This qualitative narrative study critically explores the pathways, racial identities, and mathematical identities of the transfer experiences of black male engineering students. Thirteen engineering students between the ages of 21 and 25+ were purposely selected for semi-structured interviews. The participants transferred from various community colleges to a four-year engineering program. This study obtains complementary data from online demographic surveys, researcher observation guide, memos, and field notes. The following research questions guided the study: 1) what are the experiences of black male engineering students who transfer from community colleges to four-year institutions?; 2) how do personal, social, and environmental factors shape the transfer experiences of black male engineering students who attend four-year institutions?; and 3) how do racial and mathematical identities shape the transfer experiences of black male engineering students who attend four-year institutions?

The researcher used the constant comparative method to analyze and interpret data, which resulted in several findings. First, the journeys that black male students undergo during their transfer experiences includes successfully navigating the community college transfer application process, engaging with complex engineering coursework, experiencing positive support from family and friends, becoming an engineering student, and making dreams possible in engineering. All these elements must be considered when defining the overall social and academic experience. Second, factors shaping the transfer experiences include social structures that impact engineering student success, enhancing knowledge
through communities of practice, and applying knowledge to engineering grand challenges. Furthermore, the students’ identity awareness evolves from their racial identity development, their developing engineering identity, middle and high school academic experiences in mathematics, and their post-secondary academic experiences in mathematics and engineering.

Three conclusions were drawn from the findings. First, students’ academic and social experiences revolve around the socialization process that leads to the development of their engineering mindsets. Second, collaborative and mentoring interactions within engineering communities of practice foster the development of their engineering mindsets and complex problem-solving. Third, positive racial and mathematical identities influence the educational participation of engineering transfer students in a positive way.
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Black Male Engineering Transfer Students: A Critical Exploration of Their Pathways, Racial Identities, and Mathematical Identities

by

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DEDICATION

Thanks be to God for all the strength, courage, and wisdom that He bestowed upon me to complete this doctoral dissertation. Everything is possible with Christ who is my strength, refuge, and comforter. Thank you to my beautiful daughters, Dalya and Andreya, for their unconditional love and zealous admiration. Thank you to both of my parents, Bassam and Evangelie who are excellent role models of what it means to be faithful Orthodox Christians, hard workers, and great influential leaders. Thank you to my sisters, Rena, Roula, and Mary, for your loving support. I love each one of you very much and I am so grateful for your support.
BIOGRAPHY

Olgha Bassam Qaqish is a practicing Orthodox Christian and a mother of two multiracial girls who since birth remind her of God’s grace. She is the daughter of a mother who spent two decades raising up four strong daughters and who lost her battle with multiple sclerosis in June of 2015. She is also the daughter of a compassionate father who completed philosophy college courses and is currently a behavioral care counselor. She is the sister of three professional women who offer her candid feedback and loving support.

Olgha spent the first fourteen years of her life in Kuwait, escaping the Iraqi invasion in 1990. Her identity development evolved during her adolescence year as she learned to navigate the American culture as an English as a second language student in Waltham, MA. Her first-hand interaction with an influential mentor, Mr. Collins and algebra teacher, shaped her identity development. He saw her potential despite her difficulty expressing herself eloquently in the English language. Mr. Collins recommended Olgha to switch into the Honors class from day one. Indeed, mathematics is a universal language that crosses cultures.

Olgha has a BS, from Boston University, and MS, from North Carolina State University and University of North Carolina- Chapel Hill, in Biomedical Engineering and enjoys solving mathematical problems. She’s currently a co-author of an algebra textbook that was published in the Spring of 2016. Also, she spent over four years at Wake Tech Community College as a mathematics instructor and tutor for the General Educational Development (GED) test and developmental students. She enjoys teaching students and helps them see the relevance of mathematics in and outside of the classroom. In addition, she currently serves as the education coordinator for a mentoring incubator at NC State college of
engineering to support underrepresented students in engineering laboratory internship opportunities. This research presented a great opportunity for Olgha to delve into an aspect of her life that is increasingly important – racial identity and mathematical identity of black male students transfer experiences in higher education.
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I am grateful to my dissertation committee, co-chaired by Dr. Tuere Bowles and Dr. Christine Grant. I am very appreciative of Dr. Bowles’ insightfulness and organizational skills. I am thankful for Dr. Grant’s mentorship and global thinking that inspires me and keeps my ideas and thoughts moving forward. To my other committee members, Dr. Duane Akroyd and Dr. Malina Monaco, thank you for your scholarly guidance and quantitative expertise. I also would like to acknowledge Ms. Barbara Smith for her continued support of my scholarship.
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CHAPTER ONE: INTRODUCTION

Over the past three decades, the results of social, educational, and economic instabilities for African American males (AAMs) in the U.S. have been more systemically devastating than outcomes for any other racial, ethnic, or gender group (The Schott 50 State Report, 2015). Due to an underrepresentation of AAMs in the fields of engineering and engineering research, organizations such as the National Science Foundation and the American Association for the Advancement of Science have created initiatives to broaden and diversify participation in Science, Technology, Engineering, and Mathematics (STEM) fields. AAM engineering students have several pathways to reach their goal of receiving an engineering degree, which includes beginning their education at community college (CC) and eventually transferring to a four-year institution (Wood, 2010).

AAM engineering transfer students face many obstacles on their journey to earning a degree. This begins at the high school level, where AAMs have lower graduation rates compared to White males. During the 2012-2013 school year, the national graduation rate for AAMs was 59%, compared to 80% for White males (The Schott 50 State Report, 2015). At the CC level, African American (AA) student persistence rates are low, with only 14% earning an associate’s degree within three years (Gándara, Alvarado, Driscoll, & Orfield, 2012). According to the National Science Foundation, AAMs received less than 4% of the total engineering bachelor’s degrees awarded to men in 2012. This number has more than doubled in two years. In 2014, AAMs received less than 9% of the total engineering bachelor’s degrees awarded to men, while White males received nearly 63% (2015).

Several research studies have illustrated a link between AAs’ racial identity and academic performance (Chavous et al., 2003; Harper, 2007; McGee, 2009; Oyserman, 2008;
Sellers, 1993). Racial identity is a social construct based on the individual’s beliefs, perceptions, and shared collective identity within a racial group (Helms, 1999). A strong salient racial identity is specifically linked to stronger academic performance (Chavous et al., 2003; Harper, 2007; McGee, 2009; Oyserman, 2008; Sellers, 1993). Additionally, AA students who have a strong racial identity are better equipped to navigate negative climates, deal with racism, and tend to have strong self-esteem (Bowman & Howard, 1985; McGee, 2009; Rowley & Moore, 2002; Sanders, 1997). Thus, the racial identity of AAMs is an important contributor to academic success, and potentially contributes to challenges they face.

Along with racial identity, mathematical identity plays a role in the success of AAM engineering students. Mathematical identity can be defined as an individual’s beliefs, attitudes, and feelings towards mathematics (Boaler, 2002; Edwards, 2010; Grootenbower & Zevenbergen, 2008). To master mathematics is to master a universal second language that is practiced by engineers across all disciplines and cultures (Henderson, 2003). An engineer’s fluency in mathematics directly correlates to their fluency in the field overall.

The only research conducted around mathematical identity has been focused on the K-12 level. For example, Martin’s (2007) research on high school students noted that students who perform poorly in mathematics tend to develop weak relationships with mathematics and tend to view its application inside the classroom only in a more abstract sense. At the time of this research, there is no evidence of research around the influence of positive mathematical identities and academic performance of black male engineering students at the collegiate level.

The pathway for black male engineering transfer students begins with the CC. There
are two studies that focus on AAM students’ academic success in CCs (Gardenhire-Crooks et al., 2010; Wood 2010). Gardenhire-Crooks et al. (2010) noted that some AAMs explicitly rejected racial stereotypes and frequently avoided peer engagements, as well as faculty interactions. These actions reinforced the students’ masculine identities on campus, though it hindered their chances of academic success at other times (Gardenhire-Crooks et al., 2010). Wood (2010) developed a conceptual model of AAM academic success in the CC that suggests their academic success is directly influenced by personal, institutional, academic, and psychological factors.

Black engineering transfer students continue to face obstacles during their higher education journeys. While their success rate is low compared to other ethnicities or races, AAMs that successfully complete engineering degrees have done so despite these obstacles. Study of the experiences of triumphant AAMs would help to build a foundation for understanding, and the potential to eliminate the many obstacles these students face during their studies (Allen, 1986; Cuyjet, 1994; Harper, Carini, Bridges, & Hayek, 2004; Mason, 1998; Perrakis, 2008; Wood, 2010).

**Statement of the Problem**

Despite the prevalence of well-documented evidence of AAMs’ community college experiences, there is limited published research exploring the experiences of black male engineering students who started their higher education journey at community colleges and transferred into four-year institutions. The personal, social, and environmental factors that shape their experiences have been left unresearched. Furthermore, there is a limited amount of published literature on the intersectionality of racial identity and mathematical identity for black male engineering transfer students. With limited scholarship regarding this group of
individuals, it is unclear what triumphs or struggles these black male engineering transfer students experience. The success of their educational journey from CCs to four-year institutions is unique, and the existing literature does not provide enough understanding of the factors that influence these black male transfer students.

Furthermore, most of the published research on CCs uses a quantitative methodology. Although quantitative research offers the advantages of variable control, prediction, and generalizable research findings, important contextual insights are missing. A quantitative approach also tends to bury the voices and experiences of individual participants.

The goal of this research was to explore and learn from the experiences of black males who have successfully transferred into four-year engineering programs from CCs. The findings of this work add to the existing literature by answering critical questions around the personal, social, and environmental factors that shaped those events as well as how racial and mathematical identities contribute to black male students’ transfer experiences.

**Purpose of the Study**

The purpose of this qualitative narrative study is to explore the social and academic experiences of black males who transferred from CCs into engineering programs at four-year institutions and to learn how racial and mathematical identities shaped their participation on campus. This exploratory research presents one of the initial steps in demystifying our understanding of the transfer endeavors of black male students at both Historically Black Colleges and Universities (HBCUs) and Predominantly White Institutions (PWIs).
Research Questions

1. What are the experiences of black male engineering students who transfer from community colleges to four-year institutions?

2. How do personal, social, and environmental factors shape the transfer experiences of black male engineering students who attend four-year institutions?

3. How do racial and mathematical identities shape the transfer experiences of black male engineering students who attend four-year institutions?

This study investigates black engineering transfer students’ educational journeys and documents their narrative stories captured through semi-structured interviews and a demographics questionnaire survey.

Theoretical and Conceptual Frameworks

Critical race theory (CRT) was used to consider the effects of race and power on black male engineering students who successfully transferred from CCs into four-year institutions. The intersectionality between race and gender was analyzed using some of the tenets of CRT. These tenets offered a means to critically examine the participation of black male transfer students.

A qualitative narrative study approach provided a useful framework to examine the social and academic journeys of black male engineering students. The voice and perspectives of thirteen minority male students who transferred from CCs into HBCUs and PWIs could be heard through storytelling and counter-narratives. The use of CRT in conjunction with a qualitative narrative approach created a unique theoretical and practical combination for use in study evaluation.

In addition to the theoretical CRT framework, racial identity and mathematical
identity serve as the conceptual frameworks for this study. With a focus on black male transfer students’ academic experiences, this research investigated how these students learn mathematics and engineering concepts and successfully complete the required mathematics core courses to transfer into four-year institutions. How these academic experiences influenced and morphed their racial and mathematical identities is explored by the study.

Significance of the Study

This qualitative study is needed to improve the existing literature with respect to underrepresented black male transfer students. Their journey to HBCUs and PWIs contributes to CRT perspectives on racial and mathematical identities. The study also deepens the current understanding of black male students’ participations in CCs, explains notable trends and persistence of outcome inequities, and frames the meanings that students derive from their social and academic interactions on CCs campuses. For example, Flowers (2006) noted that empirical research on AAM in CCs concluded that social and academic integrations had a positive influence on retention, but data were not available in terms of what students enjoyed and found worthwhile about these interactions.

Qualitative inquiry is an effective mechanism in pursuing this and similar knowledge gaps. Very few studies provide understanding and reasons for this persistent gap, particularly with respect to black male transfer students majoring in engineering. Therefore, there is the need to expand the literature on AAMs to account for the factors that are unique to their transfer journey into engineering programs at four-year higher institutions (Wood & Palmer, 2013). Students’ self-identified stories describe how they scaffold their math and engineering knowledge while climbing the higher education ladder despite limited educational opportunities (Phillipe & Mullin, 2011).
Further, this study is significant in practice with the potential to increase engineering enrollment in two- and four-year institutions and improve underrepresented participants’ understanding and awareness of their own racial and mathematical identities. This research can inform and enhance the professional development of math and engineering instructors in academic settings.

**Definition of Terms**

**Academic success.** Academic success is the process in which students maintain their GPAs and/or successful completion of classes towards their degree goals. Research studies indicate that factors associated with academic success for African American male students at community colleges are influenced by personal, institutional, academic, and psychological factors (Chickering, Peters, & Palmer, 2006; Daloz, 1986; Fleming, 1984; Goldrick-Rab, 2010; Greene, Marti, McClenny (2008); Hughes, 1987; Lavant, Anderson, Tiggs, 1997; Perrakis, 2008; Pope, 2002; Wood, 2010; Woolbright, 1989).

**African American (AA).** An African American is a person descended from any black racial groups of Africa who reside in the United States (U.S. Census Bureau, 2010).

**Black male.** A male who self-identifies as a member of black racial groups who reside in the United States. According to the National U.S. Census (2010), black or African American is referred to as an individual who has origins in any of the Black racial groups of Africa such as African American, Kenyan, Nigerian, or Haitian (U.S. Census Bureau, 2010).

**Communities of practice.** A community of practice exists with three explicit elements: a knowledge domain, a communal group of individuals who facilitate the domain’s existence, and shared practice or collection of resources (Wenger, 1998). Communities of practice for the black male engineering transfer student takes place in multiple physical space
settings, the campus environments they participate in during assigned course lab sessions and/or research experiences in engineering research labs, and the professional community of practice during co-ops or internships at engineering firms or centers.

**Engineering mindset.** Engineering mindset is defined as an analysis tool that involves solving real-world challenges and systems. It is a way of thinking that engineers engage in and develop as they matriculate into the engineering academia and industry. Halsmer (2008) describes it as “useful in thinking about the power and scope of a worldview because diverse elements of the worldview must come together to form a unified explanation that makes sense” (p. 6).

**The National Academy of Engineering grand challenges for engineers.** The National Academy of Engineering (NAE) grand challenges for engineers are defined by the National Academy of Engineers and include a set of 14 challenges, identified by an international committee of leading engineers and scientists. Their 14 game-changing goals for improving life on the planet fall into four cross-cutting themes: sustainability, health, security, and joy of living.

**Motivation.** Motivation is a process that begins, guides, and maintains the individual learner’s behaviors. It enables the learner to engage in the meaning making process, whether by picking up a book and reading, attending lectures, or spending countless hours writing research papers. It involves a combination of biological, emotional, social and cognitive factors, and barriers that initiate the individual learner’s behavior. Motivation answers why individuals engage in the learning process. Research has shown that adults are often motivated to participate in learning activities by developmental issues and changes in their lives (Merriam, Caffarella, & Baumgartner, 2007).
Persistence. “Persistence refers to students' continuation toward their previously established academic goals” (Wood, 2010, p. 13).

Retention. For this research study, retention is defined as the successful completion of a two-year degree at a community college. Retention can also represent the successful completion of the necessary credits and GPA to transfer from community college to a four-year institution (Wood, 2010).

Chapter Summary

This chapter introduced the topic of social and academic factors that shape the transfer experiences of black males at four-year institutions. In the past several decades, very few AAM students have successfully transferred from CCs into HBCUs and PWIs while majoring in engineering. Because of the inherent challenges, there is a wealth of insight to glean from the voices of those who succeed in their academic transfer journey into four-year institutions.

The results of this study sought to address a series of critical questions: what academic factors influence black males’ academic journey in development and curriculum math classes? What social experiences influence their transfer process? How do their racial and mathematical identities influence their transfer experiences at four-year institutions? Without hearing the perspectives of this group, their small numbers are going to continue to minimize their societal contributions within the engineering profession. The lack of insight into this group is pervasive. Lastly, the chapter explored potential contributions to theory, as well as implications for research and practice.

In the next chapter, a series of scholarship is reviewed to examine chosen concepts about Critical Race Theory and racial and mathematical identities in the realm of engineering.
education. In addition, it presents the findings from related studies that illustrate what is known, and what gaps remain in this scholarship.
CHAPTER TWO: REVIEW OF THE LITERATURE

From the case presented in chapter one, this chapter synthesizes the literature to address the importance of exploring the ways black males experience their transferring process and engineering academic journeys. Their perception of racial and mathematical identities may shape those experiences in ways that contribute to their educational progress in engineering at both HBCUs and PWIs in the southeast region of the U.S.

To better position this study and to provide a meaningful understanding of its context, the researcher conducted a review of the literature around five scholarly topics: CRT, AAMs in higher education, racial identity, mathematical identity, CC successful transfer, and engineering education experiences at the university level.

The strands of literature that were used in this study intersect at race, racism, and understanding the overall participations of black males in engineering education. Largely perceived from a deficit model, black males face obstacles to successfully transfer from CCs, navigate engineering curriculum, and successfully persist in both HBCUs and PWIs. Key questions that undergird the work include the following: What are the higher education systems that promote the successful transfer of students from CCs into HBCUs and PWIs? What other factors help to guide black male students along the way? Is the potential to promote the development of positive mathematical and racial identities a protective factor towards persistence in engineering education?

Critical Race Theory

Many researchers and theorists utilize CRT as a theoretical framework that not only provides meaning to educational protest, but also acts as a powerful scholarship and praxis. This includes epistemological tools to address the issues of race and racism in education
(Watkins, 2005). The present study furthers the aims of CRT through the lens of legal scholarship, social history, and philosophical constructs. This is an effort to address and serve the black male students’ needs in CCs. The next section presents an overview of the legal scholarship as it relates to CRT; an important foundation for understanding CRT’s application in higher education. This is followed by a discussion to support the theoretical appropriateness of CRT in education. Then the relationship between AAMs, CRT, and education is presented.

**CRT in legal scholarship.** Throughout history and present time, race continues to play a role in the dismissal and marginalization of African Americans and people of color (Du Bois, 1973). CRT gained momentum in the 1970s, when minority legal scholars noticed insignificant progress after the 1960s civil rights movement and found various critical explanations for the continuing presence of racism in the U.S. (Aguirre, 2000). CRT is often defined, by scholars in this area, as a theory that embraces a movement of left scholars, predominantly non-white law students, whose work challenges the ways in which race and racial power are constructed and represented in American legal culture and in American society (Crenshaw, Gotanda, Peller, & Thomas, 1995).

