science prerequisites

Interviews

Each participant, with the exception of one, discussed having difficulty with the engineering prerequisite courses and the foundational major courses. Brandon was the only participant of the four primary participants who did not verbally state having experienced difficulty in the courses in regards to academic performance. Brandon also did not provide an unofficial academic transcript or any class assignments. Question 4 of the interview of the one-on-one interview specifically asked: “What are your thoughts and feelings about the academic environment in the College of Engineering?” Participants expressed having difficulty with performing well in the courses and understanding the content. In addition to the foundational major courses, participants also were met with difficulty in the mathematics and science prerequisite courses. Although the participants were considered high performers in mathematics and science prior to enrolling in the university, they expressed finding those same courses challenging. In a previous qualitative research study by McClain (2014), he found “mathematics” to be a emergent theme from his data. His research looked at African American STEM majors, inclusive of engineering, and their experiences in those disciplines. Courtney, a former computer science and electrical engineering student stated:

It’s over your head and they don’t have time to bring it down. . . if I don’t understand, I get frustrated. . . So in class, they would give an example but like if you give an example on a first grade level and the assignments assesses you on a senior level, where’s the in between?

Lamont, a former computer science major expressed having similar frustration in his foundational engineering courses:

E101 wasn't bad. CSC 116, I did alright but the second half of the course, it got more difficult. With CSC 216, I just wasn't getting it at all. I took one coding class in high school but that's it. I just didn't understand the concepts.

I just wasn't doing well in the classes, like calculus 2 and 3. It took me until last year to come to a decision to change my major. I tried really hard. I really wanted to do it [continue with engineering] . . . It was just really tough.

Kandace, like Lamont, expressed having difficulty in her core classes and feeling somewhat lost:

With engineering, they give you a lot of material and they give it to you very by the textbook. Just the concepts, at least for me, were difficult and I didn't have prior knowledge of it. . . There was like an expectation that you would be confused for a lot of it, so you kind of just tried to figure it out. . .

...I heard physics here [at the University] was unpassable. Even the smart kids said it was really hard and it's like 150 people so I took it at a community college. I took calculus 2 and I had difficulty with it so I withdrew the first time; the second time I passed. I had okay success. I got a C. Calculus 3 was risky because it was my first online class and it was already difficult. I was doing really bad in calculus. . . I just accepted I wasn't going to do well. But I didn't drop the course, I was going to see what happened...

According to Covington and Beery (1976), the self-worth theory addresses issues, particularly in the classroom, with a student's ability and effort. A student's perception of their ability is essential because having high ability signifies to a student that they're worthy or successful in an area, in this case it would be engineering. Academic transcripts are also

examined, however, in the participant responses, it reveals a correlated concept of self-worth. Three of the four participants expressed coming to a point of frustration or even quitting in their courses. Even prior to examining the outcome of the participant's grades, this is directly correlated to a failure-avoidant strategy. *Nonparticipation* is a failure-avoidant strategy coined by Covington and Beery tied to students "psychologically" dropping out. To protect their self-worth, effort diminishes because inability is apparent (Covington & Beery, 1976). There is also another failure-avoidant strategy such as *impossibly high goals*. Within the interviews, two of the participants seemed to display a *nonparticipation* strategy, while the academic transcripts showcase how one student seemingly exhibited the *impossibly high goals* strategy.

Academic Transcripts

Each of the primary participants, with the exception of Brandon agreed to provide an unofficial academic transcript which disclosed final grades from their engineering courses. The unofficial transcripts affirmed the sentiments expressed by the participants during the one-on-one interviews regarding academic difficulty.

In an analysis of the participant's grades displayed on their academic transcripts [see Table 3, 4, 5, and 6] , the participants seemed to have some success in major-based academic support courses. These courses are not content driven nor are they mathematics and science related, however, they are focused to provide support and academic success to engineering students by teaching essential college success skills such as study habits, time management, writing, and engineering basics. The participants were entreated with difficulty in their mathematics and science courses and their major-focused courses [See Appendix A for Course Names]. All of the participants had to take at least one of the mathematics courses more than once.

Table 3: Participant Transcript Data

Participant: Courtney	Mathematics Grade	Science Grade	Major Specific Grades
Academic Year			
Summer Session I <i>(Freshman Year)</i>	MA 141: U	N/A	N/A
Fall Semester <i>(Freshman Year)</i>	MA 141: B+	N/A	E 115: S ECE 109: B-
Spring Semester <i>(Freshman Year)</i>	MA 241: B-	PY 205: U PY 206: A+	ECE 209: F

Table 4: Participant Transcript Data

Participant: Lamont	Mathematics Grade	Science Grade	Major Specific Grades
Academic Year			
Summer Session I <i>(Freshman Year)</i>	MA 141: CR	N/A	N/A
Summer Session II <i>(Freshman Year)</i>	MA 241: D-	N/A	N/A
Fall Semester <i>(Freshman Year)</i>	MA 242: D	PY 205: C PY 206: A	E 101: A E 115: U E 144: A
Spring Semester <i>(Freshman Year)</i>	MA 241: C	CH 101: D+ CH 102: A+	E 115: S GC 120: C+ E 122: A-
Fall Semester <i>(Sophomore Year)</i>	MA 305: C ST 370: C+	PY 208: C- PY 209: A	CSC 116: C

Table 5: Participant Transcript Data

Participant: Kandace	Mathematics Grade	Science Grade	Major Specific Grades
Academic Year			
Summer Session II (<i>Freshman Year</i>)	MA 141: B-	N/A	N/A
Fall Semester (<i>Freshman Year</i>)	MA 241: C	CH 111: B	E 101: A E 144: A
Spring Semester (<i>Freshman Year</i>)	MA 242: W	CH 101: B- CH 102: B+	E 115: S E 145: A
Summer Session I (<i>Sophomore Year</i>)	MA 242: F	N/A	N/A
Fall Semester (<i>Sophomore Year</i>)	CSC 226: W		ECE 224: W ECE 200: W

One participant, Courtney, performed moderately fair in her engineering courses. She only failed one course. When examining Courtney's transcript, her current major courses, she boasts nearly all A's. In her engineering courses, although she did not perform extremely poor, they were not A's. It can be proposed that Courtney can be classified as an overstriver in terms of self-worth. Her worth was diminished when she didn't perform to her expectations and she was met with other barriers, to be discussed later.

During Lamont's freshman year, he took 15 hours for the fall semester and 16 hours for the spring semester. During his first semester as a freshman, Lamont was enrolled in five engineering courses and one lab. His first semester freshman GPA was a 2.3. In Lamont's interview, he continued to reiterate how hard he tried and he later disclosed that while in engineering he was failure-avoidant. The data suggests that Lamont, in setting *impossibly high goals* during his freshman year and continuing to take those courses when difficulty arose showcases in his attempt to "try hard" and become an engineer, those lofty goals may have caused his non-persistence.

During the one-on-one interviews and mentioned in the participant reflection responses, participants had a hard time understanding the material. Although these participants came into the University seemingly decorated and academically adept, when they were met with academic challenges, they began to question if engineering was a major that was best for them. Their grades on their academic transcripts reflect their troubles with the courses. For one participant, Lamont, his transcript revealed a rigorous course load for his freshman year.

Class Assignments

Only one participant was able to provide a class assignment for analysis. The class assignment did not relate to the theme of academic difficulty, however, the analysis of the assignment will be discussed in another emergent theme.

Reflective Journals

The four participants who agreed to participate in the one-on-one interview also agreed to provide reflective journal statements. Participants were given reflective journal prompts and asked to write responses that allowed them to reflect on their experiences while in the College of Engineering. The reflective journal prompts were structured to ascertain depictions of self-worth in relation to the participant's pursuit of an engineering degree. The reflective journal responses juxtaposed with the interview responses, and academic transcript details revealed a wealth of data regarding the academic performance of African American students in engineering majors. Each participant journeyed into the major with the intent to persist. The prompts allowed the participants to reflect and take a self-analysis of their experiences. Out of the eight prompts provided, participants selected five prompts upon which to reflect. In regards to academics, participants were given two prompts which directly correlated to feelings about academic ability and self-worth. Those two prompts were: 1) **Prompt 3:** Would you consider yourself success-

oriented or failure avoidant? Explain why.; and 2) **Prompt 7:** What were your high moments and low moments while in engineering? The following participant responses detail their personal reflections.

Courtney

Courtney provided several paragraphs in her reflection prompts that were directly related to academics and self-worth. Her responses were rich and detailed. She disclosed a unique and personal experience she had in one of her engineering courses. Her reflection provided an inside look at her frustration and a hindrance in her self-worth on the road to her pursuit to engineering.

Prompt 7: What were your high moments and low moments while in engineering?

Honestly, a lot of my high and low moments sort of went hand in hand. For example, I had a programming assignment. The program was meant to take an input (number/symbol associated with a card from a standard deck of cards), calculate the total, and finally display the total and the cards entered. I used the entire allotted (probably a week or two) to finish and eventually get the program to work! I remember sitting on a couch in the 4th floor student lounge of Owen hall and finally finding the error causing my program not to function properly. I was thrilled; I read the rubric, made sure I had all the required components, and finally submitted my program and waited to receive full credit on this assignment. The grades finally got posted for the assignment roughly a week later and I was so annoyed with my grade. . . I had points deducted because of my programming “style” and because my program did not pass one of the “secret test” the graders performed on our program. That was infuriating and disheartening. . .

Brandon

Although Brandon answered the prompts that were self-worth and academic focused in the reflection prompts, he seemed to avoid disclosing that he had any academic difficulty, neither did he elaborate in those responses.

Prompt 7: What were your high moments and low moments while in engineering?

The high moments were the math. I was good at math in high school. I was always a math nerd so I enjoyed the math and learning the new stuff in those classes. My low moment. The low was the coding. That's when I decided to change my majors.

Lamont

Lamont offered an insider perspective on what a failure-avoidant motivation resembles. Although his reflection for this particular prompt was relatively short, it was very straight forward and revealed a great detail about his motivation and distress as an engineering major.

Prompt 3: Would you consider yourself success-oriented or failure-avoidant? Explain why?

Now, I would say I'm more success-oriented. Before I switched majors, I may have been more failure-avoidant because I was always just trying not to fail the next test. I was always thinking about not failing or an assignment. But I tried very hard.

Kandace

During Kandace's interview, she alluded to having external problems which also affected her academic performance. This outlier will be discussed later in this chapter. In revealing her external troubles, she mentioned being "spaced out." There were times in Kandace's interview where she would provide a lengthy response to a question but she would seem to ramble in her discussion. Out of all the participants, Kandace seemed to exhibit and detail a lot of self-worth

motivational issues which could be affected by some other intrinsic factors not disclosed by Kandace. Kandace would often refrain from making eye contact and seemed to ramble while in thought. In her reflection responses, she offers a candid and personal response about her motivation and personality.

Prompt 3: Would you consider yourself success-oriented or failure-avoidant? Explain why?

I am a failure-avoidant person because I am reactionary as a student. Being a student is a classification I've had since memory serves, so it can represent my whole life for the question. If a class is hard or easy, it will affect how much energy I put into it. I will put in how much keeps me from feeling like I am failing, usually.

In the analysis of the journal prompts, it became evident that the participants experienced distress and disdain while pursuing engineering. Their reflection prompts showcase issues with self-worth. Upon discovering they lacked an innate ability to perform at a high level, the participants opted to travel another route. Two of the four participants classified themselves as failure avoidant; however, all participants exhibited failure-avoidant strategies, including overstriving (Courtney) nonparticipation (Brandon and Kandace) and impossibly high goals (Lamont).