CRT is a scholarship and an activist movement that focuses on researching and altering the race, racism, and power dynamics of underrepresented racial groups (Delgado & Stefancic, 2001). It contemplates the same issues as the civil rights movement and ethnic studies by placing these individuals and groups in a broader perspective to include their interest and economic situation. As well as their psychological, sociological, and historical context. CRT questions liberal order foundations such as equality, legal reasoning, rationalism, and the neutrality of the U.S. constitutional law (Delgado & Stefancic, 2001).
CRT decodes and changes our social situation by considering how society organizes itself along racial lines and hierarchies. It admits that racism is part of the American legal structure and delves beyond the popular belief that eliminating racism simply means wiping out ignorance or encouraging all citizens to agree. CRT fosters a space to exercise the creativity, power, intelligence, and humanity of non-dominant voices to influence change in the legal institutional structure.

Scholars and researchers utilize CRT to enhance their understanding of race relations and racial identity (Delgado & Stefancic, 2001). CRT is an analytic device used in other disciplines to better understand non-dominant group interactions in many settings. For example, CRT has been applied by educational researchers to understand the school inequity as discussed in the next section (Ladson-Billings, & Tate, 1995).

**Theoretical appropriateness of CRT in education.** CRT is a theoretical lens that further develops a nascent intellectual space to understand the institutional structures in the American education system (Tate, 2005; Zamudio, Russell, Rios, & Bridgeman, 2011). CRT in education delivers a “rhetorical and analytical mechanism to question assumptions of both liberals and conservatives with respect to the goals and the means of racial reforms” (Tate, 2005, p. 122).

Technology and digital media provide the perfect platform for the public to share their thoughts and support of CRT as a theoretical framework for use in public education. As stated by Tate (2003), “Most academic movements are restricted to college campuses, think tanks, [and] policy consortium, etc.” (p. 123). He stressed the work of CRT scholars and called for the need to expand the CRT movement beyond the walls of academia.
African American Males in Higher Education

As of the late 1960s, policymakers opened the doors for AA students to enter higher education, however, the current enrollment status of AAs remains low (Harper, Patton, Wooden, 2009). Policy efforts have been undercut by numerous factors: 1) AA students low enrollment at PWIs, 2) steady over-dependence on college entrance exams that are racially biased, 3) constant efforts to disassemble affirmative action, 4) higher state admission standards for public universities, without corresponding advances in public K-12 institutions, 5) reoccurring racism and negative AA student experiences at PWIs, 6) low AAM student retention, 7) low degree attainment rates, and 8) the drop of need-based federally funded financial aid (Harper, Patton, & Wooden, 2009; Reyes, 2011).

CRT is not only a theory but also a call to action; it offers tools to address the challenges that AAMs face in higher education. CRT is unique and does not follow other traditional theoretical frameworks. Its analysis is a byproduct of the scholar’s participation in rigorous efforts to abolish oppressive educational conditions (Watkins, 2005).

In the context of adult education, CRT provides methods and approaches to adult learning that may lead to building a society that radiates fairness, justice, and compassion as its values. CRT of adult learning fosters hope that humanity can transform the world to be more inclusive and more compassionate to all citizens (hooks, 2004). hooks pleas for literature to celebrate the daily experiences of AAMs. The author notes that political and progressive movements for social justice provide the theoretical and practical strategies necessary to enhance the emotional well-being of AAMs and to increase their quality of life.

The real challenge in American society does not exist as a dichotomy between black and white. The challenge is the way every citizen, regardless of their ethnic and racial
identity, is positioned in relation to whiteness (Dixson & Rousseau, 2006; Prashad, 2001). CRT researchers and scholars must explore and highlight the symbolic and structural barriers constructed due to white supremacist discourses using narratives (Prashad, 2001).

CRT scholars construct narratives out of historical, sociocultural, and political realities of AAs’ lived experiences. A researcher’s role is to provide context for understanding the way inequity manifests in policy, practice, and people’s experiences. Rather than thinking of race as positivist social scientists do, CRT scholars challenge traditional notions of diversity and social hierarchy using racial theory (Dixson & Rousseau, 2006).

**Voice.** Although there is no one uniform canonical understanding of CRT that all scholars agree upon, the CRT tenet which seems appropriate for this study is the *voice.* As Delgado (1989) indicated, although the term *voice* is singular, it does not imply that there exists a single common voice for all people of color, and the stories of individuals will differ. However, although there is not one common *voice,* there is a common experience of racism that structures the stories of people of color and allows for the use of the term *voice.*

When CRT is adapted into education, narratives and counterstories are mainly used to examine race and racism. These anecdotes help researchers understand *voice.* The collected narratives are considered a research methodology, and the counterstories told by AA students are instrumental in uncovering and challenging the dominant, racially privileged stories (Dixson & Rousseau, 2006; Stinson, 2006; Terry, 2011).

CRT educational researchers build on these lived experiences with perspective, viewpoint, and the power of persuasive stories to enhance our understanding of how Americans perceive race. By examining narratives and counterstories, researchers and
theorists seek to understand why certain stories are transformative in nature and others are not (Delgado & Stefancic, 2001).

Narratives often develop into “a valid destructive function” to our society (Delgado & Stefancic, 2001, p. 42). Our society often bombards the public with media-images, scripts, and stories that embed preconceptions that often marginalize others or conceal their humanity as a legitimate function of fiction. CRT counterstories question, displace, and mock these fictional narratives and beliefs.

Counterstories provide an alternative view of the dominant attitudes of the time and challenge the narratives of the majority. In addition to challenging the U.S. dominant ideologies, CRT emphasizes the historical context of slavery and the possible methods of escape. CRT incorporates this historical context into its accentuation of the societal centrality of racism and the struggle of people of color (Stinson, 2006; Terry, 2011).

The intersection of education and CRT produces three major themes: 1) race continues to be a significant factor in determining inequity in the U.S., 2) U.S. society is based on property rights, and 3) the intersection of race and property creates an analytic tool through which we can understand social and, consequently, school inequality.

Storytelling can be a powerful psychic function to give voice to the shared experiences of underrepresented communities. Social reality “is constructed by the creation and exchange of stories about individual situations” (Watkins, 2005, p. 201). Storytelling is a cure for individuals who have been silent about racial discriminations and alienations for their predicament.

This voice, a basic tenet of CRT, is applicable to the scholarship of STEM education of underrepresented male students in CCs and universities because it captures their
storytelling narratives. This experiential knowledge provides an understanding of people of color’s experiences with racial realism.

Storytelling is often criticized because it is regarded as “unscientific” and subjective, however, CRT was never intended nor never claims objectivity or rationality. CRT is a scholarly approach that integrates lived experiences of AAs in the context of race and racism (Dixson & Rousseau, 2006). Often, AA students who attend PWIs “underscores a general institutional ambivalence toward their educational needs, a lack of appreciation for their cultural heritage, and callousness towards values other than those held by the majority population” (Bakari, 2006, p. 2).

In a CRT focused research about the campus racial environment for AA students at PWIs, found that students often described their social and academic journeys as a “very tense racial climate on the college campus” (Solórzano, Ceja, and Yosso, 2000, p. 65). Students identify an effective counter measure to such an environment and join a communal group in academic spaces. These “academic counter-spaces” become safe havens for black students and are manifested in study groups, mentorship, and more. Safe haven “challenge deficit notions of people of color” where higher institutions provide and sustain positive racial environments (Solórzano, Ceja, and Yosso, 2000, p. 70).

Racial Identity

Cultural researchers examine the ways in which AA students’ racial identities, racialized opportunities, and expectations influence their academic achievement in mathematics (Nasir, Hand, & Taylor, 2008; Sellers, Caldwell, Schmeelk-Cone, & Zimmerman, 2003). Race and racism are often defined within a monoracial paradigm as “contextual, situational, and variable” (Knaus, 2006, p. 9). Research shows that gender,
class, ability, and the spirituality of individuals mold their lives and become more complicated based on the variations of skin tone and how the individuals identify culturally, or ethnically (Cross, 1991; Knaus, 2006; Phinney, 1990; Sellers et al., 2003; Sfard, & Prusak, 2005).

The effects of racial identity are observed through the ways that societal and personal definitions of race influence an individual’s self-concept, consequent actions, and behavior (Cross, 1991; Helms, 1990; Sellers, Sfard, & Prusak, 2005; Smith et al., 1998). As research in this area continues to emerge, it points to shared findings that a shaky and fragmented racial identity of AA is related to weaker academic performances. Whereas a strong and salient racial identity is linked to stronger academic performances (Chavous et al., 2003; Harper, 2007; McGee, 2009; Oyserman, 2008; Sellers, 1993).

Research on the development of racial identity indicates that racial identity is based on the individual’s perception of a common racial heritage with a particular group (Cross, 1991; DeCuir-Gunby, 2009; Helms, 1990; Sellers, Rowley, Chavous, Shelton, & Smith, 1997). AA students with realistic beliefs about their race tend to be protective in their thinking and actions (McGee, 2009).

Research shows that AA students who have a strong racial identity are better equipped to navigate negative climates, deal with racism, and tend to have strong self-esteem (Bowman & Howard, 1985; McGee, 2009; Rowley & Moore, 2002; Sanders, 1997). AA students’ racial identity is an integral part of their student development. The development of a positive racial identity assists in fostering a positive attitude and confidence in their ability. Thus, a positive racial identity is crucial for the academic achievement and professional development of the black student. Students are more likely to persist in college when they
have “positive racial identity and knowledge of self” (Bakari, 1997, p. 2).

As black students develop their identities and connect with others within the same racial group, they experience a sense of belonging and acceptance in that group. According to Strayhorn:

Sense of belonging consists of both cognitive and affective elements. An individual assesses his/her position or role in relation to the group (cognitive) which, in turn, results in a response, behavior, or outcome (affective). Sense of belonging, then, reflects the extent to which students feel connected, a part of, or stuck to a campus. It is a subjective evaluation of the quality of relationships with others on campus (2008, p. 505).

The intersectionality of black male student’s sense of belonging and where they stand in terms of their racial identity development improves our understanding of students’ social and academic experiences in higher education.

Black male students develop a sense of belonging on campus as they interact within groups of students and faculty as a learning community of practice. Communities of practice are groups of individuals who share a common interest or express concern for a set of specific challenges (Wenger, 1998). This group of students applies and practices their knowledge and understanding of difficult math and engineering concepts in and outside of academia. When students gather together in classrooms, study groups, or assigned group projects, communities of practice are formed. In the context of engineering education, communities of practice may influence the development of mathematical and racial identities for black males.
Racial identity development models. Cross’s (1991) Nigrescence model represents the racial identity development of AAs and their experience at different stages of their racial identity development (Cross, 1991; Parham, 1981). Cross’s framework defines individual’s racial identity development through various nonlinear stages of understanding that occur between childhood and adulthood. According to Cross’s (1991) model, individuals progress from multiple stages of the model, from race having little relevance to an identity in which race is very salient and fully present.

For example, during the pre-encounter stage, individuals view race as a less important part of their identity. During the encounter stage, racial experiences prompt a reexamination of racial challenges. In the immersion-emersion stage, AAs become pro AA and against Whites. While during the internalization-commitment stage, they are satisfied and secure about their race and welcome other racial and ethnic groups; in this stage, they incorporate their internalized racial identities into their behaviors and actions (Cross, 1991). The Racial Identity Attitude Scale (RIAS) operationalizes the Nigrescence model to measure a direct relationship between racial identity and outcomes for AAs (Parham & Helms, 1981).

In tangent with Cross’ Nigrescence model, Helm’s (1990) model measures “an individual’s attitudes, thoughts, feelings, and behaviors toward oneself and others with respect to racial group membership” (McGee, 2009, p. 34). Helm’s model describes racial identity development of AAs as a movement “from having self-degrading racial identity attitudes to self-enhancing racial identity attitudes” (McGee, 2009, p. 34), where individuals feel secure about their own racial group and appreciate other racial and ethnic groups.

The challenge with Cross and Helm’s theoretical models is that they both do not
holistically consider individuals in context of their other identities (gender, economic status, etc.). Therefore, use of a multifaceted model for racial identity development is needed to address this issue.

The Multidimensional Model of Racial Identity (MMRI) was first introduced by Sellers and others in the late 1990s; MMRI treats each AA individual uniquely with different thoughts, cultural views, and behaviors. This model provides an integrated view of racial identity development of AAs by placing more emphasis on situational and cognitive elements and focusing on their self-concepts related to membership within their race (McGee, 2009; Sellers et al., 1997).

Like other racial identity development models, the MMRI consists of dimensions of racial identity: salience, centrality, ideology, and how highly the person regards AAs. The salience and centrality dimensions address the significance of race as defined by the individual; while the racial ideology and regard dimensions address the qualitative meaning that individuals ascribe to their race.

The instrument that is commonly used by researchers to measure three MMRI dimensions is called the Multidimensional Inventory of Black Identity (MIBI). It emphasizes the individual’s self-concept about race and ethnicity. MIBI exposes the situational and contextual issues shaping the ethnic and racial identity of individuals (Cross, 1991; Erikson, 1968; McGee, 2009; Phinney, 1990). McGee (2009) further explained that “the salience of race is conceptualized differently for AAs according to their individual beliefs and that racial identity cannot be understood without examining the larger social context” (p. 36).

Research on racial identity development has demonstrated that AA students with a positive identity toward their racial group and realistic perceptions of racism have an
improved overall self-concept and ability. Students with positive self-images are better equipped to combat racism and negative barriers (O'Connor, 1997; Sellers, Chavous, & Cooke, 1998). For example, O'Connor (1997) found that low income, high-achieving AA high school students articulated with acute recognition the relationship between oppressive social and educational structures and their agency. Similarly, Altschul, Oyserman, and Bybee (2006) showed that AAs receive higher grades in school if they connect their racial identity with academics. Rowley, Sellers, Chavous, and Smith (1998) reported that private regard is positively associated with self-esteem among young AAMs (McGee, 2009).

**Mathematical Identity**

Mathematical identities are constructs that investigate the individual’s beliefs, attitudes, and feelings towards mathematics (Boaler, 2002; Edwards, 2010; Grootenbower & Zevenbergen, 2008). Mathematical identities describe the students’ ability to perform mathematics and how they experience learning mathematics as a process within the broad context of the classroom environment.

Cultural models are often used to represent mathematical identity constructs, such as “math is hard” and “math is for geeks” (Edwards, 2010). These cultural models either enhance or hinder the individual learner’s relationship with mathematics. For instance, adult learners who have a strong relationship and identify strongly with mathematics tend to utilize mathematics in a different sociocultural context (Berry, 2005; Boaler, 2002; Crombie, Sinclair, Silverthorn, Byrne, DuBois, & Trinneer, 2005; Edwards, 2010; Solomon, 2009).

However, students that are academically underachieving in mathematics tend to develop weak relationships with mathematics. Their view of mathematics is abstract, and they tend to restrict the importance of mathematics to the classroom setting. They are
inclined to focus on procedural knowledge associated with exams and passing the
standardized, remedial mathematics test rather than learn new mathematics concepts with
higher level knowledge. They view mathematics as unrelated to their daily life activities.
Beyond the classroom, mathematics is irrelevant and uncool (Berry, 2005; Boaler, 2002;
Martin, 2007; Solomon, 2009).

It is the responsibility of the school, family, and community to influence the
development of black students’ mathematical identities. This can be accomplished by
encouraging them to relate mathematics to their everyday life. It helps to set an essential
foundation for students’ mathematical involvement and participation. The researcher
believes that these are fundamental contributors to student’s mathematical identity and sense
of self. In addition, supportive social circles can also maintain and merge positive
mathematical identities in the contexts of being a black male and being a learner of
mathematics. It is a struggle that is brought on by many forces that racialize the life and
mathematical experiences of AAM students in community colleges (Martin, 2007).

Martin (2007) expressed through his scholarship a common thread among AA adult
participants’ roles and strong beliefs about their racial and status identities as defined by the
dominant culture. Success stories of black males in mathematics education are an example
of the voice that the Critical Race Theory (CRT) scholarship highlights to counteract the
stories of the dominant group. Dixson and Rousseau (2006) described the dominant group as
those who tell stories designed to:

remind it [the dominant group] of its identity in relation to outgroups and provide a
form of shared reality in which its own superior position is seen as natural…We must
learn to trust our own senses, feelings, and experiences, to give them authority, even
in the face of dominant accounts of social reality that claim universality…Thus, voice scholarship provides a counterstory to counteract or challenge the dominant story (p. 35).

AAs racial and status identities seem to be defined by status quo to create real and perceived boundaries that limit their opportunities in the larger social structure, including mathematics. Martin noted that those who overcome these obstacles and had success stories in mathematics did not accept these preset boundaries passively, but rather exhibited a range of positive, agency-related behaviors (Martin, 2007). They took note of the negative connotations assigned to them as AA both in and outside of their classrooms and yet they maintained a strong racial identity and a firm belief in the importance of mathematics literacy for both themselves and their kinsmen.

The struggles to transcend these boundaries also reveal how closely their identities as AAs and identities as learners of mathematics are linked. These struggles for mathematical literacy continued to frame their sense of self as AAs. The strong racial identity made AAs more committed in their struggle for mathematics literacy (Martin, 2007).

This is analogous to a novice runner who joins a runner’s club. At first, the novice has to struggle to overcome the physical and mental limitations required to stick with the routine and practice running; overcoming internal and external boundaries in the process. Once the beginner commits to the process of overcoming these barriers, the sky becomes the limit. They are able to continue to push themselves for success and eventually complete marathons, if they choose.

The mental and verbal strategies that some runners use to assist new and advanced runners creates a sense of empowerment and encouragement. Not every runner will stay
committed to this club. Some will come, and some will go; some will succeed independently, and some will not. As cited by Perry (2003), Martin’s interactions with AA adults reveal:

That the experiences and motivations characterizing African American struggle for mathematics literacy often extend well beyond the school context. On the one hand, this struggle is often linked to a desire for meaningful participation in the larger opportunity structure. On the other hand, it is emblematic of a philosophy of education that has been passed down in the African American narrative tradition: literacy for freedom and freedom for literacy. [This narrative tradition includes] stories about struggles for literacy, stories and the purpose of literacy, stories about what people were willing to do to become literate, and stories about how people became literate so that they could be somebody (p. 92).

These stories are also important because they “link literacy and education to the social identity of African Americans, to the very notion of what it meant to be African American” (Perry, 2003, p. 105).

According to Anderson (2007), one dimension of learning mathematics is when the individual develops an identity as a math learner. AAMs may be required to enroll in remedial mathematics classes; however, the student’s mathematical identity is only in its initial stage of development, also known as mathematical identity through alignment (Anderson, 2007). As the students engage in the learning process of mathematics, the interactive activities may appeal to them, and their identity is further developed through engagement. Similarly, students interested in engineering may envision their participation in mathematics classes as preparation for their future career as engineers. Mathematics is both
a requirement for entrance into the career and a necessary knowledge to pursue the
career. Thus, identity in mathematics is maintained through both imagination and alignment
(Anderson, 2007).

**Engineering Education**

In the last decade, there has been a call to improve the way engineering is taught and
how students learn engineering concepts (Felder, Sheppard, & Smith, 2005; Johri & Olds,
2011). Previous research focuses on the need to develop a better understanding of
engineering education and often includes “an ad-hoc path without a systematic understanding
of how learning occurs and without the development of a body of knowledge upon which to
build” (Johri & Olds, 2011, p. 152). With the advancement in technology comes also an
advancement in the way engineering is taught. Engineering education now and moving
forward requires “research guided by theories grounded in cognitive science and educational
psychology and subjected to the same rigorous assessment and evaluation that characterize
first-rate disciplinary research” (Felder, Sheppard & Smith, 2005, p. 9).