Focus Group

The focus group interview consisted of five participants. Three of the five participants were current engineering students, one engineering interest and one participant was non-affiliated but had taken one engineering-related course. The researcher confirmed the participant's engineering or non-engineering status by searching for them in the University's directory database. The focus group questions were re-worded when addressing the current

engineering participants. Although three of the participants were considered to be persistent in the College of Engineering, the statements given by those participants revealed similar sentiments as those given by the primary participants in the interviews. These participants also offered candid responses about personal opinions and their African American peer experiences in the College of Engineering. During the focus group session, one participant was particularly vocal. There were times when the researcher had to specifically direct questions to other participants to give them an opportunity to provide a response. Overall, the focus group participants provided responses which closely revealed similarities to those of the primary participants from the one-on-one interviews.

Table 6: Focus Group Participant Data

Focus Group	Affiliation	Classification	Reasons they would leave engineering
James	Mechanical	Freshman	Science classes
Tony	Aerospace	Sophomore	Bored
Mark	University College	Sophomore	Bored
Samantha	Mechanical	Freshman	Science classes
Jessica	Business	Sophomore	Lack of Relationships

During the focus group interviews, Mark and Jessica were not very vocal. At times the researcher had to get them involved in the conversation. They seemed timid and reserved. The engineering students seemed confident, positive and maintaining stability. The non-engineering students from both the focus group interviews and one-on-one interviews, with the exception of

Courtney, all seemed to have some self-worth and confidence issues, visibly and heard in their responses.

When the focus group participants were asked an iteration of the question: “How did you decide to leave engineering and pursue another major?”, to include “Do you know why people would leave engineering?”, the participants gave the following responses:

Samantha: The weed out classes like Calc 2 and Stat.

James: I think it just gets like hard and I know for me, I was used to getting straight A's but that's not how it goes. I think kids who are not used to not like failing but not like succeeding on everything, they just give up or not give up but say ok this isn't for me. When really okay, you're just struggling but struggling isn't the end of the world.

Samantha: Like the Physics test I just took. I feel like if I was not like solidified on doing engineering then...

James: Right like, you'd just be like I want to be a mechanical engineer and that's heavy in physics and I just bombed my physics test, so let me just quit. But it doesn't work like that. But some people function like that, like oh that's it. You know.

James: It's like, can you handle not doing well all the time? . . .

James: Like when I left physics. I felt like garbage and I never done that but then everyone else didn't feel good either so it's like, you're not the only one. It's not like you leave the test and everyone is like "man that was easy"...you're just going "well uhh."

James: . . . I feel like some people are different. Some people will struggle but if they make it...like even if they didn't get like the best grade, but they made it. So that's something to do. But some people, it's A or nothing.

In taking an analysis of the one-on-one interviews and the focus group interviews, the research revealed clear connotations of self-worth. The persistent engineering students experienced performing poorly in academics also, however, their acceptance of failure or their positive ability perceptions overrode the outcome of their actual grades. Their self-worth was not diminished because of ability, neither did they disclose decreasing effort because of poor performance. They stated continuing to have a strong intent to pursue engineering and accepting failure as somewhat part of the process to complete an end goal.

Theme 2: Lack of Enjoyment for Engineering Content

Subtheme: Bored in class and lack of hands-on application.

Interviews

Data revealed three of the four participants expressed some form of displeasure for the content while pursuing engineering. Lamont was the only participant who never alluded to being bored in his interview or reflective journal responses. However, three out of the four participants expressed lacking enjoyment, having a need for creativity, or desiring more hands-on experiences in the classroom. Engagement and interest in course content was also a prominent finding from the research literature regarding non-persistence in engineering (Marra, Bogue, Shen, & Rodgers, 2007). According to the President's Council of Advisors on Science and Technology (PCAST) (as cited in Adams, Dancz, and Landis, 2015) persistence, or retention, of women and minorities in STEM fields such as engineering, involve educators better engaging students and providing the students with the resources to flourish. Berry et al. (2007) presented qualitative data from their research study where a student also suggested a need for application and interaction, having stated "effective instruction starts with an instructor who is a life-long learner and a facilitator, comprehensive curriculum/resources, and adequate instructional time.

When instruction incorporates real life examples, the use of technology and the opportunity to reflect upon learning ... that's a great course.” During the one-on-one interviews, in Question 3, participants were asked: What caused you to leave the College of Engineering and change majors? The participants provided varying reasons, however, three of the participants also detailed some form of a lack of enjoyment as a response to question three or throughout their interview responses for other questions. A timeline of typical non-persistence of the participants is shown in Figure 9 and 10.

Courtney

Although Courtney’s response here is fairly short, she pinpoints exactly what her specific issue was, therefore, providing a straightforward answer without room for much assumption.

Engineering just wasn’t what I thought it would be. It’s very theory based . . .

Brandon

Brandon’s response was interesting because he stated he no longer had an interest in the coding, however, he expressed still having a desire to work with computers as a career with simply a creative output.

I didn’t find much enjoyment after taking the classes; I liked the math but the coding and science classes, it didn’t peak my interest as much as I thought it would—needed something to better suite personality . . .

Even though I’ve changed my majors from computer science, I still want to work with computers but I want to be creative and artistic but still playing towards my strengths. I still want to pursue some type of computer related field but something that allows me to present myself and my work.

Kandace

. . . I hadn't had any face to face time. It was all theoretical. But in my current major, it's hands on. I'm artsy. . .

Reflective Journals

Although there weren't any questions which specifically entreated to gauge whether participants lacked enjoyment, the data from the reflection prompt responses cross examined with interview responses showcased repetitive patterns which were categorized into the emergent theme and subthemes indicating a lack of enjoyment in the courses. A few participants specifically addressed a lack of enjoyment in their reflection responses.

Courtney

One of the biggest factors for me leaving engineering was the lack of hands-on, applicable projects. Unfortunately, engineering was not what I had assumed or expected it to be. The classes were heavily theory based, and lacked the application portion of the theories (where do I use these, how do I use these, and why would I want to?). I am a hands-on, active learner that wants to know the why and then be given the chance to apply it. There seems to be a lack of projects that allow you to apply in the engineering department.

I did not enjoy the work, most of the groups I worked in, or the content that was taught. It is hard to stay motivated when quite literally nothing about the class is interesting. A lot of the engineering classes are lecture heavy, lacking in applicable examples, and required a lot of independent learning outside of the lecture and lab sessions.

Brandon

Near the end when I decided that I didn't want to pursue engineering anymore I felt like I didn't belong. I felt like I was the only person in my coding class that didn't really want to be there or pursue computer science. Everyone else was enjoying it. At that point, I felt like I didn't belong.

Lamont

In classes when everyone else would understand something and I still wouldn't get it.

Most of my friends were also in engineering, so I felt a bit misplaced when around them.

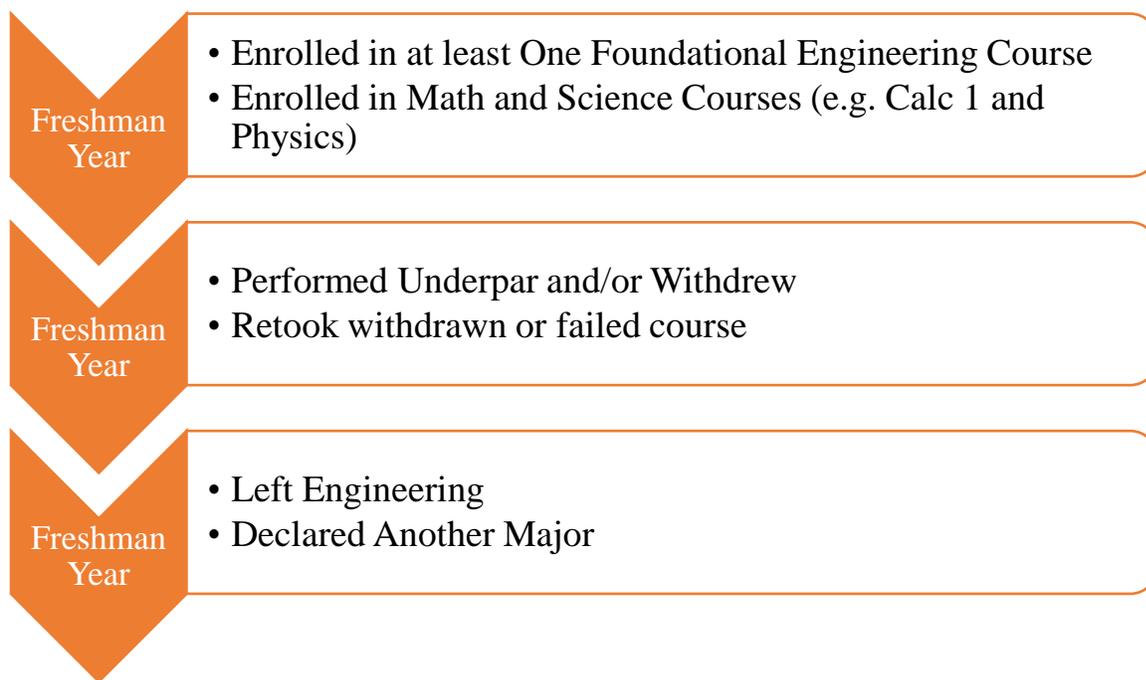


Figure 9: Persistence Timeline I

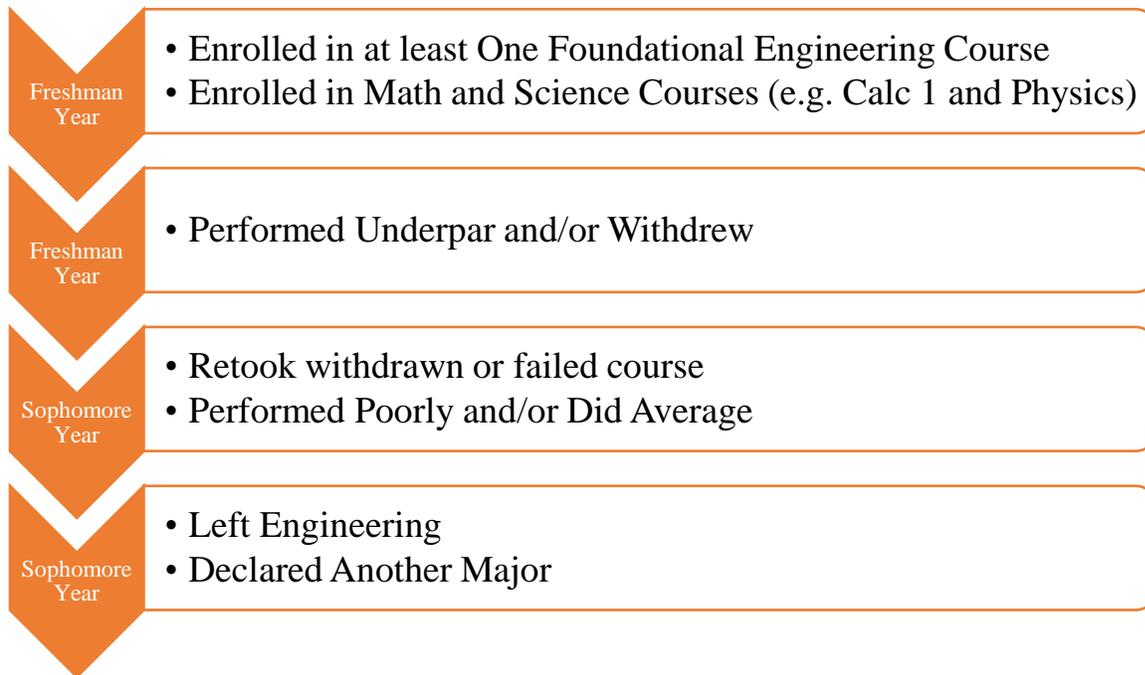


Figure 10: Persistence Timeline II

Focus Group

The focus group participants offered varying responses. The theme surrounding boredom quickly emerged with the focus group participants.

Researcher: What are you guys persistent? What keeps you going?