Research over the past two centuries provides evidence of the importance of
mentoring for students in higher educational settings largely through the development of a
positive identity (Jacobi, 1991) and through increased student engagement (Tinto, 2006).
The development of a positive racial identity for underrepresented groups is critical for their
overall student development (Bakari, 1997). There is even evidence of the power of
mentoring programs to buoy blacks towards higher rates of higher educational persistence
(Cuyjet, 2006).

**Contextualized learning.** Engineering education researchers investigate the impact
of situative learning in science and engineering. Johri and Olds (2011) define situative
learning as learning in the physical, social, and environmental context. Situative learning in science and engineering emphasizes the socially and culturally negotiated nature of thought and action of persons in interaction. The scholars in this work provided a foundation for engineering learning and suggested ways engineering education research communities might work to their mutual benefits (Johri & Olds, 2011).

**Engineering mindset.** According to Halsmer (2008), it is understood by the engineering community that most of engineering education is based on mathematical systems or scientific concepts. To succeed as engineers, it is important that these systems be logically consistent. Therefore, many professional engineers appreciate and value the use of logically consistent systems.

In addition, engineering students and engineering professional must develop, adapt, and foster an engineering mindset. Halsmer (2008) refers to the engineering mindset as systems that are “useful in thinking about the power and scope of a worldview because diverse elements of the worldview must come together to form a unified explanation that makes sense. Engineers who have experience with complex systems are better able to engage in this kind of analysis” (p. 6).

According to Halsmer (2008) the engineering mindset is an important analytical tool because it offers “a view of a transcendent engineer who has designed this universe as a laboratory where humans can gain the wisdom needed to participate in relationships” (p.11). Suggesting that engineering students who develop, adapt, and foster an engineering mindset find their engineering profession meaningful, inspirational, and motivational “for a fulfilling life, infused with purpose, and marked by service and mission” (Halsmer, 2008, p. 11).

According to Udwadia (1986), the engineering mindset is pragmatic in nature. The
pragmatic question that oftentimes engineers ask is whether their solutions are applicable, effective, and feasible, under given specifications and conditions. Engineers logically design devices and systemic solutions that solve complex real-world problems. The global community is well-served by engineers and their engineering mindsets (Halsmer, 2008; Udwadia, 1986). Engineers are trained to conduct a broad range of problem-solving activities to suit these convoluted systems and are well-needed by our society worldwide.

**The NAE grand challenges for engineering.** National Academy of Engineering (NAE) grand challenges for engineering are defined by the 2018 National Academy of Engineers and include a set of 14 challenges, identified by international engineering and scientific leaders. Their 14 game-changing goals for improving life on the planet fall into four cross-cutting themes: sustainability, health, security, and the joy of living.

**Sense of belonging.** As black students develop their identities and connect with others within the same racial group, they experience a sense of belonging and acceptance in that group. According to Strayhorn:

Sense of belonging consists of both cognitive and affective elements. An individual assesses his/her position or role in relation to the group (cognitive) which, in turn, results in a response, behavior, or outcome (affective). Sense of belonging, then, reflects the extent to which students feel connected, a part of, or stuck to a campus. It is a subjective evaluation of the quality of relationships with others on campus (2008, p. 505).

The intersectionality of black male student’s sense of belonging and where they stand in terms of their racial identity development improves our understanding of students’ social and academic experiences in higher education. Black male students develop a sense of
belonging on campus as they interact within groups of students and faculty as a learning community.

**Community of practice and engineering identity.** Meaningful participation and engineering identity development of students in engineering education are important concepts to consider within contextualized instruction and “cognitive apprenticeship” (Wenger, 1998).

According to Wegner (1998), communities of practice are formed from groups of individuals who share a common interest for a set of specific challenges (Wenger, 1998). Communities of practice exist with three elements. First, a domain of knowledge is shared. Second, a group of individuals who facilitated this domain of knowledge share their experiences. Third, the same group then practice their knowledge and expand their cognitive understanding of the topic.

When applied to engineering education as a context, communities of practice are formed when students and faculty gather together, apply, and practice their math and engineering knowledge. Students enhance their cognitive knowledge and understanding of difficult math and engineering concepts in and outside of academia. When students gather together in classrooms, study groups, or assigned group projects, communities of practice are formed. In the context of engineering education, communities of practice may influence the development of students’ identities.

Engineering identities are constructs that explore the individual’s beliefs, attitudes, and feelings towards engineering (Johri & Olds, 2011). Engineering identities describe the students’ ability to do engineering and how they experience learning engineering as a process within the broad context of the classroom environment.
In engineering higher education, the academic and social experiences of students define their engineering experiences and influence the students’ engineering identity development. Each student’s path takes different turns, detours, and makes impactful stops. During this journey, they socialize with peers, faculty, and staff on and off campus. This socialization process is fostered by their involvement in lab work, study groups, research experience, and internship environments. Additionally, through this process, students learn different values and social norms. They learn to continue in pursuit of maturing practice epistemologies and the prospect of developing their professional identities. Students can practice constants and norms associated with the engineering profession.

According to Schön (1987), this socialization is not an independent one-time event but rather a perpetual process that begins from the first group interaction that engineering students embark on, whether in- or outside of the classroom, and continues from there.

African American Males Academic Success at Community Colleges

Several scholarly articles study the persistence and academic success of AAM students in CCs. A substantial number of minority males are dropping out before graduating and never return to an educational setting. In CC, minority student degree persistence rates are low; only 14% of AA students and 15% of Hispanic students earn a degree within three years. This leaves institutions frantically seeking the salient factors that may be contributing to this dilemma. Some of the reasons discovered include peer pressure, family conflict, low academic achievement, low self-esteem, and other economic factors (Gándara, Alvarado, Driscoll, & Orfield, 2012; Gardenhire-Crooks et al., 2010; Tyler, Sterling, & Grays, 2013).

Furthermore, AAM students have the lowest graduation rate of any other racial category, where only 16% graduate in three years. Their academic success, measured by an
average GPA of 2.64, has been shown to be lower in comparison to White males (2.90), Hispanic males (2.75), and Asian American males (2.84).

As educators and researchers, we must be cognizant of how persistence and academic success are measured and how they can be over critical of CCs. It is important to note the lack of documented and published literature examining the persistence and academic success of AAM students in CCs (Gándara, Alvarado, Driscoll, & Orfield, 2012; Gardenhire-Crooks et al., 2010). Black male students that attend CCs may be less engaged in campus activities due to lower social integration than seen at four-year institutions. Therefore, there is a great need to expand the literature around black male students attending CCs and what contextual factors account for their academic success.

According to Gardenhire-Crooks and researchers (2010), racial identity plays a role in influencing the success of AAM students in CCs. CCs allow access to many Americans who might not otherwise be able to follow their higher education dreams. However, despite the critical role these two-year institutions play in promoting diversity, underrepresented male students continue to struggle in persisting and completing their degrees (Gardenhire-Crooks et al., 2010).

Additionally, Gardenhire-Crooks’ (2010) fieldwork explored the influence of developmental math classes on AAMs at the community college and its effect on their academic success. They explored how their high school experiences and racial identities influenced their college entry decision and their involvement on campus. The findings of this study illustrated that the majority of black male CC students come from a diverse family situation and economic backgrounds with an elapsed time between high school graduation that ranges from one year to a decade or more. Regardless of their backgrounds, most of the
men shared a common motivation in entering CC. They cited that college enrollment allows them to improve their financial status earning potential, and ability to be a role model for their children.

Second, findings illustrated the low expectations and negative stereotypes these men have experienced due to their race and gender. These conditions were seen as salient elements of their experiences in high school, communities, and at times on their CC campuses. While the nature and intensity of these experiences varied, all recounted that they had been unfairly judged based on their appearances (Gardenhire-Crooks et al., 2010).

The final finding revolved around an increased sense of belonging from high school to CC. However, they still reported negative encounters over time with CC faculty and staff. These men explicitly rejected stereotypes based on their race and stated that these negative attitudes did not affect their self-efficacy. In addition to their racial identity, their identities as men were characterized by self-reliance that exerted a powerful influence on their ability to engage in college. Whether by avoidance of social engagements or academic assistance from faculty, these men frequently acted in ways that reinforced their masculine identities on campus, while at times hindering their chances of academic success (Gardenhire-Crooks et al., 2010).

In addition to student persistence, academic success for AAM students at CCs is mainly documented in doctoral dissertations with minimal occurrence in peer-reviewed journal articles (Wood, 2010). AAM students at CCs bring social, economic, and academic attributes to their learning process. Research studies indicate that factors associated with academic success for AAMs at CCs are influenced by personal, institutional, academic, and psychological factors (Chickering, Peters, & Palmer, 2006; Daloz, 1986; Fleming, 1984;
Wood (2010) developed a conceptual model as part of his doctoral dissertation about the academic success of AAM students at CC (see Figure 1). Wood’s contributions consisted of a meta-analysis of 50 peer-reviewed articles around AAM students in CCs that guided his effort. Wood conducted in-depth semi-structured interviews with 28 AAM students attending CCs in Arizona. Discussed in the following sections are the four factors that influence the academic success of AAM students at CC.

Figure 1. Wood's (2010) conceptual model of African American male academic success in the community college. Personal, institutional, academic, and psychological factor are interrelated and influence one another. The +/- symbols are indicators of the complexity of the relationships among these factors.
**Key to success through personal factors.** According to Wood (2010), seven personal factors that contribute to AAM students’ academic success in CC include: transportation, life stability, family support, finances, employment, religion, and peer support (Wood, 2010). Transportation, according to Wood’s scholarship, is a barrier to academic success of AAM students in CCs. The further away the students lived from campus, the more challenging transportation became to students, especially those who rode the bus to class (Wood, 2010).

*Life stability* is a personal factor that influences students’ academic success. It is defined in terms of the students’ relationship with others outside of campus (i.e. peers, family, or partners). When life became unstable for students, they distanced themselves from school, stopped studying, skipped class, or missed assignments. Examples of instabilities included a death in the family and critical illnesses (Wood, 2010).

*Family support* positively influences the students’ academic success. For example, a female role model from the students’ family inspired them towards academic success (Wood, 2010).

*Finances* create personal barriers to many students’ academic success. Lack of financial aid funding and financial stability was a distraction to students’ educational focus. Many students were required to find work while attending school (Wood, 2010).

*Employment* played a negative role in most of the students’ academic success. Many of the participants in Wood’s study worked in the evening in physically demanding positions to financially support their academic endeavor, taking away valuable study time (Wood, 2010).

*Religion* played a positive role in students’ academic success. Belief in God
empowered the students and inspired them to excellence. Their faith enabled the students to overcome obstacles and to achieve their academic success (Wood, 2010).

Peer support seemed to uniquely influence the students’ academic success. Many of the students’ external peer support seemed to convey a negative message about attending school. However, a handful of the students described external peers as an encouraging support to their academic success (Wood, 2010).

Additional research extends the seven personal factors discussed in Wood’s conceptual model (Wood & Palmer, 2013). Wood and Palmer (2013) demonstrated the relationship between AAM student success in CCs and personal goals set by the students (Wood & Palmer, 2013). Personal goals are life goals of AAM students that promote their academic and psychological development. AAM students are conscious and pursue non-academic goals as well, including goals that pertain to their intellect, social, political, economic, and spiritual aspirations. The three statistically significant personal characteristics pertaining to AAM students in CCs included: community leadership, financial prosperity, and residential mobility experience (Wood & Palmer, 2013).

AAMs in CCs are more likely than other male students to set a personal goal of becoming influential community leaders (Wood & Palmer, 2013). Therefore, leadership roles such as student government, clubs, and sports must be available to AAMs to encourage them to participate on CC campuses. In addition, CCs should consider setting up a student outreach extension and engagement for AAM students to advise high school students. AAM students can advise on the process of applying to CCs and share their stories and motivations with high school seniors. This may also provide opportunities for AAM students in CCs to take on immediate leadership roles. Research supports the positive influence of leadership
roles for students and how it may be applied in the classroom to assist academic progress and
enhance student success among AAMs (Chickering, Peters, & Palmer, 2006; Wood &
Palmer, 2013).

Financial prosperity was another personal goal for 90% of the AAM participants in
Wood and Palmer’s empirical research study (2013). This personal goal may be supported
by CC administrators in career counseling, financial aid specialists, and transfer center staff
while maintaining the autonomy of the students. CC administrators should not direct them
toward specific majors that offer career options with high financial returns, unless the student
has a legitimate interest. Instead, CC administrators can help AAMs achieve financial
prosperity by delivering student professional workshops on managing finances to increase
AAM students’ basic financial literacy. Topics such as creating a personal budget, filing
income taxes, investing, and improving credit scores would be very useful to this

In addition to community leadership and financial prosperity, AAMs in this study
indicated a significant personal goal of residential mobility (Wood & Palmer, 2013). The
majority of the AAM participants in this study expressed a great desire to move away from
their respective hometowns. Keeping this goal in mind, CC administrators can encourage
students toward the possibility to transfer to four-year institutions beyond their local area by
encouraging attendance at college fairs. Also, students that are interested in the workforce
after graduation may be interested in researching non-local companies that may be hiring
(Wood & Palmer, 2013).

**Key to success through institutional factors.** Faculty-student interaction is one of
the ways colleges meet student needs (Wood, 2010). CCs are encouraged to establish places
where students can study, congregate, and develop relationships to meet the students’ needs and an increased sense of belonging on campus. AAM students need to feel a sense of attachment and belonging to the campus where they attend classes to persist in their learning and to succeed academically. Mentorship is an apprenticeship process that has been identified as a great retention strategy. Mentors act as both supporters and challengers of students during their time in CCs. Mentors often encourage the students to question their conceptions of self and the world around them. They push students to formulate new, more developed perspectives (Merriam, Caffarella, & Baumgartner, 2007).

Through this transformative learning process, mentors listen to the students and determine how they are progressing towards their educational goals (Daloz, 1986, p. 21). Mentors share their personal- and academic-lived experiences with students to promote adult development. These mutually shared stories allow the mentors to offer support and a vision as well as a challenge for the students (Merriam, et al. 2007).

Mentoring programs significantly increase enrollment, retention, and overall satisfaction of AAMs’ academic journeys (Pope, 2002). Despite the benefit of formal mentoring, AAMs in CCs often find themselves short on time, energy, and the necessary ability to participate in such well-designed programs. Students are limited because of the many responsibilities and barriers that put them at risk; such as family, employment, lack of support, and lack of transportation (Pope, 2002).

“The ultimate success of any of these types of programs lies in the ability of CCs to assist the student in dealing with the everyday challenges faced by minority students” (Pope, 2002, p.32). Minority male mentoring programs are one institutional solution to ensure the success of AAM students. The establishment of these programs creates an increased sense of
belonging for students on CC campuses and maintains a sustainable service in an environment conducive to AAM success and achievement (Pope, 2002; Wood & Palmer, 2013).

Multiple-level mentorship is where AAM students are exposed to a variety of individuals who are committed to ensuring that they adjust to life as college students. Individuals will be able to help students overcome some of the pre-college considerations such as academic preparation and first-generation college student status. These mentors can also guide students that are dealing with some of the conflicts that arise because of their enrollment in college, such as life-school balance.

Additionally, research shows that a range of students participating in mentoring programs are more likely to be satisfied with their academic learning than those who do not participate in mentoring programs (Fleming, 1984; Jones, 2001; Hughes, 1987; Lavant, Anderson, & Tiggs, 1997; Pope, 2002; Woolbright, 1989). Pope’s research results (2002) suggest that AAMs in CCs prefer multiple types of mentoring, both formal and informal. AAM students in this study preferred peer-mentoring and faculty-student mentoring. Educational policies and practices like the ones discussed above can be created to advance the interests of AAM students to improve enrollment and retention rates.

Mentorship promotes a holistic adult development of students. It is a process where the mentor/mentee relationship is reciprocal and nurturing to all involved. It supports AAMs’ success and increases their confidence in their abilities to persist and overcome obstacles to complete their academic degrees. The mentoring relationship encourages the use of creative activities that can assist in discovering connections in unlikely places between apparently unconnected and disparate ideas and experiences. All these events bring forth
transformation and teach students strategies that cross cultural borders (Merriam, Caffarella, & Baumgartner, 2007).

**Key to success through academic factors.** Academic success of AAM students in CCs can be positively influenced by academic factors such as successful study habits, regularly attending class, and taking advantage of student academic services (Wood, 2010). Wood’s (2010) research demonstrated that the most effective studying time is shortly after each class, on a regular basis, and a few days before the next class meeting. Instructors can encourage their students to engage in these successful study habits to assist in their academic success. In addition, study groups seemed to provide academic support to students on a peer level, where students are collaboratively learning from each other to succeed academically.

In addition to successful study habits, attending classes on a regular basis positively influences the students’ academic success. Faculty must collaborate to ensure that the courses offered to students are socially and culturally relevant and tied to the lived experiences of students. Lastly, utilizing academic support services positively influenced the students’ academic success at CCs. These academic services that were available on campus included tutoring centers, libraries, and computer laboratories.

**Key to success through psychological factors.** Psychological factors that emerged from Wood’s (2010) in-depth interviews with the students included motivation, focus, and academic confidence. Internal and external motivation, as seen earlier, is key to students’ persistence and academic success. Students’ academic focus and personal commitment to their academic careers can also positively influence their academic success in CCs. Expressing an academic confidence also positively influences the students’ success in
their educational journeys. Students that believe that they are capable of academically achieving their goals are more likely to succeed.

**African American Male Transfer Students’ Academic Experiences in Engineering**

Approximately 20% of engineers that hold a higher education degree started their academic journey at a CC (Adelman, 1998). In addition, 40% of those with a bachelor’s and master’s degree in engineering from 1999 to 2000 attended CCs as part of their academic journey (Tsapogas, 2004). The main reason students choose to begin their higher education pathway with CCs is the need to reduce financial costs of their education. According to a 2005 National Research Council study, CCs have not achieved their full potential for these reasons: 1) a lack of understanding among parents, teachers, counselors, and students of the effectiveness of CCs in producing engineering graduates, 2) less than effective articulation agreements (policies and programs designed to foster transfer) between CCs and four-year institutions, 3) a lack of cooperation and coordination among high schools, CCs, four-year institution, and state higher-education agencies.

Effective partnership between CCs and four-year institutions should offer the following objectives and goals: 1) to promote an increase in the recruitment, retention, and matriculation of minority male students in engineering fields at two- and four-year institutions; with an ultimate goal of increasing the numbers of minority males who successfully complete an engineering degree, 2) to enhance existing collaborations among CCs and four-year institutions to build and maintain a pathway for minority males in engineering disciplines, and 3) to develop multifaceted pathways from CCs, including collaboration with four-year institutions on coursework design in science and mathematics.

The same report stresses the importance of increasing students’ awareness of the
opportunities that CCs offer their engineering students, including financial assistance in reducing college cost, and allowing for flexible course schedules. In addition, through workshops and orientations, CCs can provide both students and parents with concrete information to overcome the widespread belief that their education is inferior to that of four-year colleges and universities. According to a 1998 Department of Education longitudinal study on women and men majoring in engineering, it is the student’s perception about their credit overloads in engineering that influence their decisions to leave engineering due to the high ratio of classroom, laboratory, and study hours to credit awarded. Engineering ‘pathways’ and not ‘pipelines’ are used to describe the students’ trajectories and storylines narrated by the individual student:

It is not a paved roadway with exit ramps at set intervals, rather a trail that one constructs along the contours of the terrain. One can wander away from a rough trail marked by the footsteps of predecessors, finding another pathway that may fit one’s proclivities and changing values there from here. And “there” is not necessarily an immutable, fixed place. A path through higher education, after all, is not merely one of the curriculum. It is also very much about student growth, the discovery of interest, the sanding down of sharp edges, the construction of refuges, the honing of negotiating skills, and the development of behaviors and stances to serve in the workplace, family formation, and community life (Department of Education Report, 1998, p. 10).

The engineering pathways describe the texture of the student’s backgrounds and participation as they partake their journey on their paths of discovery, often taking meaningful detours. As educational researchers, we can improve the signs along their
engineering pathways, and in the case of AAMs in engineering, improve the quality of instruction and professorial sensitivity to minority students (Allendoerfer, Jones, Hernandez, Bates, & Adams, 2007). Engineering is a relevant career option for students. This field offers a broad group of audiences with a full portfolio of richness of its culture and practice, and with a clear map of its intersections with and divergences for bench science.

Chapter Summary

There are no quick fixes for meeting the needs of black male transfer students majoring in engineering at four-year institutions. Rather, meeting classroom needs requires a sustained process with educators remaining consistent throughout. This challenge did not come about overnight, and neither will its solution. Educators must stay encouraged. It will take time and creative ways to address this massive challenge. We need to realize that lack of proficiency in math for minority males is a symptom of much deeper problems that have been ignored for way too long. By identifying and addressing some of these problems, researchers, educators, and administrators might minimize the shortage of minority male students transferring from CCs into engineering majors at HBCUs and PWIs.

Some educators and administrators may state that change must happen from within the individual adult learner. Further, they believe that if the students do not complete their assignments and are unmotivated and unwilling to participate in the learning process, then there is no point of supporting and intervening on their behalf. What the educators and administrators might not see is the student’s daily difficult grind. Each adult student has a unique context that is regularly surrounded by negativity and other perversities.

At a minimum, the educators and administrators must provide a welcoming and edifying environment to the students; a haven from the “craziness”. Minority male students
who choose to engage in the learning process inside of the classroom may be ostracized or labeled by their peers as acting white, especially in fields like engineering and science (Edwards, 2010; Kafele, 2009). But, if they attend math and engineering class and participate in meaningful problem-solving and critical-thinking discussions, then transformation takes place; their racial and mathematical identities slowly change.

Figure 2 depicts the academic and social factors that shape the engineering transfer experiences for black male. The arrows represent the relationship between the academic factors, social experiences and academic and psychological outcomes. For example, for a student who receives math tutoring (an academic factor) and mentoring by engineering faculty or a peer (a social experience), these interactions influence his racial and mathematical identities. Therefore, his motivation and academic confidence are increased. Resulting in a positive academic outcome that is manifested in the form of an improved GPA. Thus, this student’s social and academic factors present success in his transfer experience in engineering.

![Figure 2. Qaqish’s conceptual model of black male transfer experience in engineering.](image)

Academic factors and outcomes, social experiences, and psychological outcomes are interrelated and influence one another. The arrows are indicators of the complexity of the relationships among these factors, outcomes and experiences.
This chapter reviewed chosen literature across many disciplines: racial identity, mathematical identity, and higher education transfer experiences. It explained the importance of studying black male students by highlighting their unique social and academic transfer experiences and presented some background on CRT history and engineering education. Chapter three explains the methodology involved in answering the research questions that guide this study. In addition, sample and sites selection, data collection and analysis, validity and reliability, and the researcher bias and positionality are presented.
CHAPTER THREE: METHODOLOGY

The purpose of this qualitative narrative study was to explore how black males experience their social and academic transfer journey and how their perception of racial and mathematical identities shape those experiences. The research questions that guided this work were:

1. What are the experiences of black male engineering students who transfer from community colleges to four-year institutions?
2. How do personal, social, and environmental factors shape the transfer experiences of black male engineering students who attend four-year institutions?
3. How do racial and mathematical identities shape the transfer experiences of black male engineering students who attend four-year institutions?

This study included the participants’ narratives; an insight gained into the ways in which transferring from CCs into HBCUs and PWIs provides a path for successful navigation through engineering at southeastern four-year institutions. This chapter serves as the guide and roadmap for the research approach and addresses the 1) design of the study, 2) sample selection, 3) site selection, 4) data collection, 5) data analysis, 6) validity and reliability, and 7) researcher bias and assumptions.

Design of the Study

This study was designed with a qualitative methodology which was ideal to shed light on the complex phenomena within such a study (Merriam, 1998). The level of complexity of this approach intensified as more variables were added. For example, the intersectionality of race, gender, class, and power required a research approach that could describe the relationship beyond a single measurable numeric value. Using an alternative qualitative
approach provided thick, rich, and descriptive data. In this approach, the researcher captured, through in-depth interviews, share narratives by individuals who have been marginalized by dominant educational opportunities (Baptiste, 2001).

Semi-structured interviews utilize a series of questions that guide the engaged conversation between the interviewer and the interviewees, with a level of flexibility to allow the interviewee to talk about what is of interest and importance to them (Hesse-Biber & Leavy, 2011). Conducting a semi-structured interview is an art, where the researcher asks guided questions at the same time allowing the participants to converse freely and more naturally, giving “room for the conversation to go in unexpected directions” (Hesse-Biber & Leavy, 2011, p. 102). The interviewees may have information to share that the researcher did not think about asking. “When such knowledge emerges, a researcher using a semi-structured design is likely to allow the conversation to develop, exploring new topics that are relevant to the participants and that may shed insight on the research topic” (Hesse-Biber & Leavy, 2011, p. 102).

CRT was the framework that grounded this study. CRT is grounded in key tenants such as centrality of race, challenge to dominate ideology, and the significance of counter narratives and storytelling and experiential learning. These key characteristics we taken into consideration while the research carefully interpreted her data of the transfer experience of black male engineering students. This analysis tool was useful to examine engineering programs at PWI and HBCUs that exist within a structurally biased culture (Delgado, 1989; Ladson-Billings, 1998; Taylor, 1998).

This study used semi-structured interviews with the students to capture their narratives. Storytelling enabled the researcher to effectively investigate the fables,
assumptions, and conventional understandings that make up our dominant westernized culture about race and that perpetually marginalize others (Delgado & Stefancic, 2000). The researcher’s motive is to celebrate the success of the male participants’ successful transitions from CCs into HBCUs and PWIs as engineering students. Recording the participants’ social and academic experiences empowers more students to be successful throughout their educational journeys and provides necessary strategies to increase awareness to contextual understanding and interpretation (Ladson-Billings, 1998).

In qualitative research, the researcher serves as the instrument to collect counterstories or data with a soul from the participants. This data consists mainly of textual description that includes the participants’ meaning and understanding of their personal lives that are socially constructed by them while interacting with the world. Studies show that their reality is not a single, fixed, or measurable value (Baptiste, 2001; Creswell, 2007; Merriam, 1998).

The storyteller researcher has a large responsibility as the instrument and must keep his/her subjectivity in check, while expanding his/her perception. The researcher in this study accomplished subjectivity by writing down field notes and memos in a reflective journal while collecting the data through semi-structured interviews, observations, and document analysis. The researcher subsequently investigated the data closely to ensure that all perspectives were presented equally. The researcher’s objective was to preserve the context in its most organic form without stripping or excluding any meaning or purpose (Baptiste, 2001; Creswell, 2007).

In contrast to a qualitative approach, a quantitative approach would have been objective, and the description of the complex story that is influenced by societal and
academic factors on the success of these black male engineering transfer students would be lost. Only through a subjective narrative could we hope to learn from their journey through CCs into HBCUs and PWIs. A quantitative approach would not have shown the interwoven and richly textured experiences and accumulated knowledge of these unique individuals. It would have reduced the participants and the associated data into a numerical box displayed in tables and charts with minimal textual descriptions.

Sample Selection

A purposeful sample selection initiated the data collection process for this study. Purposeful sampling is a powerful data collection process because it provides information-rich cases to conduct in-depth research (Patton, 2002). After the approval of the Institutional Review Board (IRB) from two sites (NCSU and NCA&T), a total of thirteen students participated in this study (n=13). This included eight students from NCSU and five students from NCA&T. All student participants were self-described as black males. The student participants met the following selection criteria:

1) be currently enrolled (full-time or part-time) at NCSU, or NCA&T.
2) be at least 18 years old.
3) have transferred from a community college.
4) have completed at least one semester in the engineering curriculum at the current university.

The student participants were recruited by posting fliers at each campus. The original design of the fliers was later improved by including color and more graphics to make it more appealing to students (see Appendix B for both designs). Fliers were first approved by IRB and the Office of Students Affairs at each identified site (NCSU and NCA&T). Each
participant was offered a $25 gift card to Target retail chain stores as a token of appreciation for their time and participation. Although the offering was optional, all participants welcomed the incentive. The fliers were posted in the following areas: computer labs, engineering buildings, libraries, and student affairs offices. Prior to posting the fliers, the researcher contacted the engineering department head for each university and asked them to promote the flier.

Sites Selection

The criteria used in the site selection decision resulted in two sites that served a higher population of engineering students and professionals in and around the Research Triangle area. The two identified sites included these criteria: 1) accepts transfer students at a minimum of the national average rate of 25%, 2) offers an engineering major, 3) serves as either a public or private institution, 4) is either HBCU or PWI, and 5) has an overall equal representation of male students.

The two southeastern institutions that met the above criteria for this study were: North Carolina State University (NCSU), and North Carolina Agricultural and Technical State University (NCA&T). At the time of the study, NCSU was a public PWI that served a population of approximately 34,000 undergraduate, graduate and professional students. NCSU had 54% male and 44% female students with a student body of 5% Asian, 7% African American, 4% Hispanic, 74% White, and 10% Other. NCA&T was a public HBCU that served over 11,000 students (85% undergraduate students). NCA&T had 46.5% male and 53.5% female students and a student body consisting of 0.4% Asian, 87.2% African American, 1.5% Hispanic, 4.4% White, and 6.5% Other. In both institutions, 25% of undergraduate students that attended these sites transferred from CCs or other universities.
Data Collection

This narrative study approach brought out the oppressed voice of black males who transferred into southeastern HBCUs or PWIs while majoring in engineering. Their narratives and stories were organically captured through digitally recorded semi-structured interviews at the prescribed sites, serving as the primary source of data collection. Interviews with the students from each university provided insights into the ways in which students participated in the transfer process and its influence on the students’ academic journeys, and the students’ perception of racial and mathematical identities.

Interviews locations. Interviews were held at a local research and/or engineering library to facilitate ease of meeting in a timely fashion and geographical convenience for the students. All eight interviews with NCSU participants took place in a reserved conference room at the James B. Hunt library. All five interviews with NCA&T students were conducted at a reserved room at the F.D. Bluford Library. Both locations were within walking distance from the campus’ engineering buildings. Each in-person semi-structured interview lasted an average of one hour, with subsequent communications via phone call, email, and text, for an estimated cumulative total of 20 contact hours.

Interviews. The thirteen student participants were asked, via an email invitation, to complete a demographic questionnaire and a Multidimensional Inventory of Black Identity instrument using a QUALTRICS online survey, which is found in Appendix D. After the completion of the online survey, the participants were invited to participate in a face-to-face one-hour semi-structured interview. The students were interviewed individually, while the researcher digitally recorded the semi-structured interviews. Later, she transcribed and analyzed the interviews. Finally, the researcher sent a copy of the transcribed interviews to
students to review for accuracy and student feedback. The complete student participant interview protocols can be found in Appendix E.

During the interviewing process, probes were used to encourage the participants to continue their discussion and to dig deeper to generate meaning and explanations. Probes are signs that the researcher understands and is interested in what the interviewee is sharing. Therefore, the interview protocols in Appendix E has multiple probes. In summary, the researcher used all means possible to obtain as much qualitative textual data from the interviewee via means of asking, listening, and conversing (Hesse-Biber & Leavy, 2011).

**Metaphors.** In order to explore black male student’s self-perception in engineering programs, this research employed two metaphors in the data collection and analysis process. Reviewing metaphors that are self-prescribed by the participants determines the influence of their identity development, engineering mindsets, and complex problem solving on the students’ associated academic and social transfer experiences.

**Field notes and observations.** Field notes are written text that the researcher used to capture the process of conducting the interviews with the participants for this study. Field notes are the “personal journal” that the researcher used to inscribe the context of this qualitative study (Brodsky, 2008, p. 341). The researcher reflected on the data collection procedure through detailed memos after the completion of each interview session. Memos are reflective field notes that capture the researcher’s thoughts, reactions, intuitions, and concerns about encounters. They are also a record of possible mishaps that come to the researcher as she collects, analyzes, and synthesizes the data, avoiding any alteration of the participants’ perspective and preserving the data as organically as possible (Bogdan & Biklen, 2007).
Observational research is subjective rather than objective in nature (Angrosino & Rosenberg, 2011). The researcher is a human who performed activities in physical settings which shaped the research process. The researcher captured nonverbal behaviors of the participants during the interview process by using the observation guide found in Appendix F.

**Document review.** Document review, also known as document analysis in qualitative literature, is the final step of data collection. During the document review process, the researcher reviewed a vast pool of peer-reviewed journal articles. Through this extensive process, the researcher identified gaps in the literature along with her research topic and vast literature reviews (Merriam, 1998).

Document review provides context to qualitative research. It provides deeper meaning of gathered information of the engineering transfer process, including background, events, and beliefs of the engineering programs that is serving as the context of this narrative approach (Patton, 2002). Documents, publications, and websites reviewed included published journal articles and engineering program transfer guides at both NCA&T and NCSU. All articles analyzed for this study provided context and data on the strains exerted on students and offered grounding foundations for face-to face interview questions and personal interactions.

**Data Analysis**

Data analysis within a narrative approach enables the researcher to understand and analyze instances of textual materials with a “sense of correspondence” (Merriam, 1998, p.193). The researcher systematically organized the informational text from the recorded semi-structured interviews using a process that enabled the researcher to understand,
compare, and interpret the data. This systematic process is also defined as data analysis (Bodgan & Biklen, 2007). The researcher communicated contextual understanding and meaning through her interpretation, reflection, and triangulation of the rich textual data that at first impression may be oversimplified in its interpretation (Merriam, 1998).

Narrative research analysis transforms the collected data into the story the participants want to share, as well as “turning points or epiphanies” (Creswell, 2007, p. 155). The narrative analysis approach used in this study is described as “a three-dimensional space approach of Clandinin and Connelly (2000) that involves analyzing the data for three elements: interaction (personal and social), continuity (past, present, and future), and situation (physical places or the storyteller’s places)” (Creswell, 2007, p. 158). This space is a process of “back-and-forth writing”, as described by Creswell (2007), that analyzes inward and outward and situates the participants’ involvements in engineering programs at four-year institutions. The researcher inspected inward to students’ personal participation as engineering transfer students, and reasons for doing this study and outward to the social significance of the research work (Ruona, 2005).

The elements in this approach included collecting personal narratives in the form of interviews and conversations between the researcher and the participants or field texts, retelling the stories based on a three-dimensional space narrative approach, rewriting the stories into a chronological order, and incorporating the setting or place of the participants’ experiences (Creswell, 2007; Ruona, 2005). “The writing of a narrative needs to not silence some of the voices, and it ultimately gives more space to certain voices than others” (Creswell, 2007, p. 185).

Stories emerged from the in-depth interviews with the participants as they shared
their reflections on their social and academic journeys. In-depth interviews engaged conversations between the researcher and the participants, where active listening and questioning took place (Hesse-Biber & Leavy, 2011). Face-to-face interviews provided contextual data that may be missing if the interviews were conducted over the phone or via email. Gestures, eye contact, and other means of showing interest and building rapport became possible during face-to-face interviews.

In-depth interviews tap into undisclosed and subjugated knowledge of those who often are marginalized in a society, such as black male students (Hesse-Biber & Leavy, 2011). Black males “may have hidden experiences and knowledge that have been excluded from mainstream” use of quantitative research methods (Hesse-Biber & Leavy, 2011). Interviewing permits access to some of this information.

Through the interview process, the interviewer and the interviewees embarked on a meaning-making partnership. The researcher and the participants sat next to each other on the same level rather than at a degree of division between them. This took place with careful reflexivity and practice of the researcher to avoid elusiveness. “Reflexivity is the awareness that all knowledge is affected by the social conditions under which it is produced; it is grounded in both the social location and the social observed” (Hess-Biber & Leavy, 2011, p. 39).

As an outsider, the researcher was aware of the danger and concern of how she may come across to participants as she attempted to understand and represent their perspectives (Hesse-Biber & Leavy, 2011). The researcher studied the rich qualitative textual data for concrete, contextual, biographical materials. During the interview, the researcher often prompted the participant to expand on various sections of the stories and asked the
interviewee to theorize about their lives as engineering transfer students.

In this study, several phases of the data analysis were utilized, from transcription of the interviews to comparing themes from this research to published literature to discern new meanings. The first phase included the transcription process of all thirteen student interviews and focused reading for clarity and understanding of the interview materials. The interviews were transcribed verbatim to represent the student’s voice. Students received a completed copy of each transcription for member checking of the data to reinforce validity and reliability of this work. Respondent validation or member checks were important to validate the data collected and to ensure a clear representation of students’ perspectives (Creswell, 2007).

In the second phase of this analysis process, the researcher reviewed multiple sources of data to increase her familiarity with this research. She repeatedly reviewed the interview transcripts, the participants’ demographic online survey results, document analysis, observation records, and her field notes. At this second phase, the collected data and the prescribed research questions that guided this work began to merge and become correlated.

The third phase of the data analysis process consisted of broad category, open coding of the multiple data sources described in phase two of this process. Open coding is defined by Creswell (2007) as “coding the data for major categories of information” (p. 64). Categorical themes emerged from the data sources with no new themes nor ideas left uncovered. Axial coding, then emerged from open coding, in which the researcher identified one open coding category to focus on what is known as the “core phenomenon” (Creswell, 2007, p. 64). The researcher then returned to the data and developed categories around this “core phenomenon”.
Strauss and Corbin (1990) first prescribed the categories emerging from the “core phenomenon” as: casual conditions, strategies, intervening conditions, and consequences. Casual conditions are defined as the factors that cause the core phenomenon. Strategies are the actions taken as a response to the core phenomenon. Intervening conditions are defined as “broad and specific situational factors that influence the strategies” while consequences result from the use of these strategies (Creswell, 2007, p. 64). In the last step in coding, also known as selective coding, the researcher developed a visual model and propositions that interrelated the categories to bring together a narrative that describes the interrelationship of this open coding categories (Creswell, 2007; Ruona, 2005).

The fourth phase of this research data analysis process was to compare the final categorical themes that emerged from the data to the literature used to develop the research questions and area of interest. Specifically, how black male students’ racial and mathematical identities evolve during their engineering transfer process and how social and academic factors shape their transfer experiences.