Samantha: So I'm on an Air Force scholarship so I have to finish because they're paying for school. So that's kind of the thing, to make it worth it. Like the time, getting up in the morning, not sleeping, not going to games because you have other stuff to do. Like if I don't finish, what was the whole point of not doing the stuff I could have been doing.

Tony: Well right now, I don't really like enjoy most of my classes. So I'm hoping once I get more into Aerospace engineering, I'll start to enjoy school more.

Researcher: Why don't you enjoy it?

Tony: It bores me a little bit to be honest. The teaching style and content.

Researcher: Anybody else bored?

James: Sometimes I'm bored because I'm lost. Sometimes I feel like when I go to class and like the material is just thrown out and I'm not really learning. So when I go to class, I try to go back and learn. Cause a lot of kids, they stop going to their class the first few weeks and just read the textbook . . .

Researcher: How about you [Mark]?

Mark: I only go to class for the attendance.

Researcher: Anyone else?

James: [interjects] But like I enjoy my math class because I learn stuff in there. Like I have class everyday for 50 minutes because I can't take any more than 50 minutes straight. But like I like the class, I'm learning, I know what section I'm on. But in like physics, I can't tell you what chapter we're on.

Samantha: Like with engineering [courses], it's a lot of prep work and prep work is really boring and I just want to get into doing the stuff that I'm going to be doing.

Theme 3: Apprehension of Support Systems

Subthemes: Fear of reaching out for help and personal retreat

Interviews

When performing a thematic analysis, there were a lot of patterns from the coding that addressed support systems. Some participants both the primary participants from the one-on-one interviews and the secondary participants from the focus group interviews insinuated there was a lack of support either because of fear or their own personal choice to neglect seeking out those systems. Bowman (2015) conducted research studying the trends of engineering degrees for African Americans. He shared in his research that in the engineering discipline students may face

a lack of support in their departments or programs which may aid in non-persistence in their programs. Several research studies from the literature posited the importance of these support systems for African American students pursuing either STEM or engineering. Several of the support systems mentioned were minority engineering programs (Newman, 2016), summer transitional programs (Stolle-McAllister, 2011), and general instructor-student relations Lovecchio and Dundes (as cited in Tucker & Winsor, 2013). Participant responses have been shared in this section to shed light on those internal and external influences.

Courtney

Courtney seemed to become very vocal when speaking about support systems. The tonality of her voice changed as she began to recount her experiences.

...They expected a lot from you but you didn't have any support. It was like you should know this by now. I know other people felt like this. We had our little 5 black people in the corner and we were like "it's your turn to ask now. I asked before and got ridiculed last week."

I think things like NSBE should be more prominent. Like start publicizing before you come to NC State, like over the summer. I didn't hear about NSBE until I stopped taking engineering courses. I probably would have left anyway but there would have been more support with something like that.

Brandon

Brandon was the only participant who spoke positively and mechanically about the support systems. He did not express fear or reluctance but he did admit forgoing the support offered to minority students.

I think there is a lot of good support in the environment for everyone. It's very diverse. They will find good support to help them get through it. It's a good environment for people who are interested. Support came through professors and the TAs and academic advisors are great help to figuring out stuff. Also extra-curricular that helps but I didn't dive into those...

Kandace

During Kandace's interview, she exhibited a lot of self-confidence behavioral issues and in her interview, she alluded to having such issues. Although she was talkative and friendly, she rarely made eye contact and would often be very submissive or apologetic if she and the researcher mistakenly spoke synchronously. She later admitted to not being "a social butterfly" and having to "warm up to people" then afterwards she would "be chatty with them."

I really didn't know people in that 300 member class. I was kind of lonely. One of my classes, I did try a study group but I felt like I understood the least out of everyone so I could contribute the least so I just stopped going. I ended up withdrawing from school... There were office hours but I don't think a lot of people thought it would help. Many people wouldn't ask the teachers for help.

Before freshman year started, I was in STP (summer transitions program). It's a transitional program for minorities. You go on field trips, do projects and take classes. Everyone from STP went to live in the engineering village but I went to the Scholars Village. You got to go to free seminars and plays. I already knew I wasn't going to last long but I wanted to enjoy it for a while. I was in engineering counsel as a freshman. It was a good experience. I had a scholarship and had to meet up with a faculty member a

few times. But after that and STP ended, I just wasn't inspired at all. I met with the MEP people a few times.

Class Assignments

Courtney, one of the more vocal participants provided a class assignment document for analysis. Courtney explained that the assignment was a group assignment for one of her computer science courses. The students had to collaborate on the project so they utilized Google Documents, an online cloud-based software through Google® which allows multiple collaborators for various files. Courtney expressed having difficulty in the course and was already reluctant to seek help because she felt as though she never received sufficient guidance or support when seeking help on assignments. However, for this assignment, Courtney did reach out to her group members. In Courtney's group comment, her voice was frantic and she posed multiple questions. To her dismay, Courtney received only one response and the response received did not meet Courtney's expectations. See Figure 11 below.

Courtney

Courtney's response to Prompt 6 alluded to feelings of lacking belongingness.

My motivation lessened even more when I didn't feel confident with the material and would ask the instructor or TA for help. Several times I received the comment "We went over this in class" . . . That was discouraging because it felt like the instructor/TA didn't care that I wanted to learn the information.

Brandon

Brandon's indicated in his reflection response that in his new major, he's prone to collaborate more with people than before. Brandon also mentioned in his interview response that he did not seek help from minority support groups or other extra-curricular activities. He did mention, however, reaching out to instructors.

Once I figured out I didn't want to be in engineering, I started to lose motivation. Now I work more on projects and with people than before. I'm feel more driven moving forward.

Two of the primary participants from the one-on-one interviews mentioned being involved in a summer transitional program. One of the participants, Kandace, was also in the Honors program. She lived with others the Scholars Village but she did mention in her interview that she should have lived with other engineers. Lamont, although participating in the summer transitions program, still struggled and mentioned he is normally shy around people in one of his reflection prompt responses. Table 7 and 8 show interview and focus group participant outcomes in seeking support in engineering.

Table 7: Non-persistent Support Data

Interview	Persistent/Non-	Sought Support	Sough Support
Participants	Persistent	(MEP, Programs)	(Peers, Instructors)
Courtney	NP	N	Y
Brandon	NP	N	Y
Lamont	NP	Y	N
Kandace	NP	Y	N
Total Number		2 out of 4	2 out of 4

Focus Group

During the focus group session, several of the participants also vocalized how they currently experience apprehension when reaching out for support. Some of them mentioned fear of reaching out to instructors and also being talked over by classmates in discussions.

Samantha: My professors are okay. A lot of them are just. Last semester, my professors were really awesome. But like this semester. . . I just think some people are very bad at communicating. Some of them, the way they explain it, because they already have their degree, like I am not on that level. This is not making any sense whatsoever.

James: Like some professors, like you. I just feel like you're easy to approach. Like I don't know what your response will be but I know I can bring something up and whether it's a yes or no, you'll put it in a nice way. Like some professors, I may have a question but I'm like, it's not even worth asking, especially out loud and get roasted in front of the whole class.

Researcher: Tell me a little bit about your experience in the College of Engineering?

Samantha: Well like you're one of or maybe two females in the classroom. And as far as African American, maybe one. That's pretty much it. A lot of times you have to speak for the group as a whole so now you have to try 10 times harder to try to be or show that you know what you're doing rather than being talked over.

Table 8: Persistent Support Data

Focus Group	Persistence Status	Sought Support (MEP, Programs)	Sough Support (Peers, Instructors)
James	P	N	Y
Tony	P	Y	Y
Mark	-	N	N
Samantha	P	N	Y
Jessica	-	N	N
Total Number		1 out of 5	3 out of 5

Minor Themes: External Issues and Discomfort

Only one participant within the entire research study stated having an external issue which affected their ability to persist in engineering. Kandace stated having disagreements with her parents which affected her ability to focus. Although Kandace mentioned this pertinent piece of information, she previously stated that her academic performance was already below average before the external conflict occurred.

One participant, expressed feeling uncomfortable as an engineering major and stated she experienced racial undertones from her peers. One other participant in the study from the focus

group session, Samantha, mentioned she experienced being talked over in class by group members and she felt she had to prove her ability because she was an African American female.

Closing Vignette

Today, tomorrow and the day after that, students will find themselves crusing through the various academic buildings, rushing off to class and sitting in the very same seats these participants once sat. They will give no thought about who was before them but will altogether be fancied with success and ambitions. Faculty members will continue to lecture and conduct research that will offer groundbreaking perspectives and practices. The College of Engineering will continue to set the precedent among its peers. Students will graduate and become engineers. They will have achieved their goals, met the requirements and finished their course. Then, there will always be those students who began the journey but fell short of completion. Were they unprepared? Were they responsible? Was it ever a good fit? They'll address those topics and some may come to terms with the answers. What they will find is more confidence, more satisfaction and more worth.

Chapter Summary

Overall, the primary participants and the secondary participants provided a myriad of reasons they left engineering, or would leave engineering [see Figure 12]. They expressed having trouble with learning the content, experiencing discontent or lack of enjoyment and also a reluctance to seek out support.

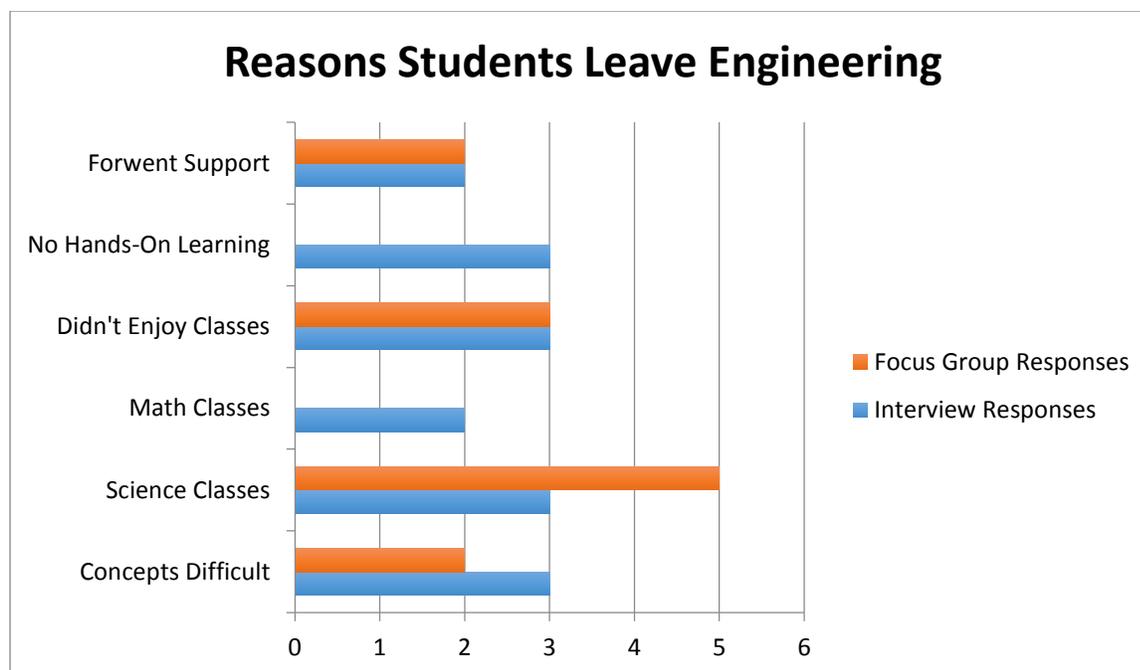


Figure 12: Reasons for Non-persistence in Engineering

The emergent themes presented in this chapter were also validated by existing literature from various researchers. African American students attending predominantly white institutions often experience barriers academically, socially and emotionally. Those barriers affect their self-worth and promote students to lose motivation. Students question their ability because of poor performance and leave the major to protect their worth. Students who persist have a positive self-perception and are afraid of failure and thereby feel no threats to their self-worth. When students are confronted with social issues such as rejection when seeking support or self-isolation, there aren't any external motivating factors to assist them when they run into barriers. In addition, some students are not able to move past a lack of enjoyment. A lack of enjoyment either stems from experiencing academic difficulty or simply experiencing a change in interest. All these factors impact an individual's self-worth. In the the next chapter, recommendations for practice and implications for future research will be discussed as an effort to combat these issues.