In the fifth phase of the data analysis process, the researcher entered and coded the categorical themes into Microsoft Excel. These categorical themes and sub-themes were coded if and only if they represented a minimum of seven participants’ responses. In other words, when the researcher refers to the “majority of the participants”, she is making a general statement that at least seven out of thirteen participants agreed or their answers fit the categorical theme or subtheme that was identified by the researcher. This allowed the researcher to analyze the descriptive text transcribed from the conducted interviews. Microsoft Excel allowed the researcher to organize the data into columns that
were mapped to various items from the text and highlights the connection that may not be obvious to the researcher.

In the final phase of the data analysis, the researcher compared her codes with another researcher, who independently coded the interview data. Multiple minds bring multiple ways of analyzing and interpreting the data while minimizing single person bias. This allowed for shared interpretations and understanding of this narrative study. Provocative questions were asked and posed resulting in richer codes (Miles & Huberman, 1994).

Data analysis assists in fitting pieces of a puzzle together. By identifying themes that fit the analytical data, the researcher may identify an important puzzle piece that allows the researcher to move toward a goal of completing the entire puzzle. Analysis memos are ideas that the researcher writes down to help process through how the researcher goes about the research or what the research means. The researcher maintained a reflective journal in which she kept an account of each step in the coding process along with keeping a detailed codebook. Questions used to guide her process included questioning the piece and its meaning and comparing it with other pieces. “Comparing analysis to putting a puzzle together is meant to remove much of the jargon that has cropped up when researchers try to explain how to analyze and interpret data” (Hess-Biber & Leavy, 2011, p. 222).

**Validity and Reliability**

The researcher collected and stored the data on a password-protected personal laptop. The recorded audio and transcribed interviews were routinely backed up electronically on an external hard drive that was stored in the cabinet of the researcher’s home office. The researcher destroyed all the collected data upon the completion of the research project. The confidentiality and anonymity of the participants were preserved
throughout the data collection and analysis by utilizing a self-selected pseudonym for each individual participant. The mapping of the participants’ real names and self-selected pseudonyms were stored in a password protected file on a password protected laptop and external hard drive.

In this research study, triangulation ensured the trustworthiness of the data. Triangulation, or the use of various data sources, confirms themes and findings that emerge from the study (Merriam, 1998). Multiple data collection methods included semi-structured interviews with students, observations, member checks, and independent coding.

To add to the validity of this study, outside and inside reviewers were asked to read and offer feedback on the researcher’s definition and analysis of this research study. The participants of this study were used as inside reviewers. As outside reviewers, a professional English editor and an evaluation researcher reviewed this document; neither outside reviewer was connected to CC or GED math education.

**Researcher Bias & Positionality**

In this qualitative research, the researcher’s role was primarily to collect and analyze the data. The researcher focused on understanding this data, along with utilizing inductive research processes to code the data; which came from a subjective stance. This qualitative researcher arrived with her own biases, beliefs, and background that she attempted to set aside while processing and analyzing the rich and descriptive data collected.

The researcher of this study is an educator, whether an outsider and/or insider to the participants, which played a valuable role in her findings and future implications of this study. Her positionality began as a GED educator and a doctoral student at the Educational Research and Policy Analysis program at North Carolina State University. Her research
interest in engineering heavily influenced her mathematical identity and her perception of this scholarship. More specifically, she was influenced by her educational career with struggling math learners and their perceptions and actions in and outside the classroom environment.

The researcher’s mathematical identity has always been strong throughout her academic career. Her narrative identity consisted and continues to consist of lifelong learning and application of mathematical concepts. The narrative that she constructed throughout her adolescence and adulthood consisted of picturing herself as strong in her mathematical identity and heavily influenced her decision in majoring in biomedical engineering and earning her master’s degree in this area of study. This enabled her to create a narrative story of herself as a strong student, fine-tuning her mathematical knowledge of fundamentals and enhancing her academic abilities by excelling in advanced mathematics courses at the undergraduate and graduate levels. This researcher believes that through her academic and professional achievements, she has become an accomplished and successful educator in mathematics at various collegiate levels.

During this phase of the research design, purposeful sampling was carefully chosen to consist of a specific population that met the research design criteria and aligned with the research goals. The choice to interview black male participants who were enrolled in an undergraduate engineering program was specific, because the researcher understood the curriculum. This comprehension allowed the researcher to understand the shared language and common professional norms with the students at an unexpressed level.
Chapter Summary

This chapter introduced the qualitative methodology and research design components of this study. Purposeful sampling approaches were discussed and addressed. Data collection and review procedures were presented to effectively interview the population of interest and ensure validity and reliability of the data. Furthermore, sample data collection tools and consent forms were reviewed.
CHAPTER FOUR: FINDINGS

This chapter presents the findings of a narrative study. The goal was to answer three research questions that explored the social and academic transfer experiences of black males to four-year institutions:

1. What are the experiences of black male engineering students who transfer from community colleges to four-year institutions?
2. How do personal, social, and environmental factors shape the transfer experiences of black male engineering students who attend four-year institutions?
3. How do racial and mathematical identities shape the transfer experiences of black male engineering students who attend four-year institutions?

In the first half of this chapter three sections are presented: 1) an overview of the participants’ demographics, 2) an overview of the semi-structured interviews, and 3) participant profiles. This will help the reader to go beyond the research design to understand how to interpret the second half of this chapter.

In the second half of this chapter, the researcher analyzes the qualitative data from the online questionnaires and in-person semi-structured interviews to answer the research questions. Through interpretive analysis, the student participants’ voices are heard, and their emotions are brought forth to the viewpoint. Their individual stories are woven into the narratives in a form of direct quotes. This chapter ends with additional findings and a chapter summary.

Participant Demographic Overview

The thirteen engineering transfer students interviewed for this research were all black male students with collective ages ranging from 21 to 50 plus years of age. Three were of
African upbringing, while the other ten students were born and raised in the United States of America. All were engineering students; eight were attending NCSU, and five were from NCA&T. Only one student was enrolled part-time, while the other twelve were full-time. Three students were 21 years old, four students were 23 years old, one student was 24 years old, and five students were older than 25 years of age. Ten participants spent a total of five semesters at CCs prior to transferring, while three attended three semesters or less. Ten students received an associate’s degree. Of those, eight received their associate’s degree in science while only two completed their associate’s in arts. The remaining three students transferred into their four-year institution without completing their associate’s.

Demographic online survey questions captured and focused on the participants’ membership and involvement in mentoring programs and engineering clubs. While attending their CC, only three participants were involved in the Minority Male Mentoring Program (3MP), while the rest did not participate in any professional services. However, an increase in participation was seen at the university level, where five participants indicated their current membership with the National Society of Black Engineers (NSBE) and eight indicated their involvement in other clubs such as engineering fraternities.

Eleven participants indicated plans to pursue a career in engineering after the completion of their bachelor’s degree, with no indication of furthering their degree. Only two students plan to pursue graduate-level engineering education in the future. Four participants were pursuing degrees in computer science, three were majoring in electrical engineering, two were majoring in industrial and systems engineering, and one student was either pursuing a degree in aerospace, civil, mechanical engineering, or double degrees in computer science and electrical engineering. Student grade point averages (GPAs) at CCs
ranged from 2.8 to 3.9 on a 4.00 scale. Their GPAs currently range from 2.7 to 3.8 on a 4.00 scale at their respective universities. It is also interesting to note that nine out of the thirteen students have taken at least one semester of courses at Wake Technical CC. Participant overview information is included in Table 1.

Each student in this research was unique with an interesting perspective. In this section, a condensed participant profile is presented, in alphabetical order by self-selected pseudonyms. Each student was asked to share his story about pursuing engineering and his participation in mathematics classes from middle school to college. In addition, they also shared two metaphors that were self-identified to describe themselves as transfer students.

Table 1

*Participant Demographics*

<table>
<thead>
<tr>
<th>Pseudonym</th>
<th>Current University</th>
<th>Race/Ethnicity</th>
<th>Current Status</th>
<th>Engineering Major</th>
<th>Community College</th>
<th>Associate’s Degree</th>
</tr>
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<tr>
<td>Adam</td>
<td>NCA&amp;T</td>
<td>African-American</td>
<td>Full-Time</td>
<td>Industrial &amp; Systems</td>
<td>John Tyler</td>
<td>Yes</td>
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<td>Carlos</td>
<td>NCA&amp;T</td>
<td>African</td>
<td>Full-Time</td>
<td>Electrical</td>
<td>Wake Tech</td>
<td>Yes</td>
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<tr>
<td>Chad</td>
<td>NCSU</td>
<td>African</td>
<td>Part-Time</td>
<td>Civil</td>
<td>Wake Tech</td>
<td>No</td>
</tr>
<tr>
<td>Charles</td>
<td>NCA&amp;T</td>
<td>African-American</td>
<td>Full-Time</td>
<td>Industrial &amp; Systems</td>
<td>Hudson Valley/Durham Tech/Wake Tech</td>
<td>Yes</td>
</tr>
<tr>
<td>David</td>
<td>NCSU</td>
<td>African-American</td>
<td>Full-Time</td>
<td>Computer</td>
<td>Fayetteville Tech</td>
<td>No</td>
</tr>
<tr>
<td>Jay</td>
<td>NCSU</td>
<td>African-American</td>
<td>Full-Time</td>
<td>Electrical</td>
<td>Wake Tech</td>
<td>Yes</td>
</tr>
<tr>
<td>Jeff</td>
<td>NCSU</td>
<td>African-American</td>
<td>Full-Time</td>
<td>Mechanical</td>
<td>Wake Tech</td>
<td>Yes</td>
</tr>
<tr>
<td>Mark</td>
<td>NCSU</td>
<td>African-American</td>
<td>Full-Time</td>
<td>Computer</td>
<td>Wake Tech</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Overview from Semi-Structured Interviews

When prompted to discuss what path led each participant to study engineering, nine identified a desire to pursue a profession in an engineering-related field prior to entering college, with only three specifically identifying engineering as the predetermined path of study as adults. In addition, six out of the thirteen participants were tinkerers as children, with problem-solving skills and innate curiosity. Their stories in pursuing engineering highlighted factors that influenced their decisions in becoming engineers. Three students had parents who were engineers; two students were directly inspired by current technologies such as smartphones, iPads, and video games. Eight percent of participants wanted to give back to their community by becoming the first in their family to earn their degree in engineering.

It is interesting to note that three out of the five participants currently attending NCA&T began their higher education journey as freshman at a PWI prior to seeking entry into CC engineering programs and later transferred into four-year institutions. When prompted about their feelings as transfer engineering students, five students expressed feeling
alienated like a stepchild or expressing low self-efficacy. Three participants either felt
upgraded in their journey or felt that their pathway required endurance. One student felt a
strong sense of belonging to a tight-knit family.

When asked about their experiences as engineering students on their respective
university campuses, only positive feelings were prevalent. Five participants felt a strong
sense of belonging or a feeling at home; four students felt supported, three students either felt
determined or felt confident and accomplished, two participants felt happy, and one felt
motivated, inspired, and empowered. Participant overview information and metaphors are
included in Table 2.

Table 2

Summary of Metaphors by Study Participants

<table>
<thead>
<tr>
<th>Pseudonym</th>
<th>Overall, being an engineering community college transfer student is like:</th>
<th>At this university, I feel like:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adam</td>
<td>Showing up late trying to figure out what’s going on</td>
<td>Supported</td>
</tr>
<tr>
<td>Carlos</td>
<td>Marathon runner</td>
<td>Inspired</td>
</tr>
<tr>
<td>Chad</td>
<td>A success</td>
<td>Sense of belonging</td>
</tr>
<tr>
<td>Charles</td>
<td>A never-ending journey</td>
<td>At home</td>
</tr>
<tr>
<td>David</td>
<td>Playing catch up with background knowledge</td>
<td>Empowered to achieve dreams</td>
</tr>
<tr>
<td>Jay</td>
<td>Upgrading from coach to first class</td>
<td>Happy, appreciated &amp; supportive</td>
</tr>
<tr>
<td>Jeff</td>
<td>Being a stepchild</td>
<td>Frustrated</td>
</tr>
<tr>
<td>Mark</td>
<td>Sense of belonging</td>
<td>Confident &amp; supportive</td>
</tr>
<tr>
<td>Matt</td>
<td>Going from high school to college</td>
<td>Challenged</td>
</tr>
<tr>
<td>Nelson</td>
<td>Cheating with taking my core courses at CC</td>
<td>Sense of belonging</td>
</tr>
<tr>
<td>Sega</td>
<td>Phone flashlight with depleting battery charge</td>
<td>Accomplished</td>
</tr>
<tr>
<td>Stormy</td>
<td>High school student upgrading to a University</td>
<td>Determined</td>
</tr>
<tr>
<td>Sully</td>
<td>Substitute soccer player</td>
<td>Sense of belonging</td>
</tr>
</tbody>
</table>
When asked about their feelings about engineering courses in general, eight students stated that the engineering curriculum has been challenging, rigorous, and requires plenty of mathematical concepts and software programming fluency. Six participants found engineering enjoyable as a major.

When prompted about their academic and social participation during their enrollment at CCs, six participants felt lonely and isolated. Seven found lasting friendships with fellow peers that had also transferred into four-year engineering universities.

When pressed about their understanding about the transfer process into the university engineering program while attending CCs, seven students stated that they knew about the overall community college GPA minimum requirement and required core courses that would transfer. However, five students felt that they did not have a handle on the transfer application process and felt lost or frustrated at times. Two students would have preferred to talk to an academic advisor beforehand to guide them through their journey and identify their trajectories.

When specifically petitioned about the obstacles that they faced during the transfer process, five students expressed their frustrations with the technical and credit transfer challenges from CCs into four-year institutions. Three of the participants expressed that they completed all their CC core coursework requirements over the fall term and had to wait an entire academic year to transfer into their current engineering program because the university only accepts fall transfers. Two of the participants found the university transfer administrators very helpful in guiding them during the transfer process. Two students also indicated an increase in their study time and found less time to socialize.

The majority of the students, except for one student, expressed positive support from
their family and friends about transferring into their current engineering program. Two of the participants experienced a negative or mixed reaction from friends and family regarding their transfer. Ten students experienced an increase in self-efficacies since becoming engineering students at a university level. Six students thought negatively and struggled with their perception of themselves since becoming engineering students at the university.

It is interesting to note that nearly all interviewees were expressive in their storytelling. They illustrated their narratives using rich, thoughtful, and descriptive language so that their personal interpretation could be captured by the researcher and conveyed to the reader. To emphasize the answers and clarify the participants’ responses, probing questions were asked to direct and guide the storytelling and to dig deeper to convey the essence of their narratives.

**Participant Profiles**

**Adam.** Adam grew up surrounded by engineers, doctors, and lawyers and their families. Both of his parents have graduate degrees in engineering, and they reinforced critical thinking and problem-solving skills early on in his life. He is a firm believer that homework should be seen as an opportunity to apply his understanding of concepts discussed in class.

Problem-solving and engineering concepts were second nature to Adam. He “excelled in math, science, history, and really anything that had to do with advanced problem-solving.” He also challenged his abilities; he tinkered with programming and played with puzzles and mind games since childhood. Majoring in engineering was the next logical career choice for him. “I went to high school and then decided that I wanted to be an engineer. I just didn’t want to do the same things that my parents did.”
His journey in his pursuit of engineering was not direct; he took a few detours. He spent the first two and a half years majoring in engineering at a PWI. He “didn’t enjoy it at all!” and he “left the program and went back home”. He then transferred to a CC with a social science focus, and then returned to engineering when he transferred to an HBCU:

Home changed location. But [I] went home to live for few years and try and figure out if I still wanted to do engineering or if I wanted to do something else. There I was interested in criminology and then applied to psychology. And so from there, I went to the community college and then [I] took engineering there for a year and fell back in love with it and then I transferred to A&T now.

Adam always excelled in math and studied independently, which is a practice he continues. “I try to do it [study] all on my own. I typically will try and trust my own ability versus sometimes [I] am working with other people”. He is self-aware about his study habits and his ability to comprehend technical concepts at a much faster rate than his peers:

Typically what will end up happening is I will understand something by just looking at it on the [classroom white] board and then have to go back. Where other people need practice problems and other stuff, I might need only one or two and it will be fine.

On numerous occasions during the interview, Adam expressed his frustrations with his fellow students’ academic performance and the slow pace of his classes:

I believe at times they [the professors] don't challenge the students to learn on their own. I think the students here…they expect teachers to hand them information rather than [to] take charge of their own education. I think that some students here are spoon-fed. I just noticed that the class moves way too slow for me…most classes. So
I get bored and then [there are] the few classes where the teacher does challenge students. I only experienced [that type of class] once since I've been here, where I really just felt like this class was [challenging for me]. I get bored all the time. I think it [the pace] is slow.

During the interview, Adam became aware of his criticism and quickly balanced his response with what he discovered to be positive about NCA&T, noting that “The school does… [a] much better job of building your brand”. In other words, NCA&T professional development opportunities assisted Adam in building his professional engineering identity. Adam spoke highly of the numerous professional development opportunities that NCA&T provided to its students such as building a social network, understanding interactions within business organizations, and building communities:

They [NCA&T] definitely have a lot of resources…like resources that I've never seen anywhere else. [Such as] dealing with putting you in contact with internships, co-ops. Expectations for getting internships and co-ops are much different than I'm used to. It really is a driving force. So yeah, those are some of the positive attitudes. They [NCA&T faculty] definitely do a lot more with trying.

Several times during his interview, Adam expressed his gratitude around the development of his racial identity at NCA&T. He compared both his social and academic experiences at a PWI and HBCU engineering programs:

They [NCA&T] also do a better job of having real conversations [around racism] that are going on outside of the classroom. And they do a good job of making sure that students understand what is going on.

Adam spoke articulately about the difference between his past CC experience and the
current program. He candidly reflected on his lack of social capital in his current institution. He expressed that his life experiences and personal goals have matured him and now clearly define and reflect his plans. He feels disconnected from the current engineering program, as he is not willing to be fully engaged in all the components of the program outside the classroom. It is clear that Adam is seeking a successful equilibrium in all of his pursuits, i.e. school, work, and family. He compared his transfer journey to NCA&T to arriving late at an event and navigating the new environment:

So it is really not that you don't or you're not able to deal with what it is. But it is just that you are trying to figure [it] out. Everybody at that point, you realize, has social connections and social ties with friends. Typically you might not have those, or most of the transfer students I know don't have those, and you are trying to deal with that aspect of it as well as do your work. So it is just in certain areas, trying to figure out who else you can study with and try to do all the things you typically do when you first meet a group of people.

Adam was interviewed on September 25th, 2017 in a conference room on the second floor of F. D. Bluford Library at NCA&T. He is a young man in his mid-twenties with strong beliefs and frank responses. He is an articulate individual that provided answers which certainly reflected his analytical mind. His examples and answers indeed provided a unique perspective as a young man who began his engineering journey at a PWI, moved to a CC, and then continued as a transfer student at an HBCU.