CHAPTER 5

DISCUSSION AND CONCLUSION

“Representation of diverse groups in science, technology, engineering, and mathematics (STEM) fields is a persistent concern in the United States” (Dika & D'Amico, 2016, p. 368). Most specifically, the engineering discipline has historically witnessed an underrepresentation of African American students (Bonner, Nave, Frizell, Villa, & Cook, 2009). Although a diverse representation remains to be an issue, there has been some positive change. As reported to ASEE by Bowman (2015), from 2005 – 2013, there was a 14% increase in African Americans obtaining BS degrees in engineering, with an increase for African American males but African American females saw a decrease. Albeit a great change, “there still remains an enrollment and graduation rate disparity” (Bonner, Nave, Frizell, Villa, & Cook, 2009).

This chapter will aim to discuss the researcher’s findings of the qualitative case study regarding the non-persistence of African American students in the College of Engineering. The purpose of this research study was to understand the reasons African American students do not persist in engineering. The second purpose of this study was to understand what influences within the College of Engineering caused African American students to not persist in engineering.

A qualitative case study was utilized to explore the phenomenon of non-persistence amongst African American students in engineering at NC State University. As proposed by Perna et al. (2009), the case study method was selected because the researcher wanted to examine a specific phenomenon and showcase the participant experiences. Utilizing this methodology, the research used several methods of data collection including setting up one-on-one interviews, conducting focus group interviews, and collecting documents including reflective

journals, unofficial transcripts, and a class assignment. A holistic analysis of the entire case was performed (Creswell, 2013). All data were transcribed and coded by the researcher and analyzed using a self-worth theoretical lens. The researcher coded the data to develop themes which were analyzed to answer research questions. Two central research questions guided this research study: (1) What are the reasons some African American students do not persist in the College of Engineering at a predominantly White institution?; and (2) What are the particular factors within the College of Engineering that prompt non-persistence in African American students? In addition to answering the research questions and presenting a summary of the findings and how they aligned with the literature, limitations of the study will be presented as well as recommendations and implications for future research and practice, respectively.

Discussion of Findings

The goal of this qualitative research study was to explore the experiences of African American students who were not persistent in the College of Engineering. Several research studies have employed the qualitative approach to explore similar issues surrounding African American students such as non-persistence in STEM and engineering. A qualitative case study approach was selected to examine the specific phenomenon at a particular university regarding a specific category of students to gather rich data which would offer meaning to their lived experiences (Perna, Lundy-Wagner and Drezna , et al., 2009). A self-worth theoretical lens was used to position the research study.

Research Questions

African American students represent a little over 3% of the population in the College of Engineering at NC State University which is a predominantly White institution (PWI). Of that percentage, 25-30 students were reported to have left engineering each academic year

(Institutional Research and Planning Office, 2017). This problem led to the formulation of the two central research questions guiding this research. The first research question: What are the reasons some African American students do not persist in the College of Engineering at a predominantly White institution?; can be answered with two of the three emergent themes. With each emergent theme, subthemes were also presented. African American students were found to be non-persistent or leave the engineering discipline due to *Academic Difficulty (difficulty understanding engineering concepts and poor performance in math and science prerequisites)* and *Lack of Enjoyment for Engineering Content (bored in class and lack of hands-on application)*. The second research question: What are the particular factors within the College of Engineering that prompt non-persistence in African American students?; can be answered with one of the three developed themes. Influences within the College of Engineering that prompted non-persistence in African American students were found to be *Apprehension of Support Systems (fear of reaching out for help and personal retreat)*.

A qualitative research study conducted by McClain (2014) at the University of Virginia explored the educational experiences of eight African American undergraduates in STEM disciplines. For the participants in McClain's study, mathematics was something they excelled in at an early age. However, upon taking mathematics classes at UVa they did not receive high grades in mathematics. Participants expressed having a hard time in Calculus II and one participant received a C. In this research study, all participants, persistent and non-persistent, with the exception of one, expressed that mathematics was an issue for them. Participants were not able to digest performing poorly in those courses. Participants also expressed having issues with the engineering curriculum in general. The biggest difference between the non-persistent students in this study and the persistent students of this study and of McClain's study was of

confidence. Persistent students from the studies were able to digest receiving an average or below average grade and felt accomplished pressing through the rigorous courses.

Ngambeki, Evangelou, Ohland, and Ricco (2011) conducted a study exploring students' motivation for migration among engineering students wherein 16.2% of the participants were African American. Ngambeki et al. (2011) also found students had a tendency to migrate due to academic performance which was previously discussed in this chapter. In addition to performance, the researchers found a relationship between the participants' satisfaction with their major, performance and less migration. "This satisfaction in their major could then help them develop confidence in their engineering ability which studies have shown lead to better performance" (Ngambeki, Evangelou, Ohland & Ricco, 2011, p. 7. Participants in this research study vocalized being bored and lacking hands-on application. This motivational element was certainly not present with the non-persistent participants. Each participant had a different expectation or perception of what engineering would be at the collegiate level. Participants were unable to navigate the first few years of the major which were heavy laden with theory and content. Participants also expressed lacking application, thereby approving a lack of satisfaction for these participants which supplemented their decision to not persist.

Lee and Matusovich (2016) provided research supporting the continued disparity and attrition of African Americans in engineering. The researchers conducted a multi-case study design exploring six engineering student support centers as assistance for undergraduate students. May and Chubin (2003) echoed the importance of support and intervention programs as recommendations to counter the lack of success for African American students in engineering programs. May and Chubin (2003) found that African American students were less likely to establish relationships across cultures and were also less likely to interact with faculty. The

researchers also suggested that Minority Engineering Programs (MEP) should provide structured study support and increase an emphasis on study time. In this research study, participants typically avoided study groups with peers and reaching out to instructors who were non-minorities. A few participants were involved with some minority engineering programs, however, those participants who were involved began to retreat from support programs and some elected to never pursue those programs altogether. Participants did not want to reach out to instructors because of fear of how their problems would be met and some students simply tried to figure things out alone.

Literature

Although one emergent theme evolved as prominent in this study apart from dominant themes initially stated in the literature review, all of the themes from this research were prevalent in existing literature. One of the dominant themes found in this research was that of African American students experiencing difficulty within the academic. The College of Engineering, the setting selected for this research study, is known for its academic rigor. Many of the participants in this research study expressed difficulty understanding concepts in engineering courses and also extreme difficulty in prerequisite mathematics and science courses, although heralded as math and science standouts at the secondary level. This discovery was also in accordance with previous literature. Meyer and Marx (2014) presented similar findings in their qualitative research study regarding African American students feeling unprepared for the academic rigor of engineering. According to Covington (1984), students often associate success with ability and performance. Having been unable to perform in the engineering courses, participants expressed dismay. This led to the conclusion that while performing poorly in engineering or below their own expectations, students lacked self-worth until finding a new major.

Participants who expressed losing an interest in engineering subject matter also expressed (1) desiring more of a practical or hands-on approach, (2) being bored in the classroom. Berry et al. (2007) presented research study which evaluated preference of teaching styles and classroom techniques for African American engineering students. Although unique to African American males, Strayhorn's (2015) found in previous literature that African American males found STEM subject matter (inclusive of engineering content) too technical or difficult to apply to solving real-world problems. They lacked a clear understanding of STEM'S role in society and its broader practical uses, which lead to their disengaging from STEM classroom instruction, avoiding study of the material, or losing interest in the major altogether. They posited that the identification and implementation of those preferences may lead to an increase in the retention of African American students in engineering through better engagement in the classroom and learning process.

Some participants marginally expressed having a lack of exposure to engineering prior to undergraduate enrollment. In a qualitative research study conducted by Denson, Avery, and Schell (2009), researchers examined the perceptions of urban African American high school students towards engineering as a career. Although unrelated to non-persistence, the researchers found that participants in the research study had a lack of exposure to engineering in school thereby affecting their inability to *define and fully understand engineering*. Similar to the participants in this research study, having been encouraged by parents or having an affinity for engineering-like games, toys and concepts in their youth, these participants pursued the discipline, yet did not have a clear understanding of the engineering discipline. Those participants became disinterested and were less motivated to perform well.

Participants, persistent and non-persistent alike, both expressed feeling unable to reach out to teaching assistants or professors because of having a perceived disconnect. This theme can also be linked to an environmental factor. Student held negative perceptions of faculty members or instructors. Although participants in this research study expressed needing assistance, most stated there was a fear of reaching out for help because of an anticipated negative response or receiving lackluster support from instructors. Participants specifically stated that faculty members at times made condescending comments or exhibited a lackluster attitude towards them when they sought help. Literature posed suggestions such as racial microaggressions or poor advising regarding faculty relations (Marra, Rodgers, Shen & Bogue, 2013; Brown, Morning, & Watkins, 2005). Racial undertones were only expressed by two participants in this study and that was from peers. However, in this particular study, participants expressed having a struggle of not wanting to go to the instructor and having a cemented perception that the faculty member would have an expectation that they should know the concepts and not help them.

Research conducted by Good, Halpin, and Halpin (2002) suggested that minority programs such as minority engineering programs and extra-curricular activities have an impact on the persistence of African American students in engineering. Participants in this research study expressed either (1) not having a knowledge of those programs or (2) personally choosing not to participate. In an earlier study, the researchers also expressed that some universities adopted peer mentoring programs to support minority students such as African Americans who were on the verge of non-persistence. The participants in this research study neglected the support of minority groups and refrained from seeking support for non-minority peers and faculty. Additional literature on social engagement of engineering students also reveals that engineering or STEM-related social engagement (rather than general social engagement) is

significant for predicting persistence (Dika & Lim, 2012). When support was sought, participants either expressed discontinuing support or having a dissatisfaction for the level of support received.

Self-worth

In one of Covington and Beery's (1976) earliest research publications regarding self-worth, the goal was to usher students from the "fear of failure and the complex relationships that exist among academic achievement, confidence, and feelings of self-worth" (p. 89). Although the researchers address failure-avoidant strategies and the complexity of the topic, they also offer strategies to reduce the threat of failure for students and encourage success-oriented learning structures in the academic environment.

Historically and in the present, societal norms suggest that worth is contingent upon an individual's ability to achieve. At the secondary and tertiary level, payoffs for schools are determined by successful performance. Therefore these implicit normalizations of success and worth are ingrained in students at the very beginning of their academic careers. The authors recommend students take charge of certain aspects of their own learning. They propose that learning should be arranged in ways to reduce the threat to self-worth, which include individual success striving and contingency contracting or establishing work contracts between students and teachers. With these efforts, the goals are to provide students with clarity of educational goals and learning steps, boost self-confidence, set realistic goals for tasks, develop positive teacher-student relations and develop systematic and proper grading strategies and practices (Covington and Beery, 1976).

Although the research specifically addresses K-12, this system for improvement can be directed towards the academic environment at the collegiate level. Specifically in the College of

Engineering, participants expressed issues with grades, instructor-student relations and the inability to achieve goals or tasks in regards to performance on academic assessments. Many of the non-persistent students from this research study did confirm having difficulty with academic coursework, forgoing support systems and becoming disinterested in material altogether, however, so did the some of the persistent students in the research study. Similar issues and conflicts were interrelated both with the persisters and non-persisters. The common dynamic that seemed to separate the persisters from the non-persisters was their self-worth, confidence, ability perceptions and their lack of the fear of failure.

In this research study, the primary participants exhibited several failure-avoidant strategies. Whether the participants were aware of the strategies exhibited during their tenure in the College of Engineering cannot be altogether assessed, however, upon changing majors those participants vocalized to the researcher their ability to come to terms with their perceptions of their ability and performance. To provide a recapitulation of self-worth failure-avoidant strategies, there were “two major kinds of achievement motivation in the classroom: 1) an orientation toward success and 2) a disposition to avoid failure. An orientation for success involved attempts to evade a sense of academic failure when the odds for success are low which involved disowning the implication that failure holds for one’s ability to achieve” (Covington and Beery, 1976, p. 43). Two strategies for this view were the underachiever and the overstriver. The failure-prone strategies presented for those who have a disposition to avoid failure were nonparticipation, false-effort, and irrationally high goal setting.

In this research study, the researcher explored student perceptions and analyzed participant responses to various interview questions and reflection prompts to determine the participant’s self-worth. Courtney, a tenacious and highly organized student often spoke with

ease and clarity. Her thoughts were never convoluted and her positive ability perception seemed apparent. Through the examination of her transcript and her verbal disclosure of her initial reaction to seek help quickly categorized Courtney as a determined achiever. Although seemingly having everything in perspective, her underlying self-worth issue became apparent. Always having been a high achiever, when pursuing an engineering degree, Courtney was met with difficulty and lackluster support. Having a strong relationship with her dad who was a consistent pool of encouragement and exhibiting an impressive academic background, the concept of struggle was foreign to Courtney. Courtney did however, express that she was success-oriented and she also stated her main reasons for changing majors involved becoming disinterested with the material and a lack of understanding in courses. However, it could also be said that as an overstriver when Courtney was met with the inability to perform perfectly this affected her confidence and worth. She therefore chose a different major.

Brandon, the hardest participant to interview and the most reserved did divulge some applicable information. Furthermore, Brandon declined to submit an unofficial transcript or any class assignments. In addition, he never alluded to having any difficulty regarding the course work. Brandon grew up in a small rural area where the educational resources were skim and he had no prior exposure to engineering concepts. He repetitively disclosed having become disinterested in the material as his exclusive reason for changing majors. Brandon was the only participant who could not be categorized into a failure-prone strategy.

Lamont clearly exhibited signs of shyness, restraint and a lack of self-confidence. Although Lamont expressed putting forth effort, he expressed always thinking of failing. His transcript also showcased the most rigorous course load of all the participants. Lamont expressed having support from his parents in the pursuit of engineering and also having shadowed an

engineer prior to enrolling into the University. Lamont was the longest persister of the participants, not having switched majors until the end of his sophomore year. Lamont's failure-prone strategy was impossibly high goal setting. With a rigorous course load, an hyper-independent personality and the insatiable desire to try hard and achieve, in this area, Lamont's failure-avoidant strategy was that even after poor performances from his freshmen year, he continued to pursue the rigorous course load, all the while thinking of failure and essentially hoping for the best chasing high goals.

Kandace was the most honest and vocal about her own ability perceptions. In her interview, Kandace offered the following statement in regards to her ability perception: "I said, maybe I'm not studying enough. It's always people smarter than you, you know. I wasn't studying as much as I needed to so I definitely didn't think I was going to get all A's. Even in high school, probably if I found something hard or boring, I didn't do it. If I didn't feel like the difficulty was too high, I did pretty good." Kandace exhibited several failure-avoidant strategies including underachieving, false effort and nonparticipation. These three concepts were relatable. Kandace once mentioned having a drop off in attendance and lacking focus. Kandace was also in the honors program but after a semester of engineering courses, she knew she wasn't going to remain in the program or get A's in engineering. This ability perception and a lack of worth in terms of achieving success ultimately lead to Kandace switching majors. Kandace even extended that she is doing better in her current major. Academically, her transcripts reflect average grades but Kandace's offers a different perspective, higher self-confidence and enjoyment in her courses which are coupled with a positive self-worth perception.

Many participants in this research study described themselves as being failure-avoidant [see Figure 13] and utilizing strategies to protect themselves from failure. The self-worth theory

was applied as a framework for this research study because of ability and performance perceptions and how they relate to motivation (Covington, 1984). Although participants in this research study were initially motivated to pursue engineering, upon performing poorly or becoming disinterested, they decided not to persist. In an effort to protect their self-worth, participants decide to pursue more palatable and engaging subject matter. When analyzing purposeful documents, many participants showcased an increased grade point average (GPA) on unofficial transcripts and expressed feeling more motivated and having a positive outlook on their education after having changed majors.

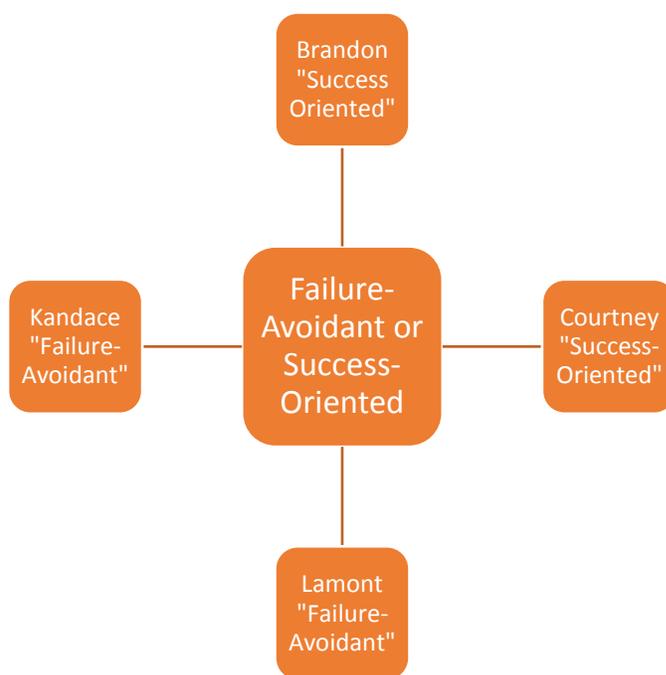


Figure 13: Self-worth Affiliation

Limitations

This research study was conducted to gather unique and rich responses based on the experiences of individuals. A single qualitative case study was employed and nine participants were interviewed to gather data. Due to a lack of response, all of the non-persistent African

American students at NC State University were not represented. The participant experiences displayed in this research study can represent the non-persistent African American students, however, due to there being an unwillingness of students to participate in the research study, any separate experiences aside from those gathered through these participant interviews are unknown.

Recommendations for Future Research

In a research study conducted by Ohland et al. (2011) regarding race and gender in engineering education, the researchers gave several recommendations for future research studies and implications for practice. A few of which are also presented in this research including developing and exploring the relationship of institutional policy to persistence, exploring institutional-level factors and performing a qualitative research study. This research was conducted using a qualitative case study approach. Within this research, it was discovered that most of the non-persistent participants were funneled from one program area within the discipline. Future research can be conducted using a qualitative case study of that specific program area which was computer science.

Recommendation 1: Conduct a qualitative research study focusing on the specific program area, Computer Science, the specific department where all of the non-persistent participants from this research study transferred. In addition, the research study showcased the experiences of multiple participants at a single site; however, a qualitative approach following one non-persistent student at different PWIs throughout their transition of deciding to no longer pursue engineering would be beneficial.

Recommendation 2: Choosing to conduct an ethnographic qualitative research study with one non-persistent student from one engineering program at a different PWI.

Recommendation 3: Capture the experiences of non-persistent African Americans from two separate engineering programs. Conduct a qualitative study involving a PWI and a HBCU. The case study should also look at non-persistent to explore the commonalities and differences.

Recommendation 4: Performing a qualitative study that looks at the impact of non-persistence for African American students at PWIs.

Implications for Practice

“STEM education stakeholders also should develop systems that catalyze students’ motivations, including more robust and intentional mentoring programs” (McGee et al., 2016, p. 187). Many of the participants expressed not having participated in minority support programs. It is suggested that the engineering program implement the following strategy. Coordinate an event geared towards incoming African American freshmen engineers such as an African American Engineering Day. This event would take place on a day during the first few weeks during the fall semester. During the event, African American College of Engineering alumni would come and speak to the students in an assembly style event, discussing careers, challenges and undergraduate experiences. Also, all minority support programs and organizations would have tables at the event. At the event, students would have an opportunity to also be paired with a peer mentor who should be a senior.

K-12 Implications

Although most of the participants from this research study expressed having performed well in mathematics and science in high school, those subject areas presented to be a weak point at the undergraduate level. Ro and Loya (2015) suggested that mathematics and science competency is a fundamental skill for STEM students, such as engineers. Researchers have implied that having skills in these subjects play a role in persistent students in STEM programs.

The question remains then, what is the level of rigor or preparation in these subject areas at the K-12 level? Researchers reported that African American male students are usually aware of their lack of math preparation for collegiate mathematics as well as the difficulties experienced in collegiate mathematics courses (McGee & Martin, 2011). Also, the lack of preparation in science among underrepresented minorities, such as African American students are noticed as early as elementary school; this affects STEM enrollment and persistence (Oakes, 2003) (as cited in Ro and Loya, 2015). Furthermore, in high school, minority students (inclusive of African Americans) only represented 5-10 percent of advanced placement (AP) test takers in computer science, biology, physics, calculus and chemistry from a national average (May & Chubin, 2003).

In addition, most of the participants desired application and understanding of how the theoretical concepts they learned. Kim and Chklouski (2015) conducted a research study which taught hands-on engineering practices to underrepresented children and families. The goal was to provide students with hands-on experience, allow them to see the relevance of engineering and produce a positive impact. Dually, parents would assist in improving the child's quality education and develop relationships with STEM professionals. In this regard, schools in the K-12 sector should develop community partnerships with engineering professionals and researchers to advocate for bringing more engineering content and exposure into the K-12 classroom beyond what is given in the curriculum. Researchers Pickering et al. (2004) conducted a research study which indicated these types of efforts for community outreach proved to be beneficial. Most K-12 classrooms in NC have instituted engineering design curriculums, however, the need for integrated practice of engineering design and the common core in classroom could be beneficial (NCDPI, 2018).

The architects of technology and engineering education have been confronted with adequately preparing for an evolving landscape (Strimel & Grubbs, 2016). Gattie and Wicklein (2007), in conjunction with a previous research study, suggested that Technology Education should focus on “a defined emphasis on engineering design and the general process by which technology is developed” in order to “increase interest and improve competence in mathematics and science among K-12 students by providing an arena for synthesizing mathematics and science principles.” A connection should be made between the science and mathematics courses and engineering content, such as the material from curriculums implemented like PLTW. Tran and Nathan (2014) insisted “at the secondary level, the poor integration of mathematics and science in pre-college engineering curricula deprives students of opportunities to make connections and apply the mathematical and scientific theory they have learned in these academic courses to engineering contexts.” (p. 154). Synthesizing the math and science and also effectively bringing engineering content into the classroom could help students make the effective transition and be successful. Strimel and Grubbs (2016) expressed the same sentiments for success by expressing that just as the industrial arts profession shifted to instruction on how technology affects people and the world in which they live, the technology and engineering education subject is situated within an opportunistic context for truly implementing engineering in the K–12 school setting.

Lastly, Dweck, a prominent social science researcher has presented research on implicit theories or mindsets (Hamovitz & Dweck, 2017). In recent research Hamovitz and Dweck (2017) proposed that teachers and parents should pass a growth mindset onto their children or students, however, that does not seem to occur. In this research, the non-persistent students were found to have a fixed mindset versus a growth mindset. Students with a fixed mindset believe

they have a certain amount of ability and that cannot change; whereas, students with a growth mindset believe they can develop their abilities by their efforts and assistance from others. It is proposed that at the K-12 level, students desiring to pursue a tertiary degree should take a seminar during their junior and senior year that focuses on this theory and helps them implement practical habits to develop a growth mindset. In addition, teachers should also be required to attend a professional development series regarding encouraging growth mindsets in the classroom.