Carlos. Carlos is a young man with a calm and collected personality. He was born in North Carolina, although he spent his high school years in Africa. He began his higher education journey as a business and journalism major at a community college and discovered
his passion for electrical engineering through hands-on research endeavors. His desire is to apply his engineering degree to improve the quality of life of African communities by utilizing sustainable and renewable energy that operates within the community infrastructure. He seemed to integrate engineering into his daily life routines and interactions. The interviewer prompted Carlos to share the influences that he believes directed his educational journey into the engineering field. His narrative illustrates the influence of his social and environmental experiences as an adolescent in forming his decision to become an engineer:

One of the somewhat of a blessing of growing up in a third world country, there [are] a lot of people who are engineers in the lifestyle we live in… especially when, in poor areas, you have to engineer your lifestyle in a way to make it easier for you to get water and do other stuff. There wasn’t a particular person. It was more the culture that I grew up in and around. They didn’t have any formal engineering [education] but they think just like engineers think.

An avid lifetime learner, Carlos immerses himself listening to educational podcasts and guided meditations. He earned his associate’s degree from Wake Tech and is currently an electrical engineering junior at NCA&T. He clearly shared his story about pursuing “a nontraditional route” in engineering:

I never started college thinking that I will pursue engineering when I started attending Wake Tech Community College. The goal was to get an associate’s in [liberal] arts and then eventually get a degree in business management which changed into journalism because I liked to write. Then it changed to software and computer programming to develop software apps because I was talking to people that had me
convinced that the future is in making apps so I should learn how to program. But I realized that I really don’t like programming.

Carlos expressed his passion for engineering and his lack of interest in software programming, “Around that same time I was really in limbo about what I should change my major to for the fourth time. I am sticking with it and I’m not changing it again”. Once he was determined to persevere in engineering as a major, he had a transformative experience through a hands-on research experience during that summer:

I worked in a biomedical engineering lab [at a local PWI]. I dabbled in it a little bit to see if that would peak any interests but eventually, through their connections, I ended up getting a research experience… [I worked] on developing smart grid technologies and renewable energy products and systems and I just fell in love with the whole prospect of energy and future energy management and energy delivery. So that’s where I decided electrical [engineering] is it… because I see an end game for it. It wasn’t because I liked the classes or the process. It’s more like I see more… I chose my career before I chose my major basically. This electrical engineering major sort of fit into the career that I wanted to be in.

Carlos’ educational journey was completely changed by this undergraduate research experience. He matured beyond his classmates and implied that interacting with other students may be a distraction and directly influence his academic progress. Through powerful reflections, he gained a new personal outlook and clearly decided to limit his social interactions while attending his engineering classes:

Student relation [is that I have] no friends [chuckle]. Yeah, yeah, it’s a self-imposed decision based on a bunch of restrictions [that] I’ve placed on myself… and who I
decide to call a friend at this point in my life. And it does get harder to make friends as you get older. When you were younger you had friends just to have friends so you can have someone around to talk to. But now that I’m older, I feel like when I call you, a friend, then I’ve gained something from you and you’ve gained something from me!

He currently tutors an undergraduate student in calculus, “That’s crazy, isn’t it?” He was elated to share this information with the interviewer. He seemed satisfied to the core with his cognitive knowledge and understanding in mathematics and assisting others:

And it’s so rewarding, because, first of all, I think in a way it helps with the more difficult math. It helps to tutor math, not simpler, but earlier math, the basic stuff, to help me with the more difficult math that I’m doing now. It’s a good exercise for me and I am learning that I enjoy teaching now. It’s something that I found about myself. [I am] learning more and more about myself.

When prompted to discuss what influences the success of black males at the university level, Carlos honestly responded while tapping his fingers on the table, “Probably faculty support is what actually is helping them”. He later expressed his personal action plan to improve the success process for engineering students by taking on a leadership role within the Engineers without Border club on campus:

I have in my mind lots of plans. I’m treating it as my own personal project for the next few years, to turn this club around and make it worth something. I’ve learned a lot about being involved in running a club from Pathways [CC 3MP] and I’m very thankful for that… how to run a club to be effective. I’m going to use some of the skills that I’ve learned there to make the Engineers without Borders club
something. I think it could be much better than what it is right now. Like I said [before] it’s a personalized project to make that club worth something.

Carlos’ metaphors recalled the benefit of keeping focused and persevering through difficult engineering courses. He described his journey as a transfer student as a marathon runner that endures his last mile and finishes strong. He is energized by knowing that he is close to nearing the end of his higher education. He is motivated by reaching beyond just earning an engineering degree. Lastly, he is inspired by reflecting on his social and academic experiences as an engineering transfer student and expressing a better understanding of his situation.

An electrical engineer at heart, Carlos would like to be involved in the design, testing, manufacture, control, and inspection of electrical and electronic devices, machinery, and systems. These electrical systems vary in size from microscopic circuits to national power generation and transmission systems.

During the interview, held on April 7th, 2017 and conducted in a conference room on the second floor of F. D. Bluford Library at NCA&T, Carlos seemed confident and eager in his demeanor and answered all questions with genuine thoughtfulness. Carlos’ dream is to become an electrical engineer and work in the sustainable and renewable energy sector. He is also dedicated to developing into a well-rounded engineer and to whatever additional career options that await him. He plans to contribute his utmost to the engineering profession and to the betterment of third world countries and their infrastructures. He truly conveyed an engineering mindset and views mathematics as “the language of the universe”. His expectations for himself and fellow engineers are rigorous and demanding to create an effective and enjoyable engineering work environment for all.
**Chad.** Chad began his career as an electro-mechanic at a petroleum company in Africa. He saw engineering as a way to improve his family’s financial status. At a later age, he applied to an American immigration program called Diversity. After some time, he came to the United States and pursued his degree in civil engineering as a part-time student at Wake Tech. He is a full-time employee of a Raleigh engineering firm and is currently a senior at NCSU.

A civil engineer at heart, he is eager to be involved in the design, construction, maintenance, and inspection of large infrastructure projects such as highways, railroads, bridges, tunnels, dams, and airports. He repeatedly mentioned that he wasted a lot of time attending CC classes that offered redundant material with which he was familiar. He wished that he better understood the transfer process early on in his educational journey. This knowledge would have given him an advantage in knowing the exact core courses that he should have taken to be able to transfer course credits from Wake Tech CC to NCSU.

His work and family demand a sizable block of his personal time. Thus, he had limited personal time beyond attending lectures and labs. He rarely interacted with professors outside of the classroom. However, he values allocating time for peer study group interactions. He categorized himself as, “excellent in math” and values the engineering degree and professional license to improve his professional opportunities and to set a positive example for his teenage children.

Chad described his overall engineering transfer process as a successful undertaking achievement. Chad experienced membership on NCSU campus:

I feel part of this university community….okay….everything is happening. The labs at NC State make a difference. It makes me feel like I am part of this
community. The difference here than [compared to] back home [in Africa] is the lab. The technology and access here at NC State are much better and more advanced. He views higher education as a long-term investment to achieve a better quality of life for him and his family. When prompted to share his thoughts about black males’ success at the university, he indicated that high school and CC academic preparations shape students’ academic outcomes:

[For] black male students, I think this question is like I said before, the change has to be done before they transfer to NC State. It has to start from way back to their basic levels, like from community college and high school. The problem doesn’t come from NC State. At NC State, you just need to focus and study and you will pass. Even if they [black males] make it into NC State and still have problems in math, I think that they just need to attend support groups to help them with that.

To excel beyond just academics, Chad encourages fellow students to strategically select their social circles very wisely, instructing them to “Choose your friends based on who can help you academically. Even in study groups, you have good people and bad people”. The dichotomy is between people who are focused on their engineering studies and others who are distracted by social engagements. “You have to know the difference between those kinds of people”.

Chad was interviewed on June 27th, 2017 in a conference room on the fourth floor of the James B. Hunt Library at NCSU. He was an effervescent African family man, in his mid-fifties. His optimistic outlook on life was infectious and he was willing to answer all the interview questions with straightforward answers and very little probing. His answers certainly reflected his real-life experiences as a civil engineering undergraduate student and
were accompanied by great cheers and laughter. His examples and answers unquestionably shined a light on and provided a unique perspective about his pathway as an African male engineering transfer student at a PWI.

Charles. Charles had an interesting journey as he pursued his industrial engineering degree. He began his journey at a community college in New York, on an athletic scholarship. His journey changed after a serious knee injury:

I was like let me figure out what I want to do with my life. So I ended up going to UNC-Chapel Hill for a little bit and at that time I was pursuing a medical [degree], trying to get into the medical field. But I didn't really like it at UNC. So I transferred out of UNC and went back to the community college.

Charles’ trajectory began at an out of state community college. He then transferred into UNC-Chapel Hill and later transferred to Durham Tech and Wake Tech. Both CCs were instrumental in his decision to become an engineer. “That's when I found my passion for industrial engineering. Trying to figure out a different way to improve different things within certain process… I found that at Durham Tech and Wake Tech”.

He described his transfer experience as a never-ending journey. He chose an engineering major because he wanted to obtain a degree where he has direct access to the workforce immediately after graduation. His perseverance and strong self-belief uplift him throughout his educational journey. He was one of the few participants who began his college career at a disadvantaged point in his academic preparation. He started with remedial math classes at CC and later excelled in the more advanced math classes, such as calculus. He valued his CC education and knowledge foundation. One of his CC professors was instrumental in shaping his success as an engineering student. His dream is to end
“finessing”, a form of cheating. He wants black males at NCA&T to tap into their full potentials while applying themselves on their engineering pathways. He feels a strong sense of belonging and is empowered by other black students and faculty at the university:

The biggest thing I would say is probably just being around people just like myself. I mean skin-color wise and just, I guess, culture-wise. Definitely; I don’t know how to explain it. But I don’t feel ashamed here and feel a sense of belonging without having to answer questions. Here I feel like I can do it and can’t do it in other places. I feel like I can ask any questions and not be judged based on how I look.

Charles was interviewed on September 25th, 2017 in a conference room on the first floor of F. D. Bluford Library at NCA&T. He was kind, gracious and forthright. Despite a knee injury while playing as an athlete at CC, he remains optimistic. He draws his strength from witnessing his fellow black peers succeed in their engineering academic and professional careers. His answers reflected his perseverance and confidence as a senior with thoughtfulness and great poise. His unique perspective was brought forth through his vivid examples and direct answers. He is a student who began his engineering career at a CC, then transferred into a PWI, followed by two CCs, and then landed at an HBCU.

David. David idolizes his mother and older brother. Both were his biggest motivators and inspired his decision to major in computer science in the college of engineering at NCSU. He was also influenced by technology and has developed his first APP game. He was very expressive in his appreciation of math and advanced technology. He finds it comforting that he excels in mathematics:

I love math! Math is something that I’m really good at. It’s something that is really comforting to know that I’m really good at. I’m in discrete mathematics right now. I
had taken seemingly the most stressful test. There was a huge projector screen in front of us that said 50 minutes and it felt just like it’s glaring down at us [classmates]. [It was] intimidating. Afterward, I felt like I did okay and I was very nervous. But the other day I found out my grade… I ended up getting 107 out of 100, on the test!

His positive self-perception has evolved since transferring into NCSU, “Because beforehand I really had a lot of doubts about actually being accepted into NC State”. David exhibited an analytical mind throughout the interview and made several personal goals for transferring into a four-year engineering institution. “I had a plan A, B, C, when it came to applying to colleges after I have gotten my degree. I ended up applying to NC State and Chapel Hill and I was going to actually apply to ECU if neither of them worked out”. He was accepted into both schools. He decided to attend NCSU since his brother graduated from there.

This young man, early in his engineering transfer journey, expresses some self-doubt in his ability to excel as an engineering student, “I think that at times, I deal with a little bit of an imposter syndrome”. Throughout the interview, he questioned his ability to succeed as an engineering student at NCSU, “Like, am I really here? Why did they choose me? Do I have the skills necessary to succeed?” During the interview, David recollected experiencing an imposter syndrome around campus. This was also evident in his response to what he thinks influences the success of black male engineering students on NC State campus:

There is a period where we can get really discouraged, like during a test. I feel like it would hurt us, even more, to think maybe this is not the right place for us, in general. [Rather this] time [can be viewed as reflection] for personal growth and
betterment for the teacher. I feel that the imposter syndrome comes out more frequently for African Americans in engineering. They [at times] do fall short [in] doing the assignments and always like [to achieve] perfect [grades] in their classes.

He then expressed the awkward feeling of the unknown, “Because, in some of my classes, it can feel like that I might not have learned everything that I could have to be prepared for these classes at the community college”. He recalls a vivid experience in his Java class at NC State:

The equivalent of the first part of the Java class I have already taken at the community college. For the first two weeks, I had a big deal of catching up on what I had as Java background, on what I learned and [was] relearning things for on campus. But, after getting that wonderful grade in discrete math, I feel [a] little more secure about my position here at NC State.

David compared his college transfer process as “playing catch up” in his pre-requisite course requirements. He further explained this as merging the learning tools that he gathered from his CC with the new tools that he needed to become a successful engineering student at NCSU. On campus, “I feel great!” was his enthusiastic reflection. He later elaborated that, “Everybody [students and staff] is so nice and welcoming. I can achieve whatever I want at this point. I worked really hard on things like that here”.

Interestingly, he discussed how he lacked a strong sense of belonging or an experience of exclusion and described himself as an outsider. Human connection is a fundamental belief that gives individuals meaning and purpose to their lives. The ability to feel connected is how humans are neurobiologically wired. This sense of disconnection and isolation was clearly experienced when he joined a PWI fraternity and believes that it is due
to both his transfer background and his race:

The first meeting that they [fraternity brothers] did, it didn’t come to my surprise, but I was the only black person in the room. They were extremely friendly and made sure to always email me all the events and invited me out to lunch. I talked to the people who had interviewed me and asked me why did you need to join this group. They possibly were very friendly because I was black and they wanted to have me in the organization so that they can have me because it [the fraternity] isn’t that diverse at all. And it makes me feel like an outsider, just a little bit. That and being combined as a transfer student, which most of them have been at NC State the whole time here. [It] does make me feel a little bit at odds at times.

David was interviewed on September 23rd, 2017 in a conference room on the fourth floor of the James B. Hunt Library at NCSU. He was the youngest participant in this study. He looked up to his mother and older brother in pursuing a career in computer science at the college of engineering. Despite his initial rejection into the NCSU program, he re-applied as a transfer student from CC and got in with flying colors.

Expressing his talent in culinary arts and gaming, he answered all the interview questions with ease and with a bright smile on his face. Thus, the interview was lively and enjoyable. His answers conveyed his novice-like experiences about his program and classmates, but he was specific and candid about the time demands of the course load. A well-rounded life of academics and social pursuits at a PWI were the constellations by which he navigated. He attended to all interview questions in relations to his personal philosophy and ambitions.
Jay. Jay grew up tinkering with electronic devices such as a mini keyboard and cherished taking the piano apart and putting it back together. He was fascinated with how the different keys operated and how sound was produced from the piano via the mini keyboard. His tinkering continued into high school and was shared by a community of other black male friends who were also interested in engineering:

We’re going into engineering, everyone is going. I wanted to be on the bandwagon. I really didn’t have a passion for it. I just wanted to just follow them [his friends] honestly. Later on down the road, it seems though I stayed [in engineering] and everyone that said that they were going, they all left and went to different majors. I stayed and I just don’t know why. I honestly had that drive. Engineering is one of those successful careers, and I just wanted to pursue it.

It took a critical incident in his life to make engineering “more passionate to me.” Jay’s father died while he was at school. His father’s passing helped Jay focus on his professional career and decide on “what type of engineering that I wanted to do”. He decided to major in electrical engineering. He has been involved in two years of undergraduate research experiences at NCSU. “I definitely want to continue that in my career in graduate school” and to focus on biomedical applications in the nanotechnology research area.

Jay confessed that he lacked motivation in middle and high school and was unable to foresee his future self. “I wasn’t using my full potential”, especially in his math classes. He recalled failing geometry during his sophomore year, “It came down to just the effort. I was putting more time into gaming and [spent] 15 minutes [on] homework [assignments]”.

With his mother at his side, he reattempted geometry and passed with a B grade, “My mom
knocked me on the noggin, [and she said] alright [it is] time to do something about it [working harder on his math education]”.

In some of his NCSU engineering classes, Jay expressed frustration and alienation from select students. On the other hand, he experienced positive collaboration and support from other students. Furthermore, Jay also contributed to the success of his peers by engaging in study groups:

There are some days where I feel like I just don’t belong! Where you sit next to a student who literally knows everything. How are you taking this class [chuckle] and you [seem to] know [all of the concepts?] I just felt belittled when you have students like that in the class. But, the good thing about that, usually is that means they are not antisocial and they are there to help you. You just find time. They will make you understand what’s going on. I’ve been that student in other classes. I’ve been one of those [who know]. But there are other classes where this guy knows everything. You definitely got to ask them questions about it.

During his academic journey at NCSU, he learned valuable lessons from his failures which helped him persevere. An example of how he faced extreme responses, which seemed like a cultural mismatch, was when he accidentally left chemicals on the floor of his research group clean room:

[I just found] out that I did get a 40 on that [math] exam [which] put me back in terms of always thinking [about failing that test] for the next three days. When I went to the clean room, my mind wasn’t there. I left dangerous chemical acids on the floor when I was refilling something, no one got hurt for sure. They [the engineering department] gave me a warning, you are expelled for 30 days. I understand things
happen. But on top of that, I’ve also learned how to word email. Because I responded in a certain tone [and] the dean saw it as though it was negative because everyone was CC’d on the email. And I responded and then the dean just slammed me. That’s another big lesson [chuckle].

Later in the interview, he discussed the collaboration model among students as a tool to overcome external barriers that he faced during his educational journey:

Time management, I was always good about that. So no problem here. The two people that were with me at Wake Tech that are here as well, they literally trained me. First, I wasn’t that good at studying, I really just didn’t care. But seeing them, improving their studies and how it improved their grades, I [told myself that I] got to reach higher. As they [reached] higher, I got higher. So we improved each other.

The metaphor that he used as an engineering transfer student was, “Going from coach into a first class”. He also expressed a big improvement in the knowledge of professors from CC to NCSU, “There seem to be good professors at CCs, but there are wonderful professors here at NC State that can actually answer the questions. They’ve been in the field, and they know what they’re doing.” The faculty was not just supportive in terms of academics; Jay shared an intimate moment that he has shared with his research professor at NCSU:

Definitely, the faculty, they looked out when I had it rough. I honestly, didn’t have enough for rent sometimes. I asked one of the research advisors if they could help me and they did give the time and gave me an RA position as an undergraduate to assist the struggles that I was having at the time. And I won’t forget it.

In addition to faculty support, Jay admires the university’s large population and state-of-the-art libraries, “The library, a common ground for everyone to meet. I like the resources
it has. We are able to check out cameras”. He was grateful for his ability to have access to many equipment and resources that were made available to him and his fellow peers throughout the university campus.

Jay was interviewed on September 15\textsuperscript{th}, 2017 in a conference room on the fourth floor of the James B. Hunt Library at NCSU. A genuine individual and a senior, he shared his seasoned experiences in his answers to all the interview questions. His examples and answers delivered a unique perspective as a black male electrical engineering transfer student at NCSU. In the fall of 2018, he plans to pursue a graduate degree with a focus on nanotechnology in the biomedical and electrical engineering fields at John Hopkins University.