Technology Engineering and Design Education

“Technology education as a specialized area within the field of K-12 education has undergone a metamorphosis over the past two decades with respect to guiding principles, objectives, purpose, and goals. Early foundations were based on industrial arts with the objective to educate high school students in aspects of an increasingly more industrialized society. The name technology education was officially adopted by the primary professional association, the International Technology Education Association to reflect the field’s transition toward an educational focus on the technological underpinnings of society” (Phillips, as cited in Gattie & Wicklein, 2007).

The Technology, Engineering, and Design (TDE) program is housed within the College of Education at NC State University. The program has two concentration areas which include the licensure track and non-licensure track. Students who pursue the licensure track take courses that place them on a trajectory to enter into the secondary environment to become educators. Students pursuing the graphics communication track focus on engineering design and hands-on application courses where they are on trajectory to obtain an industry position upon graduation similar to engineering students. Several curricular focuses for the non-licensure track include

engineering graphics, robotics, digital media, technical visualization, and electronics. A major component of the licensure track is a semester of student teaching. Many of the participants selected to participate in this research study chose to switch majors and yet remain focused to pursue an engineering-related major. Those participants chose to pursue Technology Engineering and Design as a major at NC State University. Some of the participants expressed not having a knowledge of TDE, prior to speaking with an advisor. The African American degree completion is comparable to that of engineering [see Figure 14], however, it can be proposed that some African American engineering students may find TDE more suited for their interests and more enjoyable. If the implications presented for TDE are instituted, the enrollment of African American students may increase thereby giving students an optional to continue on an engineering-related trajectory.

Table of acad_plan_description by acad_year

acad_plan_description	acad_year									Total
	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17		
13TDEBS - Technology, Engineering and Design Education	0	0	0	0	5	1	4	3	3	16
	0.00	0.00	0.00	0.00	5.88	1.18	4.71	3.53	3.53	18.82
	0.00	0.00	0.00	0.00	31.25	6.25	25.00	18.75	18.75	
	0.00	0.00	0.00	0.00	45.45	16.67	36.36	30.00	37.50	

Figure 14: African American Student Degree Completion in TDE (Undergraduate)

Outreach

Many participants admitted not really having an enjoyment for engineering, however, upon switching to TDE, having grown in enjoyment. Brandon and Courtney were extremely grateful to find TDE and expressed sentiments of enjoyment in the major. They found TDE to be inviting, creative and all the while serving the purpose of helping them hone their skills.

Brandon

I am a Technology, Design and Engineering Education major with a concentration in GC. I enjoy the major more than my previous one. It allows me to be more creative. Able to create things like in a digital form.

Courtney

TDE is an inclusive environment. They want you to be here. It's just very inclusive and supportive. Your peers and instructors are there for you. I feel like I didn't get that anywhere else at State. Coming in, I didn't even know TDE was a thing. Then I said, let me see what this is. TDE is what I thought engineering was.

Upon analyzing the participant responses, a few recommendations for TDE can be made regarding outreach. 1) The TDE department can place informational tables in prominent areas on campus where undergraduates gather such as the Talley Student Union. There, students will be able to find out more about the major from selected representatives. If student's perception engineering is more in line with TDE's focus, students can talk to the faculty and student representatives about the major. 2) For students who have already changed majors to TDE, more programming and coding courses can be instituted. All of the primary participants who were non-persistent in engineering were affiliated with computer science. Although that was not intentional, it can be used as a recruitment measure and leverage for the TDE major if a computer science component is implemented.

Institutional Relations

Administrators from the College of Engineering and the TDE department can host joint events. At these events, a panel discussion can occur where each faculty member or a alumnus from the respective department can talk about their collegiate and professional experiences. In

addition to panel discussions, current students can talk about the varying experiences in TDE and engineering and also what solidified them to pursue either major. Having these events in the College of Engineering would be most beneficial. These events could occur once a semester, during the fall and spring.

Reflexivity Statement

Although the researcher had no affiliation with the College of Engineering, there was a dichotomous relationship with the Technology, Engineering, and Design department within the College of Education. It was important for the researcher to remain objective when interviewing participants and bracket personal biases regarding African American student issues. Having experienced academic difficulty as an undergraduate, albeit not in engineering, it was important for the researcher to allow the participants to reflect on their experiences without influencing participant responses by inputting her personal experiences. During the one-on-one interviews, the researcher had to find new ways to develop rapport without playing the role as a participant or heavily identifying with the participants in their experiences.

The reason the researcher took on such a case was indeed due to a personal affinity for African American academic achievement and professional interest in STEM education. Also, having worked with African American engineering students as a graduate teaching assistant in a foundational engineering course and having witnessed some African American students struggle to master the content created a personal investment to research the topic.

There was an array of motivational factors displayed by all participants. The persistent participants had a more positive perception of self, versus the non-persistent students who stated they were happier having changed majors but even in observing their mannerisms and the initial reservations indicated evidence of negative self-perceptions. In a particular journal entry, the

researcher alluded to one of the participants showing visible emotional and social interaction issues. In the participants' interview, they also admitted to having moments where they were "spaced out" and "lonely" in class. Having those moments where students drop off in emotion, is a direct indication of self-worth issues, according to Covington (1984). Therefore, it was extremely important for the researcher to never guide participants into answering questions wherein initial assumptions were made regarding emotional or social issues

In summation, the College of Engineering would benefit to explore the social and emotional aspects of its African American constituents. The emergent themes presented in this research study could have an impact on African American students with emotional, social or worth perception issues coming in as intended engineers.

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APPENDICES

Appendix A

Participant Recruitment E-Mail

Hello:

My name is Shwanda Williams and I am a graduate student in the College of Education at NC State University. I am conducting a research study about African American non-persistence in the College of Engineering. I am emailing to ask if you would like to take about 1 hour to participate in an interview for this research project. In addition to an interview, there will be an opportunity to participate in a focus group to provide your candid thoughts and views. There will be also other ways to lend your perspective in this research project. Participation is completely voluntary and your answers will be anonymous. Participants will be eligible to receive a \$10 Chick-fil-a gift card for participating in the focus group and a \$25 VISA gift card for participating in the one-on-one in-person interviews and providing other helpful research information. If you are interested, please email me at sjwilli5@ncsu.edu. If you have any questions, please do not hesitate to contact me at sjwilli5@ncsu.edu.

Thank you for your time.

Shwanda Williams

Appendix B

Interview Protocol

Research Study:

A Case Study Exploring Non-persistence in African American Students in Undergraduate Engineering

Purpose of Research:

This research has three purposes. The first purpose of this study is to understand the reasons African American students do not persist in engineering. The second purpose of this study is to understand what influences within the College of Engineering that causes African American students to not persist in engineering. The third purpose of this study is to motivate administrators in the College of Engineering to collaborate and think strategically about ways to help African American students persist in engineering at the tertiary level.

Introduction:

In this interview, the researcher will ask questions about your experiences as an African American student who formerly pursued an engineering degree in the College of Engineering at NC State University. Your responses will provide extremely valuable information about the feelings and experiences of African American students who were once engineering majors. Please provide open and honest responses regarding your experiences.

The information obtained will be used for research purposes. All personal identifiers will be kept confidential. Your responses will help inform efforts to understand the reasons African American students do not persist in the College of Engineering at NC State University at undergraduate level. Your participation in this interview is completely voluntary. You may withdraw your participation at any time. Thank you in advance for your participation.

Script:

Welcome and thank you for your participation today. My name is Shwanda Williams and I am a graduate student at NC State University conducting my research study in partial fulfillment of the requirements for the degree of Doctorate of Education in Technology Education.

You have been selected to speak with us today because you have been identified as someone who has a great deal to share about the African American experience in the College of Engineering at NC State University. This research focuses on understanding the reasons African American students do not persist in the College of Engineering and what influences within the College of Engineering affect those decisions.

To facilitate note-taking, I would like to record the conversation today. For your information, only researchers on the project will be privy to the audio recording which will be destroyed after they are transcribed. In addition, you must sign a consent form. Essentially, this document states that: (1) all information will be held confidential, (2) your participation is voluntary and you may

stop at any time if you feel uncomfortable, and (3) we do not intend to inflict any harm. Thank you for your agreeing to participate.

This interview should last no longer than one hour. During this time, you will be asked several questions. If time begins to run short, it may be necessary to extend the time of the interview.

Interview Information:

Date:

Time:

Location

Interviewer:

Release Form Signed: Y | N

Institution:

Interview Questions

Question 1:

What is your current major?

Question 2:

What was your former major?

Question 3:

What caused you to leave the College of Engineering and change majors?

Question 4:

What are your thoughts and feelings about the academic environment in the College of Engineering?

Question 5:

What personal reasons affected your decision?

Question 6:

How do you feel about college and your future goals since you changed majors?

Question 7:

What was your initial reasoning for wanting to be an engineer?

Appendix C

Focus Group Protocol

Script:

Hello everyone, thank you for your willingness to participate in this research study. My name is Shwanda Williams I am a graduate student at NC State University. I will be facilitating the focus group today. I will also be recording the session for research purposes. For your information, only researchers on the project will be privy to the audio recording which will be eventually destroyed after they are transcribed. In addition, you must sign a consent form. Essentially, this document states that: (1) all information will be held confidential, (2) your participation is voluntary and you may stop at any time if you feel uncomfortable, and (3) we do not intend to inflict any harm. Thank you for your agreeing to participate. Upon completion of the focus group interview, I will distribute an envelope with your compensation for participating. Each participant will receive a \$10 gift card to Chick-fil-a. I'm going to provide you with a consent form to sign stating the details and intent of this research study, in addition to requesting your permission to utilize data provided by you today for the research.

Facilitator distributes consent forms.

Please sign forms. If you would like an additional copy for your records, I have them available.

I will tell you a little more about this research. You have been selected to speak with me today because you have been identified as someone who has a great deal to share about the African American experience in the College of Engineering at NC State University. This research focuses on understanding the reasons African American students do not persist in the College of Engineering and what influences within the College of Engineering affect those decisions. This research has two purposes. The first purpose of this study is to understand the reasons African American students do not persist in engineering when losing a sense of self-worth. The second purpose of this study is to understand influences in their academic environment that impacts their sense of self-worth.

In this focus group, I will ask questions about your experiences as an African American student who formerly pursued an engineering degree in the College of Engineering at North Carolina State University. Your responses will provide extremely valuable information about the feelings and experiences of African American students who were once engineering majors. Please provide open and honest responses regarding your experiences.

This focus should last no longer than two hours.

Thank you in advance for your participation.

Here are some guidelines:

1. If you feel uncomfortable during the meeting, you have the right to leave or to pass on any question. There is no consequence for leaving. Being here is voluntary.
2. Keep personal stories "in the room"; do not share the identity of the attendees or what

- anybody else said outside of the meeting.
3. Everyone's ideas will be respected. Do not comment on or make judgments about what someone else says, and do not offer advice.
 4. One person talks at a time.
 5. It's okay to take a break if needed.
 6. Everyone has the right to talk. The facilitator may ask someone who is talking a lot to step back and give others a chance to talk and may ask a person who isn't talking if he or she has anything to share.
 7. There are no right or wrong answers.
 8. Does anybody have any questions?

Focus Group Information:

Date:

Time:

Location

Interviewer:

Interviewees:

Release Form Signed: Y | N

Questions

Question 1:

What compelled you to participate in this study?

Question 2:

Tell me a little about your experience in the College of Engineering.

Question 3:

What are your feelings and thoughts now that you have changed majors?

Question 4:

What keeps you going everyday?

Question 5:

How did you decide to leave engineering and pursue another major?

Question 6:

What are your current goals?

Question 7:

Is there anything else you want to share that we haven't talked about yet?

Thank you for your time

Appendix D

Reflective Journal Prompts

Prompt 1:

Discuss a time when you felt isolated or as if you didn't belong.

Prompt 2:

Discuss a time when you felt unable to perform in the classroom? Did you put forth much effort during those times?

Prompt 3:

Would you consider yourself success-oriented or failure-avoidant? Explain why?

Prompt 4:

What influenced you to pursue engineering?

Prompt 5:

What influenced you to leave engineering?

Prompt 6:

How has your motivation for school changed? Be detail specific.

Prompt 7:

What were your high moments and low moments while in engineering?

Prompt 8:

Performance. Describe how this word makes you feel.

Appendix E

Recruitment Flyer



**NC STATE
UNIVERSITY**

Former College of Engineering Students

*Interested in lending a voice to
research?*

UNDERGRADUATE STUDENTS | FORMER COE STUDENT

INTERVIEWS | FOCUS GROUPS

PARTICIPANTS WILL BE ELIGIBLE TO RECEIVE COMPENSATION

Contact Shwanda Williams
sjwilli5@ncsu.edu
919-428-0351

Appendix F

Participant Consent Form

NC State University INFORMED CONSENT FORM for RESEARCH

Title of Study: An Intrinsic Case Study Exploring Non-persistence of African American Students in Undergraduate Engineering in the College of Engineering

Principal Investigator: Shwanda J. Williams

Faculty Sponsor: Dr. Cameron Denson

What are some general things you should know about research studies?

You are being asked to take part in a research study. Your participation in this study is voluntary. You have the right to be a part of this study, to choose not to participate or to stop participating at any time without penalty. The purpose of research studies is to gain a better understanding of a certain topic or issue. You are not guaranteed any personal benefits from being in a study. Research studies also may pose risks to those that participate. In this consent form you will find specific details about the research in which you are being asked to participate. If you do not understand something in this form it is your right to ask the researcher for clarification or more information. A copy of this consent form will be provided to you. If at any time you have questions about your participation, do not hesitate to contact the researcher named above.

What is the purpose of this study?

The first purpose of this study is to understand the reasons African American students do not persist in engineering when losing a sense of self-worth. The second purpose of this study is to understand influences in their academic environment that impacts their sense of self-worth.

What will happen if you take part in the study?

If you agree to participate in this study, you will be asked to participate in one-on-one interviews and focus groups. In addition to participating in interviews and focus groups, you will be asked to share your course grades, previous class assignments and personal e-mails sent to University faculty, staff or peers by providing tangible hardcopy versions of documents. Interviews and focus group sessions will be audio recorded. You will also be asked to write reflections via Microsoft Word. No information may be exchanged via e-mail. All information must be in a hardcopy format provided to the researcher in-person.

Data

The research data collected from this research study will help promote reform and will hopefully compel educators and administrators at the tertiary level and in the College of Engineering to work together to develop strategies and programs to help African American students persist in engineering.

Risks and Benefits

There are minimal risks associated with participation in this research. The probability of harm or discomfort that may occur by participating in this research study is no greater than that of what may occur in a normal classroom setting in your daily educational activities.

Confidentiality

The information in the study records will be kept confidential to the full extent allowed by law. Data will be stored securely using password protected computer software and a password protected computer. No obvious identifiers or references to your identity will be made in the research reports. In focus group sessions, confidentiality cannot be guaranteed due to the nature of focus groups, that participants should respect the confidentiality of fellow participants and what is shared in the focus group should be treated as private and not shared with others outside of the focus group.

Compensation

Upon completion of the research study, I will provide you in-person with an envelope containing your compensation for participating in this research study. You will receive a \$25 VISA gift card. Successful completion of the research study involves participating in the 1) focus group interview, 2) in-person interview, and 3) providing the researcher with hard copy documents in person (personal emails, an unofficial transcript, and class assignments). If you decide to voluntarily withdraw from the research study, decline to provide any of the documents or decline to participate in the in-person interview, you will not be eligible for compensation.

What if you have questions about this study?

If you have questions about the research study or procedures, you may contact Shwanda J. Williams, the researcher, at 919-428-0351 or sjwilli5@ncsu.edu

What if you have questions about your rights as a research participant?

If you feel you have not been treated according to the descriptions in this form, or your rights as a participant in research have been violated during the course of this project, you may contact Deb Paxton, Regulatory Compliance Administrator at dapaxton@ncsu.edu or by phone at 1-919-515-4514.

Consent To Participate

“I have read and understand the above information. I have received a copy of this form. I agree to participate in this study with the understanding that I may choose not to participate or to stop participating at any time without penalty or loss of benefits to which I am otherwise entitled.”

Subject's signature: _____

Date: _____

Investigator's signature: _____

Date: _____

Appendix G

IRB Approval E-mail

IRB Administrative Office <pins_notifications@ncsu.edu>

to me ▾

Dear SHWANDA WILLIAMS:

IRB Protocol 12073 has been approved

Title: An Intrinsic Case Study Exploring Non-persistence of African American Students in Undergraduate Engineering in the College of Engineering

PI: Denson, Cameron DeLeon

The project listed above has been reviewed by the NC State Institutional Review Board for the Use of Human Subjects in Research, and is approved for one year. This protocol will expire on 01/16/2019 and will need continuing review approval before that date.

NOTE:

1. This board complies with requirements found in Title 45 part 46 of The Code of Federal Regulations. For NCSU the Assurance Number is: FWA00003429.
2. If your study involves an informed consent form, you must use the approved consent forms (available in the IRB system with the documents for your protocol).
3. Your approval for this study lasts for one year from the review date in this letter and listed on the "Title" page of the eIRB. If your study extends beyond that time, including data analysis, you must obtain continuing review approval from the IRB.
4. Any changes to the protocol and supporting documents must be submitted and approved by the IRB prior to implementation.
5. If any unanticipated problems or adverse events occur, they must be reported to the IRB office within 5 business days by completing and submitting the unanticipated problem form on the IRB website: <https://research.ncsu.edu/sparcs/compliance/irb/submission-guidance/>.
6. Any unapproved departure from your approved IRB protocol results in non-compliance. Please find information regarding how to avoid non-compliance here: http://research.ncsu.edu/sparcs-docs/irb/non-compliance_faq_sheet.pdf.

If you have any questions, please don't hesitate to call us.

Appendix H

Course Abbreviations and Names

Course Abbreviation Key	
Abbreviation	Course Name
Math Courses	
MA 141	Calculus I for Scientists and Engineers
MA 241	Calculus II for Scientists and Engineers
MA 242	Calculus III for Scientists and Engineers
MA 305	Introductory Linear Algebra and Matrices
ST 370	Probability and Statistics for Engineers
Science Courses	
PY 205	Physics for Engineers and Scientists I
PY 206	PY 205 Lab
PY 208	Physics for Engineers and Scientists II
PY 209	PY 208 Lab
CH 101	Chemistry – A Molecular Science
CH 102	CH 101 Lab
CH 111	Preparatory Chemistry
Engineering Courses	
E 101	Introduction to Engineering & Problem Solving
E 115	Introduction to Computing Environments
E 122	Engineering Academic Success
E 144	Academic and Professional Preparation for Engineering I
E 145	Academic and Professional Preparation for Engineering II
ECE 109	Introduction to Computer Systems
ECE 209	Computer Systems Programming
ECE 200	Introduction to Signals, Circuits and Systems
GC 120	Foundation of Graphics
CSC 116	Introduction to Computing - Java
CSC 226	Discrete Mathematics for Computer Scientists

Appendix I

Focus Group Transcript

5 Participants

Participants:

James

Tony

Jessica

Mark

Samantha

SW: Why did you choose engineering?

James: I feel like having an engineering degree would always get me a job.

Tony: Like he said, I was always good at math and science and I had an interest in planes and figuring out how they work.

SW: Do you guys have family members or friends who were like insistent about you being an engineering?

Tony: I know others whose family pushes them. They feel like the title engineers is the most important.

James: I don't have anyone putting pressure on me but I've seen other people. It's kind of like if someone in your family wants you to be a doctor. Like if you have parents that's engineers. They're going to have to do the same thing.

SW: Tell me a little bit about your experience in the College of Engineering?

Samantha: Well like you're one of or maybe two females in the classroom. And as far as African American, maybe one. That's pretty much it. A lot of time you have to speak on the group as a whole so now you have to try 10 times harder to try to be or show that you know what you're doing rather than being talked over.

SW: Anybody else, as far as your experiences?

James: I mean I don't really feel as much pressure. But when people point out how few minorities there are, then that's when I notice. When I get in a class, I don't really think about it. But when someone does point it out, I think about it. So it's kind of like you are representing everyone. So it kind of does put a lot of pressure on you.

SW: Do you think that some people who leave the College of Engineering that that pressure was too much?

Samantha: I don't think the pressure would make me stop.

SW: Are you guys in like NSBE or MEP?

James: I'm not. But I had the E144 class but I had like people who were in it.

SW: Do you think NSBE or MEP helps as far as with getting acclimated to COE?

Tony: I did STP (Summer Transition Program) over the summer and I feel like it gets you connected with other minorities and they feel the same way you're feeling, like if you're feeling uncomfortable.

SW: If you weren't doing engineering, what would you do?

James: I always wanted to be a fighter pilot. It takes a long time.

Tony: And you have to have 20/20 vision.

James: Even if you meet all the requirements, you have to be the best of the best.

SW: Where are you guys from?

James: I'm from Charlotte.

SW: [interjects] Do you think people who are from rural areas, do you think they struggle in engineering or classes like this?

James: I'm obviously not from a rural part but if I didn't have this experience (like in sketching), I would definitely be thrown off. So if I had no experience, it would be frustrating.

SW: Talk about your engineering classes. Is it hard or easy? [to James]

James: This isn't brand new so it's not difficult but I'm sure next semester, I'll get hit with something.

[silence]

SW: So where are you all from?

Mark: Charlotte.

SW: How about you? [points]

Samantha: Jacksonville.

Jessica: Fayetteville.

Tony: Greensboro.

SW: Do you know why people would leave engineering?

Samantha: The weed out classes like Calc 2 and Stat.

James: I think it just gets like hard and I know for me, I was used to getting straight A's but that's not how it goes. I think kids who are not used to not like failing but not like succeeding on everything, they just give up or not give up but say ok this isn't for me. When really okay, you're just struggling but struggling isn't the end of the world.

Samantha: Like the Physics test I just took. I feel like if I was not like solidified on doing engineering then...

James: Right like, you'd just be like I want to be a mechanical engineer and that's heavy in physics and I just bombed my physics test, so let me just quit. But it doesn't work like that. But some people function like that, like oh that's it. You know.

James: It's like, can you handle not doing well all the time. And also, you get pressure from outside people. That makes it even harder. So like if your parents want you to be an engineer and you just failed a test...then what happens.

James: Like when I left physics. I felt like garbage and I never done that but then everyone else didn't feel good either so it's like, you're not the only one. It's not like you leave the test and everyone is like "man that was easy" ...you're just going "well uhh"

James: And I don't know. I feel like some people are different. Some people will struggle but if they make it...like even if they didn't get like the best grade, but they made it. So that's something to do. But some people, it's A or nothing.

SW: Do you have to maintain a certain GPA in the college?

Samantha: 2.0 cut off for the school. But me, I have to keep a 2.5 because I'm on a scholarship.

SW: Do you think people just choose to leave instead of being kicked out?

James: I think if you're that low, you'll probably just end up leaving. To hit 2.0 or you gave up before you got to that point in a class.

Tony: At the same time, there are like C walls in a class. And you only have two attempts to take a class. So if you don't get over a C in those two attempts, you don't really have a choice.

SW: What do you think a reason they (African Americans) would get to that point of giving up? Talk about academics and faculty and environment. What is your relationship with faculty?

James: Not only are you outnumbered in class but I don't have any professors that...well I have maybe one but I don't know where she's from...she's really nice though. But other than that, most of my professors are white. So maybe they feel like that can't reach out the same or can't connect.

Tony: Like in MEP, Mrs. _____, she'll let you know if you need anything, you just have to ask for it.

Jessica: I just sit in the back.