**Jeff.** A U.S. Army veteran, Jeff is now a mechanical engineering student at NCSU. He found his passion for engineering design in his 20’s while diagnosing and operating an F-18’s as a mechanic in the Marines. He expressed fascination with improving the design of machinery and systems and possesses the skills to problem-solve and to repair mechanical problems:

I can remember working under an F-18, working with its parts and seriously questioning the wisdom of the engineer that designed the system. I could’ve done a lot better. Why is this like this? I understand and know enough to know that issues like time and money were factors that go into designing systems. And I felt like that some of it could’ve been done better.

He expressed a great desire to become a successful mechanical engineer where he can design, manufacture, inspect and maintain machinery, equipment, and components as well as control systems and instruments for monitoring their status and performance. He described
his interactions with engineers in the Marines as “magical”. He admired the engineers and aspired to become one of them:

Part of my job was working hand in hand with engineers. I got to talk to them. I got to know them. I got to know what their jobs entailed. What it meant to be an engineer. I admired all of them because they filled a role that to me was kind of magical.

Jeff continued to elaborate on the type of work that engineers are involved with, “You look at a bridge and you just see a bridge. But you never really think about all the little things that went into designing that bridge and making it stable and safe enough for use by the public”. Jeff is mindful of bridges and the process of building them. Bridges are made to walk on and to endure stress. “To me [it] was a little bit of a magical process, because the average person doesn’t get to see the in’s and out’s... you just see the end product”. He is optimistic in his views of engineering and engineers:

I believe that engineers are special. That they fill a unique role. And that primary purpose is to make the lives of their fellow man better. And to do so in such a way that requires the utmost integrity and goodwill. Like you can’t cut corners. You can’t cheat. I mean and sometimes your only purpose is to make somebody else comfortable.

He had positive journeys both at the CC and NCSU. “My academic experiences were very positive. Especially coming from the community college”. His CC journey launched at Wake Technical. Jeff was very impressed with the faculty and staff. “They’re very good. I didn’t have any or hardly any negative experiences”. As a student at the CC, he “excelled in all of [his] courses” and he interacted with “really good instructors and staff”. When asked
to elaborate on what he meant about “the staff”, he explained:

Because it was a smaller institution, the staff was able to give you time and attention. Instructors and academic advisors [at Wake Tech] had time to give to us [students]. If they presented material in a way that I struggled with, I was always able to seek out that individual afterward for hours [at a time]. They [the CC instructors] were available and approachable.

He later described his social engagements at the CC as a mentor who encouraged younger students to excel in their academic and social journeys “I did participate in the male mentoring program, 3MP”. He continued “[I] really didn’t need anything. A lot had to do with my age and experience. I’m not a high school kid. I am in my thirties and spent a decade in the Marine Corps”. In other words, he did not see the value in mentorship for himself, instead, he mentored other “younger students”. Jeff is an individual who found time in his busy life schedule to help others while excelling in his academics. He stated that he has:

A strong interest in helping other students succeed in their [CC academic] journeys. And socially, I mean I didn’t really have a problem. I just didn’t have time for it. For the most part, I studied alone. I did try study groups a couple of times, but my grades suffered. Well, I just had more drive than most of them. From my experience, a lot of the kids were only there because they felt that they had to be there. Not many of them were there because they wanted to be there. It was more like a stepping stone for them to get to the next level.

Jeff consistently expressed his struggle with grasping difficult engineering concepts, especially theoretical material and wished that NCSU had a STEM learning center similar to
Wake Tech’s to support students with their advanced courses:

I feel that they [engineering concepts] are very difficult. I want to say the math makes them difficult. Because it’s very math heavy. I expected that to a certain extent. I also expected that I wouldn’t have as much of a difficult time as I’m having grasping some of it. Some of the concepts are more theoretical.

Despite his struggle with grasping difficult engineering concepts, he expressed gratitude towards his educational opportunity at NCSU. He is proud and inspired to complete his engineering degree. His biggest motivators are his wife and two daughters. Despite his daily long commute, he spends countless hours on campus attending classes, engaging in labs, and working on his assignments.

Jeff was interviewed on October 18th, 2017 in a conference room on the fourth floor of the James B. Hunt Library at NCSU. A military veteran, he was open to discuss his frustrations and struggles that he faced while pursuing his mechanical engineering degree at NCSU. He answered all the interview questions with a sense of hesitation at first, but with probing became at ease in discussing his concerns. His answers reflected his seniority level with a matured perspective. He offered a cordial description that echoed with his personal positions, engineering experiences, and his own outlook as a black male engineering transfer student, who continues to question his sense of belonging at this PWI.

Mark. Mark was the only participant who was homeschooled during his K-12 years by both parents. His father is a respiratory therapist and was influential in breathing life into his son’s math education. He applied visual graphs to demonstrate difficult mathematical constructs during his son’s high school years. Mark was also surrounded by his paternal uncles who were electrical and chemical engineers. He was self-confident and fell in love
with technology as a high school student, which influenced his decision to become a computer engineer. Mark gained a strong mathematical foundation from Wake Tech that was crucial to his success in engineering courses at NCSU.

He grew up yearning to attend Georgia Tech. However, his low scores on the Standardized Assessment Test (SAT) posed an external barrier while applying for the engineering program. He stated, “I was horrible at taking the SATs. And every time [I took them,] it didn’t matter what I did, [I still scored low]. So that was kinda a huge barrier and first of all getting into the university, that’s kinda why I wound up at Wake Tech.”

He described his transfer journey to NCSU as being part of a smaller family, where transfer students found each other and worked collaboratively with one another. He enjoyed more independence from his family and relied on his CC transfer classmates for support. “They definitely help each other and that made the experience more enjoyable and easier than trying to start a new group with people who are already started at NCSU from the beginning”. As an NCSU student, he expressed a strong sense of belonging and felt “in a way confident and supported”. He raved about the great support system that is available to students on campus as one of the biggest reasons for his own confidence in getting through the engineering program. He also believed that a great support system has an enormous influence on the success of other black male engineering students:

I’d probably say the same thing that helped me… having a good support system. That’s something that a lot of us talk about since we’ve been here at NC State. It’s been a great support system! I haven’t really tapped into any resources for black engineers like NSBE. No, I really haven’t gotten involved in that.

His optimistic view of the engineering field as, “essential and very necessary to
improve life”, influences his dream of leaving his own, “thumbprint in engineering to improve access in third world countries to have the same technology that we have here in the United States.”

He described his professors at NCSU as supportive, relatable, and approachable. He believes that a strong presence of black male leaders is important to empower, inspire and encourage black male students throughout their engineering transfer experiences and four-year institutional journeys.

Mark was interviewed on June 19th, 2017 in a conference room on the fourth floor of the James B. Hunt Library at NCSU. He is a goal-oriented individual with a strong focus on pursuing his degree in engineering. He was willing to respond to all the interview questions with straightforward answers and with very little probing. As a senior engineering student, his seasoned responses illustrated another individual perspective about his cognitive knowledge as a black male engineering transfer student at an NCSU.

**Matt.** Matt knew as a child that he wanted to become an electrical engineer. “I opened up a computer one time and I just saw the components and was like, how are these wires and all of these little chips working together to make the computer work?” His innate curiosity for how electronics and computers function and love of tinkering ignited his interest in engineering.

Throughout the interview, he expressed that there was an increase in rigor and the amount of time he currently spends completing his engineering course assignments in comparison to his time at Wake Tech:

I got this. I mean more time is dedicated to work. At Wake Tech, I had the luxury of enjoying my weekends, and not really having to worry about work. [I] come here and
then [I have to] work, work, and work. [I] work on the weekend and stay late at the library, which is stuff that I never did at Wake Tech. I normally would get out of work, quit and then I wouldn’t have to worry about it [working on school assignments]. But here, I have to work until 10 or 11 [PM] some nights.

The researcher asked Matt to verbalize how he felt about himself as an engineering transfer student. His description of this transition was compared to someone who has transitioned from high school and into college:

[In] high school, most people don’t take things really seriously. I didn’t and you kind of do your own thing. And [in] college, that’s when people really start to bunker down. It requires more work to do well [in college]. That’s how Wake Tech versus here was like. I didn’t really have to apply myself too much at Wake Tech. I didn’t have to dedicate as much time to studying. I looked over my notes a little bit and might [have] read the book a little bit. But I didn’t do a lot like right now. Now, we [Matt and his classmates] work [on] homework problems. I got to crack the book [open], read a chapter and I should do well on the test, and that in itself is stressful. At Wake Tech, I didn’t really feel as pressured as I do feel here.

As an NCSU student, Matt was “challenged” by the harder classes and increased course load. “I definitely had to step up and really apply myself, focus and work hard”. According to Matt, the two important aspects that influence his success as an engineering student were collaboration with his peers and the combination of increased rigor and management of challenging assignments. The study groups he was involved in began as strictly transfer students and later evolved into both transfer and non-transfer engineering students. “It’s all connected and you have to work as a team [with fellow students],
absolutely.” He unquestionably valued collaborative learning and peer engagement in order to understand difficult engineering concepts and to pass his class load. When prompted about his thoughts about what influences the success of black male engineering students at the university, he was quick to state that:

Some of it is just personal. You [must] have that drive and the will to want to succeed, do well, and make your mark. Another part of it is having a support group like NSBE and being part of a group, where you see a lot of people like you and are successful and doing well. You look at that and you want to also mimic it [the behavior of being successful]. So [by] just seeing someone like you do good makes you also want to do good as well.

Matt believes that in addition to the availability of strong black mentors, supportive family members instrumentally influence the success of black male students:

As far as black males dropping out [of school], that part has a lot to do with their family. Because you know in my situation, I didn’t have too many successful black males around me, so I took on that role that I need to be the first. And some black males may not have that same thought or drive as me. I feel like the family is a big part of it. You know, they don’t see everyone around them successful, like strong dad or strong granddad or uncle or something like that, brother. Then they probably just won’t be as motivated to continue [with their higher education]. If your father has like a Ph.D., then there is a good chance that you also want at least to go to college and complete that! But, if you have a father who dropped out, then you’re probably not going to be as inclined or want to complete your education.

Matt was interviewed on September 15th, 2017 in a conference room on the fourth
floor of the James B. Hunt Library at NCSU. A tinkerer at heart, he disassembled a computer at a young age and was fascinated with its electrical components. With a supportive and proud family, he excelled during his years at CC and university, as a computer science major in the college of engineering.

He viewed engineering as a large field with many facets and applications to improve society and the well-being of all citizens. He was a talkative individual and answered the interview questions with ease. His intrinsic motivation and lifelong learner qualities as an undergraduate engineering student were prevalent in his examples. They provided a distinctive perspective about his cognitive knowledge development and application as a black male engineering transfer student at a PWI.

**Nelson.** Characterizing himself as shy and a consumer electronics admirer, Nelson is a tall, slim young man who exhibits a cool, quiet demeanor. From the onset of the interview, he exuded a passion towards computer science and electronics and has a smile that is heartfelt.

Nelson portrayed himself as a self-directed learner who openly admitted to experiencing intimidation on numerous occasions and shutting down during his collegiate engineering and math classes. He expressed frustrations with mastering software programming concepts and navigating the social structures and expectations inherent to an engineering setting. His introverted personality naturally isolated him from others. His demeanor genuinely conveyed his desire to excel in computation and advancement in technology. He expressed his passion for computer science and engineering early on. He credited his father, an electronics technician, for igniting his desire in learning mathematics at an early age and introducing him to computers.
A critical event in Nelson’s journey negatively resonated with him, influencing his self-perception in his ability to become a successful computer scientist and engineer. He was rejected by the NCSU college of engineering in the computer science program as a rising freshman and had to begin his academic pursuit at the CC. Even though he was eventually accepted, the experience affected his confidence and performance as a transfer student:

Everyone that I knew was very shocked that I didn’t get in. I was sad because I think it was just my SAT/ACT scores. I tried to come to State as a freshman and didn’t get in. My scores weren’t as good as those who applied that year. So, I took that year at Central and Durham Tech [the] summer of last year.

Later during the interview, he expressed how his attitude as an engineering student remained defeated in comparison to other engineering students on campus, “I feel pretty average. Everyone seems to know what they’re doing. I don’t feel that much different [than the CC and] my attitude hasn’t changed”. He then rationalized feeling this way. “I feel like I belong a little bit, but not that much. I do feel a little out of place. Not sure if it’s because I wasn’t here the first year or because I feel a little intimidated”.

He later expressed how he viewed himself as an engineering CC transfer student. “It feels like I’m cheating. I just took those core courses at community college and came here”. He continued with a sense of belonging and feeling “at home” on NCSU campus because he was acquainted with students already in his program. He also credited it to the abundance of resources that NCSU offers to its engineering students in comparison to Durham Tech and North Carolina Central University, the two institutions that he attended simultaneously for a year prior to transferring.

When asked his opinion about assisting black male engineering students on campus,
he was unsure at first. However, as indicated in his response, he had thought about this prior to this interview. He remained silent and then stated, “I don’t know if there is anything that would change that would only impact black male students”. Then he gave a very powerful statement, “I would change history” about racism and its existence within lower income communities:

May be it’s because of how history was. I recently learned that they [government officials] wouldn’t allow certain races to buy certain houses, even if they could move into certain neighborhoods. Those who were in poor neighborhoods had to choose the worst schools, which meant they got the worst education. Since they had a bad start may be that impacted how they learned when they got into a good school. I would change history, so that they have the opportunity from the get-go, rather than changing anything at NC State.

Nelson questioned his ability and knowledge as a transfer engineering student. When internships and co-ops were mentioned during the interview as a means of discovering and learning about computer programming, he was quick to respond:

I’m mostly worried about the knowledge that I need to know to get the internship. That’s what I am the most scared of if I actually go into an internship. Since, I have dropped that class [Java software programming], I don’t know how I can get internships for this summer or next year.

Nelson was interviewed on October 11th, 2017 in a conference room on the fourth floor of the James B. Hunt Library at NCSU. He is another computer science student who was indirectly influenced by his father, an electronics technician. He has been interested in consumer electronics such as smartphones from a very young age and has also played
videogames since the age of ten. He was timid at first and shared few words but with the right amount of probing was able to express his thoughts and his engineering transfer narrative. His answers reflected his analytical mind and the unique lens through which he views the world. His examples and answers conveyed a luminous perspective about his personal drive towards improvement and growth in his abilities as a black male engineering transfer student at a PWI.

**Sega.** An athletically built and tall young man, Sega had a studious presence and an outspoken personality when first met. With his long hair pulled up in a bun, his sporty visor and glasses matched his self-directed learner’s persona and insightfulness. He began his engineering education journey at a PWI. However, his dream of becoming the first in his family to earn an engineering degree from a PWI was shattered a year into it when he had to attend to financial struggles in Greensboro, NC.

When prompted about his pursuit in aerospace engineering, Sega was quick to state that he was an advanced video game player since elementary school. His countless hours of playing inspired him to pursue his engineering passion, based on a favorite character with jet propulsion air skates called Sonic the Hedgehog. The concept of Sonic’s air shoes inspired him and ignited his curiosity about aerospace engineering. “How great would that be to actually build or develop… in today’s society. I’ve always been fascinated with futuristic appeal with space exploration”.

Shortly after his return to Greensboro, Sega restarted his career in engineering at a local CC. He described his CC journey as, “A step down from attending a PWI”. To cope with his disappointment, he expressed no attachment to CC and socially excluded himself. Throughout his educational journey at NCA&T, he focused only on his academic
work, a tunnel vision mentality, until his junior year in engineering:

My mindset [or academic tunnel vision] definitely evolved especially during my junior and senior years. I saw the errors of my ways. Because what happened, especially when you try to do everything yourself as a transfer student, you don’t allocate all of the resources that you have point blank, you run thin and burn out.

In addition to attempting to move his engineering journey along, Sega experienced miscommunications while interacting with his chairperson and transfer officer. “I didn’t really communicate with [his academic] advisement. The person who was in charge of the transfer students was not, never really there…he was very unapproachable… that’s… how I felt”. He continued to describe the transfer administrator as “very cold and logical, with no emotion”. He attempted to visit him in person at his office and knocked on his door. “What do you want? Don’t come in here if you can’t figure it out [chuckling] with stupid questions” was the typical response that Sega received and continued to describe him as a “very abrasive” administrator. Sega’s transfer journey was a process where “in the beginning”, he required “a little bit of hand-holding”. However, his negative and positive interactions with professors and peers shaped his social and academic experiences and made him “independent… I did learn from that and I did grow from that”.

This articulate young man was at ease expressing himself in the 100-minute interview. As an aerospace engineer in the making, he will, in my opinion, go far in the design, manufacture, and testing of aircraft and spacecraft. When pressed about how he defined the idea of becoming an aerospace engineer, he responded:

I didn’t like history and I was good at writing, but I hated the whole idea of being under a time constraint and having to turn in papers. The creative flow or the creative
process in terms of writing was a struggle for me, because when that pressure comes in. But I’ve been told [by students and instructors] that I am a pretty good writer. But I’ve always had a niche for the math and sciences. My father’s side was more about the English and literature side. My mother’s side was more about the mathematics and seeing tangible things with numbers.

When further asked about his mother’s influence on his decision to be an engineer, he confirmed it, “Definitely… Definitely… Between her being a technician operator and having the dynamics with RF engineers”. Then he proceeded to acknowledge the culture he grew up in and how it shaped his decision in becoming an engineer:

I don’t know if this is biased, even if in black communities… When you find certain individuals that do well in math and go off and excel… You do want to cultivate and nurture them into those avenues. I think that’s what my mother re-enforced in me. It’s not like engineering is something for me. Things just started to fall into place… I like games… I found out that I like certain concepts. How do I make that a reality? And the easiest avenue [chuckling]…It can be very emotional when you start to un hinge about the things that you perceive about yourself and about your community. Do you have the capacity to be different? Do you have the capacity to withstand or to change something? It’s a lot of pressure on me to be different.

Becoming an engineer for Sega means more than just a career opportunity; it has a deeper meaning to him, his family, and his community. He was pressured to succeed in engineering as a young black male. He then expressed that he abandoned his dream of becoming an actor to pursue his engineering degree. When congratulated for his accomplishment in making it through engineering, he responded:
Thank you, thank you. That is the hard truth right there! I stuck around because I thought it was the only thing that I can do. It was my last chance and last effort. I couldn’t see myself struggle as an actor, or in sports, or all of the other stereotypes. I didn’t care for writing. Music was alright with me. But I just liked the fact that I was alright in the math and science department. And the fact that I was cultivated to put more emphasis on that during my middle school years and my high school years.

Sega continued to rationalize his decision about majoring in engineering, “It just started to make sense that this is the better option for me”. He viewed earning a degree in engineering and working in the field as a way to improve his family’s financial stance, “This pressure can sometimes be a burden”. He further explained that this pressure is created when individuals “have other aspirations and desires” than just engineering:

In my perspectives, I had to forgo some of the other things that I might have wanted to try out like acting. I watch horror movies, sci-fi movies. Alien is my ultimate favorite, with Sigourney Weaver, that’s my favorite. I always wanted to put myself on some kind of a movie poster, where I am playing an intense role. That would not be really my reality. The only safeguard that I have is to stick with engineering. I do have a passion and I do have a love for it. But there is also a fine line that needs to be drawn. And it has to start with the individuals themselves. They have to realize that I am doing this because somebody asked me to? Or am I doing this because I want to? It takes time. It’s not a quick decision.