Samantha: My professors are okay. A lot of them are just... Last semester, my professors were really awesome. But like this semester, and I don't think it has anything to do with race, I just think some people are very bad at communicating. Some of them, the way they explain it, because they already have their degree, like I am not on that level. This is not making any sense whatsoever.

James: Like some professors, like you. I just feel like you're easy to approach. Like I don't know what your response will be but I know I can bring something up and whether it's a yes or no, you'll put it in a nice way. Like some professors, I may have a question but I'm like, it's not even worth asking, especially out loud and get roasted in front of the whole class.

SW: How about female faculty?

Samantha: I think it's pretty cool having a female teacher because obviously most of your professors are going to be male.

James: Some of the female faculty, I've had bad experiences with them. I feel like some of them are trying to prove something so they're even worse. It's like they're trying to prove their worth. They're all about business. I wouldn't even want to be with them one on one.

SW: What are you guys current goals?

James: Hopefully I would have made it that far (to senior year).

Jessica: I take it one day at a time.

SW: What are you guys persistent? What keeps you going?

Samantha: So I'm on an Air Force scholarship so I have to finish because they're paying for school. So that's kind of the thing, to make it worth it. Like the time, getting up in the morning, not sleeping, not going to games because you have other stuff to do. Like if I don't finish, what was the whole point of not doing the stuff I could have been doing.

Tony: Well right now, I don't really like enjoy most of my classes. So I'm hoping once I get more into Aerospace engineering, I'll start to enjoy school more.

SW: Why don't you enjoy it?

Tony: It bores me a little bit to be honest. The teaching style and content.

SW: Anybody else bored?

James: Sometimes I'm bored because I'm lost. Sometimes I feel like when I go to class and like the material is just thrown out and I'm not really learning. So when I go to class, I try to go back and learn. Cause a lot of kids, they stop going to their class the first few weeks and just read the textbook . . .

SW: How about you [Mark]?

Mark: I only go to class for the attendance.

SW: Anyone else?

James: [interjects] But like I enjoy my math class because I learn stuff in there. Like I have class everyday for 50 minutes because I can't take any more than 50 minutes straight. But like I like the class, I'm learning, I know what section I'm on. But in like physics, I can't tell you what chapter we're on.

Samantha: Like with engineering [courses], it's a lot of prep work and prep work is really boring and I just want to get into doing the stuff that I'm going to be doing.

SW: Do you think that causes people to switch majors?

James: Right. Like I find some classes entertaining but I'm like where does this lead in the future?

SW: Do you think the material should be more practical?

James: Yea

James: Yea, I'm the same. I'm hoping that when we get more into specified stuff, like I'll be like okay, "this is why my first year sucked."

Appendix J

Interview Transcript

Participant: Brandon

Interview Transcript

SW: What is your current major?

B: I am a Technology, Design and Engineering Education major with a concentration in GC. I enjoy the major more than my previous one. It allows me to be more creative. Able to create things like in a digital form.

SW: What was your former major?

B: Former major was computer science. (initially wanted to do computer science) took a lot of computer related courses; took coding csc 116, writing codes—didn't find it enjoyable after first semester; sought to look into other majors, into a future career...it wasn't as exciting as you thought it.

SW: What caused you to leave the College of Engineering and change majors?

B: I didn't find much enjoyment after taking the classes; I liked the math but the coding and science classes, it didn't peak my interest as much as I thought it would—needed something to better suite personality; nothing in environment or atmosphere that would make me feel uncomfortable

SW: What are your thoughts and feelings about the academic environment in the College of Engineering?

B: I think there is a lot of good support in the environment for everyone. It's very diverse. They will find good support to help them get through it. It's a good environment for people who are

interested. Support came through professors and the TAs and academic advisors are great help to figuring out stuff. Also extra curricular that helps but I didn't dive into those. Changed major at the beginning of sophomore year.

SW: What personal reasons affected your decision?

B: At first I was undecided because I knew my family wanted me to go in that direction because I was really good with working with computers. Helped me with better options to make it more enjoyable to pursue.

SW: How do you feel about college and your future goals since you changed majors?

B: I think NC State is a great University to help students first getting into college. Great support helping students figure stuff out (programs, teachers, academic advisors, projects, meetings).

Even though I've changed my majors from computer science, I still want to work with computers but I want to be creative and artistic but still playing towards my strengths. I still want to pursue some type of computer related field but allows me to present myself and my work.

B: From my experience, I didn't feel much difference from TDE or engineering as a Black person; didn't feel any discrepancies between majors. Didn't know anyone who experienced any problems that was African American.

SW: What was your initial reasoning for wanting to be an engineer?

B: Pretty much like I said earlier, when I was younger and in high school, took computer related courses; I'm good at this so I'll see where it goes in college.

Participant: Courtney

Interview Transcript:

SW: What is your current major?

C: Technology, Engineering, Design (TDE) and a GC (graphics communication) minor.

C: TDE is an inclusive environment. They want you to be here. It's just very inclusive and supportive. Your peers and instructors are there for you. I feel like I didn't get that anywhere else at State. Coming in, I didn't even know TED was a thing. Then I said, let me see what this is.

TDE is what I thought engineering was.

SW: What was your former major? [Give detail].

C: Came in with the intent to be a computer engineer. I took Intro to EC and EC 209 and a lab. I ended up withdrawing. The classes were huge. It was like 200 students. I was 1 of 3 Black students and the only female. After those classes, I didn't take anymore engineering courses.

C: There are 3 types of people in that classroom and I didn't fit into any of those categories. It was exclusive in that right. It was older white males, Indian males and Asians.

SW: What caused you to leave the College of Engineering and change majors? What are your thoughts and feelings about the academic environment in the College of Engineering?

C: It's over your head and they don't have time to bring it down. It's not that I'm not interested in the content but if I don't understand, I get frustrated. There's not a lot of teaching happening. It's ranting about what you did in industry. It's a lot of independence. So in class, they would give an example but like if you give an example on a first grade level and the assignments assess you on a senior level, where's the in between?

C: I would call the environment inferior. They expected a lot from you but you didn't have any support. It was like you should know this by now. I know other people felt like this. We had our little 5 black people in the corner and we were like "it's your turn to ask now. I asked before and got ridiculed last week.

C: I think personally there are racial undertones in the college of engineering. It's not the entire issue. It's more so with student to student (racial undertone) but there is some with instructor-student.

C: I think things like NSBE should be more prominent. Like start publicizing before you come to NC State, like over the summer. I didn't hear about NSBE until I stopped taking engineering courses. I probably would have left anyway but there would have been more support with something like that.

C: Sometimes African American students get shafted because instructors don't believe that can. They're not prepared to by instructors. It's not an intellectual thing. If you're not given the tools and resources, you'll look silly trying to do a job.

SW: What personal reasons affected your decision?

C: Engineering just wasn't what I thought it would be. It's very theory based and academically, it just wasn't a welcoming environment. It wasn't comfortable. Also, I didn't get the same support from peers like I do now in TED.

SW: How do you feel about college and your future goals since you changed majors?

C: I love NC State. I love my major and its prepared me for what I inevitably want to do. The job market is so saturated with engineers without jobs. Since I transferred into my major, I receive emails about jobs a lot. One of my biggest concerns initially was job security. This was the best decision for me and my aspirations. As African Americans, we have a little more uphill battle in

things and I just knew engineering was a saturated field and now I'm going to teach for a couple of years.

SW: What was your initial reasoning for wanting to be an engineer?

C: People push it you know. Be a doctor, engineer, something in a field with longevity. I wasn't told there were other options. Black students are told college is the only way you're going to do anything. I had a family where there were engineers and went to State and that was a reason. I feel like other Black students feel the same. Also money too. Because engineers do make money. But what I didn't know is vocational work makes money too. But no one tells you about that (like carpentry, electrical work). You're not telling us (Black students) our options and we're pushed in a direction but we won't succeed because we didn't have the resources.

Participant: Kandace

Interview Transcript:

SW: What is your current major?

K: TDE, licensure education

SW: What was your former major?

K: Computer engineering

SW: What caused you to leave the College of Engineering and change majors?

K: Probably the classes. I heard physics here was unpassable. Even the smart kids said it was really hard and it's like 150 people so I took it at a community college. I took calculus 2 and I had difficulty with it so I withdrew the first time; the second time I passed. I had okay success. I got a C. Calc 3 was risky because it was my first online class and it was already high difficulty. I was doing really bad in calculus and I didn't reach out to the teacher at all. I just accepted I wasn't going to do well. But I didn't drop the course, I was going to see what happened. I was also having issues with my family. It was affecting my school work. I got a B in chemistry. I had problems at home but it was already heading that direction. I retroactively withdrew. I was pretty bummed out with family and gave up half way through. I really didn't know people in that 300 member class. I was kind of lonely. One of my classes, I did try a study group but I felt like I understood the least out of everyone so I could contribute the least so I just stopped going. I ended up withdrawing from school. Up until this semester, I hadn't taken and finished a course since the previous summer

SW: What are your thoughts and feelings about the academic environment in the College of Engineering?

K: I didn't like the large classes in engineering. I hadn't had any face to face time. It was all theoretical. But in my current major, it's hands on. I'm artsy so I liked TDE 205.

SW: What personal reasons affected your decision?

K: I took E101 and I thought I was headed in the right direction. But my willingness to go to class just dropped. Attendance just dropped. Before freshman year started, I was in STP (summer transitions program). It's a transitional program for minorities. You go on field trips, do projects and take classes. Everyone from STP went to live in the engineering village but I went to the Scholars Village. You got to go to free seminars and plays. I already knew I wasn't going to last long but I wanted to enjoy it for a while. I was in engineering counsel as a freshman. It was a good experience. I had a scholarship and had to meet up with a faculty member a few times. But after that and STP ended, I just wasn't inspired at all. I met with the MEP people a few times. With computer engineering, it was more about STEM and a good paycheck. But now in TDE, I look at a few things like how I feel.

With engineering, they give you a lot of material and they give it to you very by the textbook. Just the concepts, at least for me, were difficulty and I didn't have prior knowledge of it. There were office hours but I don't think a lot of people thought it would help. Many people wouldn't ask the teachers for help. There was like an expectation that you would be confused for a lot of it so you kind of just tried to figure it out on your own or with a small group of friends.

SW: How do you feel about college and your future goals since you changed majors?

K: I'm learning and not struggling and not understanding. I know what's going on in TDE.

SW: What was your initial reasoning for wanting to be an engineer?

Kandace: One part was money. It seemed like a very valuable job. With engineering, you will get a job. It's sort of prevalent. It's a trend right now. Everyone is migrating towards engineering. It's important to society.

Participant: Lamont

Interview Transcript:

SW: What is your current major?

L: TDE, GC (industry track)

SW: What was your former major?

L: Computer Science

SW: What caused you to leave the College of Engineering and change majors?

L: I just wasn't doing well in the classes, like calculus 2 and 3. It took me until last year to come to the decision to change my major. I tried really hard. I really wanted to do it ... It was just really tough.

SW: What are your thoughts and feelings about the academic environment in the College of Engineering?

L: E101 wasn't bad. CSC 116, I did alright but the 2nd half of the course, it got more difficult. With CSC 216, I just wasn't getting it at all. I took one coding class in high school but that's it. I just didn't understand the concepts.

SW: What personal reasons affected your decision?

Lamont: I didn't know TDE was a thing. I was considering transferring out of NC State but an advisor told me about TDE.

SW: How do you feel about college and your future goals since you changed majors?

L: I feel a lot better. I've picked up my GPA. Freshman and sophomore year, I was getting C's and D's. I like the TDE teachers. TDE is a lot smaller, you get to know people but people are

like “what’s TDE?” The college of engineering is more well known. But both of them you can do similar things with the degree.

SW: What was your initial reasoning for wanting to be an engineer?

L: I wanted to do something that was math and science related. Engineering seemed good.

Before I came to State, I shadowed another student. I did STP but I didn’t do well in Calc 2.