In addition to the pressure and the expectation from friends and family to academically excel in his engineering education, Sega faced challenges during the transfer experience process:
Going back and forth with the administration and faculty [at CC and] trying to figure out classes and tuitions. There was a lot of mind games to be played and lots of ambiguity. That’s not really good for a student who’s just trying to get back into school [and] academic life. [I was] feeling like it’s a setback. It doesn’t inspire you… again, this is my own personal experience.

Sega discussed the “tunnel vision” that transfer students experience when they are faced with “all these setbacks” with the transfer process. “When I came into A&T, I also came in with this sense of indifference. I need to get my degree and get out”. He carried this “tunnel vision” mentality into NCA&T and only focused on his academic performance:

I didn’t want to really foster friendships or anything that would hold me back. To be honest my grades were very good when I first came here. And I was just about [doing] my business. I wasn’t doing extra talking to my instructors… I definitely did at first. Having those kinds of friendship dynamics, especially if they were not in engineering, I dealt with that in high school. At my first year at PWI, I latched on to the group of black people at the PWI and stuck with them, and none of them were engineers. They were all arts students. It seemed that all of my friends are artistically inclined. I really don’t have a lot of engineering inclined friends.

This accomplished young man compared his experience as an engineering CC transfer student to a flashlight in the dark and navigating his way out:

The battery is dying and you are just trying to get to point B. And your flashlight battery is dying, you have that yellowish/whitish hue. When you first had it on, you had your drive on, you had your energy, and as things started to come to a place, it just started to dim, and you become lost, lost, just lost.
When asked about what influences the success of black male engineering students at NCA&T campus, Sega honestly stated that many students enter the engineering profession lacking the passion. Instead, they are interested in the financial stability that it presents for them:

A lot of people become lost in the sauce, especially the graduate students that I know. It’s just like, they start engineering because they want to get out of their financial situation and to provide for their family in the future. My friend definitely has a passion for music. It’s not always about just being an engineer. If you’re going to do it… if you might not be the most passionate about it, then [you need to] know how to utilize it! Know where it [engineering] can take you. Not like using engineering as a stepping stone, but as a secondary option. Just so you are more stable financially!

You can definitely foster your passion in music [while pursuing a career in engineering].

Sega continued his train of thought about the engineering journeys many students adventure into when they first enter the engineering program and only focus on their academics. However, as they mature in their journeys, then they become more aware of their passions and become self-aware of their identities:

There are many people that are all about engineering. But the people that decided to stick with the engineering track because of other reasons such as financial obligations towards family, that’s primarily what it is, then [I encourage them to] know how to use engineering [while pursuing their passions outside of engineering]. And let it [engineering] take you to where it needs to take you.

Sega was interviewed on April 7th, 2017 in a conference room on the second floor of
F. D. Bluford Library at NCA&T. He was a talkative person and eagerly willing to answer all the interview questions with straightforward answers and with very little probing. His answers reflected his maturity level as a senior engineering student with thoughtfulness and great poise; his examples and answers offered an ordinary viewpoint about his engineering pursuit as an black male attending an HBCU.

Stormy. A cheerful, outgoing young man, Stormy is an electrical engineering and computer science major at NCSU. A hands-on learner who enjoys tangible activities, he recalled the critical incident that framed his decision to become an engineering student. Stormy attended a summer engineering camp after high school that was held at John Hopkins University in Maryland. He expressed the amount of studying and conducting research that he and other participants had to undertake:

It was this little project that we did during the camp. I had to work with two other people and we had a breadboard. We had to pretty much design this small circuit that would sense a flashlight. And as soon as the sensors sensed the flashlight, its two wheels would start moving. It was a light sensor that worked with motor wheels that caused the motion. It was an interesting project, even though we had to do a lot of research and studying to complete it. But that was the incident that really shaped my decision in becoming an engineering major.

Stormy appreciates the education that NCSU provides and expresses the level of rigor necessary to succeed as an engineering student:

I spend most of my time here studying. I study a lot more than I did at the community college. Not that I’m saying that I was slacking off at the community college. It just the course load now is much more difficult, especially that I’m taking
the majority of the engineering courses.

Stormy spent the majority of his first year on campus studying and focusing on his academic performance. He stated that he did not have any time to be involved in extracurricular activities and he “was trying to get adjusted to the course load here at State. It is really challenging and is vastly different than it was at the community college”.

His positive attitude around NC State campus was eloquently and candidly illustrated with, “I love it”. Stormy then continued to describe his academic journey as an engineering student. “It took me a while to really appreciate the education that I get from here because it’s been challenging”. He expressed how “important [it is] to balance out [his] school work otherwise [he] gets burnt out”. He explains that he has been trying “to stay on top of studies while at the same time trying to do that extra curriculum [activities]. It’s still challenging… how to study and how to manage… time”.

When prompted to discuss what defines him as a transfer student in the engineering program at NCSU, he offered a heartfelt description that resonated with his personal beliefs, current academic and social development, and his own expectations. With thoughtfulness and a sincere intent to share his story, he continued by describing his definition:

It’s like a student going from high school to a university. The reason is that community college is not as challenging [course wise] compared to most four-year universities, specifically NC State. High school was a bit easier than community college. Community college is still easier [than NCSU] but a little harder than high school. And now at the four-year university, I have only to take engineering courses. It is completely different and more challenging than it was at community college.

On campus, he expressed determination. He quietly responded with hesitance at first,
but later blossomed with perseverance and inspiration to finish his degree, displaying strength found during the challenges he faced while attending engineering classes and completing difficult assignments:

I guess I feel determined because all of the hard and challenging courses that I’ve taken at NC State [laughing out loud], I had to go outside of my comfort zone and push myself just to get through each course. No matter how challenging, they were, I was able to get through them to get to this point. So now I am in the final stretch, no matter how challenging my course load may get, I am going to get through it.

He spent three years at CC and another three years at NCSU. His social circle at CC mainly consisted of friendships established through his participation in the basketball team as the mascot, Stormy. His mother influenced his decision in majoring in engineering by enrolling him in a one-month engineering summer camp at John Hopkins soon after graduating from high school. This camp is where Stormy uncovered his passion for electrical and computer devices. The hands-on projects that he was involved in ignited his interest in technology and made his decision an easy transition into engineering studies.

Stormy was interviewed on August 29th, 2017 in a conference room on the fourth floor of James B. Hunt Library at NCSU. Interested in sustainable energy and positively shaping society with his dual degree in computer science and electrical engineering, Stormy was eager to share his story. He carefully and methodically responded to every interview question with very little probing. He spoke with ease and clarity, his answers reflecting his maturity level as a senior. His examples and answers illustrated his ambition and perseverance as a black male engineering transfer student at a PWI.
Sully. Sully was a tinkerer at heart, timid, and shy in personality. He was originally from Africa. Exuding a self-assured air, he is fascinated with technology advancements. He arrived at the interview offering concise and brief answers to the prompted interview questions. He was quick to articulate his career goal of designing and creating innovative technologies as a computer engineer.

While attending Wake Tech Community College, he spent countless hours in remedial math classes. Sully expressed his frustration with these developmental courses that offered much redundant information and minimal value to his computer engineering education:

I started with developmental and remedial math and they were a waste of time! It was a waste of time to take these classes because I knew the stuff in them. The first math class was in class and the second one was mostly on the computer but it was instructor guided. I felt that I already knew the subject and didn’t need to be in that class.

When prompted about taking a placement math test in the beginning of his CC career, he expressed the frustration with the test and its outcome. “Yes, I took it. Basically, I just got bored taking the test and didn’t answer the rest of the questions”. This cost him a great deal of time at the CC, where he was then required to take two remedial classes. Once he completed his developmental class requirements, he took pre-calculus, calculus, differential equations, and linear algebra classes at Wake Tech. “I actually struggled with the math classes. I took pre-calc II twice. And then calc. II twice [silence]”.

Sully did not take any math or physics classes at NCA&T. The closest to math classes he took were his engineering courses, which included numerous mathematical
concepts and formulas. Throughout the interview, Sully expressed the intensity of his engineering courses and how they required numerous mathematical concepts that he was not expecting at first, as a computer science major. He also expressed a sense of alienation and exclusion at the community college. He was the only black male student in his computer engineering courses at Wake Tech and made a distinct comparison between the professors here and at the university:

I’d say the professors. Yeah, at Wake Tech, they have more time for you. Here, I think that they care a little bit less. They are a bit tougher on the students here.

A soccer substitute player was the metaphor that he chose to describe his overall engineering CC transfer experience. He then proceeded to ask the interviewer, “Do you watch any sports like soccer? During the game, you substitute players”. He further explained his analogy to represent students who begin their educational journey at the four-year institution as the startup players in a game and the ones that transfer as the substitute players:

The people here, they’ve already been here, and they were already used to the system [social and academic process]. I had to learn to do things the way they do it here. Learning my way around the systems here and the way to get things done.

When asked to complete a sentence about how his self-perception as an NCA&T student on campus, he promptly responded, “I feel like I am part of something and a sense of belonging”. He continued to explain that at Wake Tech, “there were very few black people and there was a lot of stereotyping”. However, now at NCA&T, “I see a lot of smart black people that look like me”.

Sully was interviewed on April 22nd, 2017 in a conference room on the second floor
of F. D. Bluford Library at NCA&T. When asked about his pursuit in engineering, he concisely answered with a grin, “every time something broke in my house, I just wanted to fix it. And I love fixing things so it squared into engineering.” His answers to the interview questions were brief at first. However, with probing questions, he provided deeper responses to thought-provoking questions. His answers certainly reflected his maturity level as a senior undergraduate engineering student. He was thoughtful and passionate about innovation; his examples and answers demonstrated a unique perspective and delineated expectations of peers to act professionally and pull their weight academically and socially at an HBCU.

**Overview of Study Design**

This narrative study represents the experiences of thirteen black engineering male students who have transferred from CCs into four-year engineering institutions in the southeast region of the U.S. The purpose of this research study was to explore how racial and mathematical identities influenced black male students’ academic and social experiences post-community college transfer.

This scholarship gets us closer to inspiring our current engineering transfer students and permits the space to celebrate their academic accomplishments and the extraordinary research that they are currently conducting. These aspiring engineers will continue to use their education to excel in STEM professions.

The narrative text was interpreted and analyzed with the constant comparative method (Glaser & Strauss, 1967). Then, the researcher deconstructed and reassembled the thirteen interviews collected from the primary data source, utilizing participants’ narratives to define categorical themes. Eventually, all data sources combined during this data analysis process, including researcher observations, field notes, document analysis (engineering
transfer guide), and researcher memos, were used to fully explore the social and academic experiences of black male engineering students who transferred from CCs into four-year institutions. Table 3 presents a concise summary of the findings for each research question. Followed by detailed explanation and support for the categorical themes from narrative texts.

Table 3

Data Display/Summary of Findings from Interviews

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Table 3 continued

| iii. Serving dualistic purposes | iv. Technically challenging and only for elitists |

RQ3: Racial and mathematical identities shaping the transfer experiences of black engineering students

a. Racial identity development.
   i. Perceiving other students’ performance and success
   ii. Improving black male engineering students’ experiences

b. Developing engineering identity.
   i. A sense of belonging
   ii. Out of place/Outsider
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   iv. Intrinsically motivated and empowered
   v. Overcoming external barriers

c. Middle and High School Academic experiences in math

d. Post-Secondary Academic experiences in math and engineering

Defining the Engineering Transfer Journey of Black Male Students

In addressing the first research question, interview data were collected around the transfer processes that black male engineering students utilize. Since the interview process was semi-structured, discussion of developing an evolving process revealed five themes that the students correlate to their transfer journeys: 1) navigating the transfer process, 2) learning complex coursework, 3) experiencing positive reactions from social circles since transferring, 4) becoming an engineering student, and 5) making dreams possible and improving the success rate in engineering.

Navigating the transfer process. Through this semi-structured interview data collection method, many of the participants shared their transfer experience processes. The sub-themes that emerged while navigating the transfer process were: 1) meeting a set GPA threshold and passing core courses at the community college, 2) engaging with an academic advisor at community colleges and/or a university transfer administrator, 3) consulting with engineering students, and 4) utilizing university websites for transferring application
Meeting GPA and core courses requirements. Many of the study participants identified two concrete requirements that they understood to be crucial in the transfer process. The first requirement was meeting the minimum GPA for CC students to transfer. The second requirement was completing a set of core courses at the CC to apply for their transfer process. Jay and Matt both presented this process in a methodical and clear manner.

Jay, an NCSU student, stated during the interview that “the process of transferring was clear and simple! If you have 3.5 [GPA] or above, you are in the clear… You needed to be a well-rounded student… it was very obvious and that’s what you needed”. Additionally, Jay expressed understanding of the requirements for CC core classes for engineering majors to transfer. “You have to do your own research to see if this class is going to transfer. Because some of the times the classes that you do take won’t transfer. When I came here [NCSU], I had a whole list of classes [already taken at the CC].”

Matt had a similar experience as Jay. However, he was discouraged by one of his CC professors about the transfer process. He expressed his frustration with the GPA requirements and this CC professor:

To me, it [the transfer process] was very difficult. I remember one of my engineering advisor[s] used to always… talk about how hard it is to get into State. You need… a 3.5 [GPA] and even then it’s not guaranteed. [This CC professor] used to make it seem like it’s almost impossible to get in [NCSU as a transfer student].

Engaging with academic and/or transfer administrators. During the interviews, most of the students remarked on the guidance of staff from the CCs and the universities. At the CCs, some of the students relied on their academic advisors to assist them in the transfer
application process. Similarly, while attending the CCs, other students depended on the four-year university transfer advisors to guide them through this process. Sega, an NCA&T student utilized both services at the CC and the university. During the transfer application process, he visited the dean of the engineering program at NCA&T and consulted with CC advisors:

I would say that I was pretty ignorant to some of the [transfer] requirements. The only thing that I really could take back was meeting with the dean of engineering at A&T. I met with him… with my father… he [gave me] a short list of classes that I needed to take [at the CC] to get… accepted into the program… and I just went for it. After all of the back and forth between going from an advisor to other faculties at the CC, [I was] trying to figure [out] what [does] aviation systems technology [his CC major] have to do with aerospace engineering [his potential engineering major at NCA&T]. But I was under the impression that this was aligned with aerospace engineering, where really it wasn’t and no one at the CC really gave me that clear description.

Sully also expressed the importance of administrators’ assistance in his transfer application process. “At Wake Tech, the dean of the engineering department was helpful in getting us [potential transfer students] contact information here at NCA&T”. Sully relied on faculty at NCA&T to assist him navigate his transfer application process.

**Consulting with university engineering transfer students.** During the transfer application process, participants consulted with other university engineering transfer students. These peer consultations were highly pervasive throughout the students’ narratives and were highly influential on their transfer experiences. Mark, an engineering student at
NCSU, depended on engineering students’ shared transfer experiences in order to learn about the application process. “[I] talk[ed] to students who’ve already transferred [to NCSU]”.

In addition to Mark, Nelson implied that his NCSU friends guided him through his transfer process experience, while he was still at the CC. “Each Friday, I’d go… to State to visit friends”. Like Mark and Nelson, Chad consulted with NCSU enrolled students about the transfer process, saying “I have friends and some friends who were already at NC State. I talked to them and asked how did [you transfer from the CC]?”. Through this interaction, Chad learned that obtaining an associate’s degree from the CC may influence the professional engineering certification process, “I heard that… they had a degree in engineering technology so then I preferred NC State, where I am able to have my PE”.

**Utilizing four-year university websites.** As students traveled the path of transferring, they obtained information about the transfer process from their prospective universities’ websites. Most of the participating students found the universities’ websites to be essential to their transfer application success. Mark, an NCSU student, heavily relied on the university transfer website to navigate his application process to the engineering program:

That part was probably the hardest part of the whole transfer process. Because the community college has their information and it doesn’t most of the time lineup with [the] universities’ information. I took a lot of time actually to talk to a representative from NC State to try to figure out what classes to take and when to take them. It was probably one of the most challenging parts and I went online a lot to find out the information [about transferring].

Similarly, Nelson employed NCSU’s website for additional information on transferring into the engineering program. “The website from NC State helped a lot”. Nelson raved about the
detailed list of “all of the courses needed to apply and needed to graduate with a computer science degree. It was very neatly laid out and defined”.

**Learning complex coursework.** Engineering students rely on multiple sources to succeed in learning their engineering coursework. Students cannot merely draw from one body of knowledge to address engineering problems that are complex in nature; they gather from theoretical, procedural, and practical knowledge (Schön, 1987). Some of the strategies used in this process collaboratively engage the students in study groups, attending office hours, redefining study habits, and increasing disciplines.

**Collaboratively engaging in study groups.** Study groups at CC were an integral part for many of the study participants. David was very appreciative of his positive academic and social collaborations with his peers. “We definitely did study groups… it was a very comfortable experience being around the same people all the time”. Similarly, Sega shared his positive interactions while studying with his fellow students:

In my calculus I, II, and III, there were no more than 15 students [in the community college]. We really had to foster a network in order to pass the class with each other and with our teachers, study sessions, things of that nature to keep us connected.

Mark also saw value in networking and socializing with fellow students in and outside of the classroom. “Academically and socially I had a pretty good experience. I made sure that I had a lot of friends to study with.” He experienced the benefit of social capital and networking with peers:

[It] helped me a lot… to have study groups…There were [students]… that I can ask questions and then there were [students] who can ask me questions. That really helped out a lot and helped me balance things off. I really didn’t have any problems.
Jay emphasized the importance of two transfer students that he collaborated with throughout his engineering education. He noted how they also influenced his academic and social experiences at NCSU:

As a transfer student, I’ve met two people that have transferred with me to… NC State. We were the rock-solid group. These people stayed with me through it all. I know that I wouldn’t have the same experiences. But it seems as though I worked day in and day out to make sure that I was exceeding the expectations that NC State or any other college wanted.

*Attending office hours.* Students have overcome challenges in complex math and engineering assignments by attending office hours, addressing questions, and re-discussing new engineering concepts with professors and peers. Many students limited their interactions with their professors outside of the classroom and only attended office hours when they needed it the most. For example, Nelson had only been to one professor’s office hours. “I’ve only gone to office hours of one teacher a lot”. Meanwhile, Charles’ relationship with his professors was very positive. “A lot of faculties here are nice, open and willing to talk to you. [They are] willing to meet with you outside of class and outside of their office hours”.

Contrary to Charles, Jeff had a different experience interacting with his four-year university professors. He was honest about his uncomfortable interactions during office hours, critiquing that “They do offer an hour or two of office hours but you have to share that time with hundreds [of] other kids from other sections at the same time”. By sharing the office hours with other students, Jay experienced a lack of attentiveness from his professors. “Even when they do have the time to give you 15 or 20 minutes, they are not willing to spend
that time revisiting the material in a detailed manner where they feel like they are re-giving the lecture over again”. He proceeded with a frustrated tone, “and they say at this point, I’ve given you the lecture, you need to go back and read the book and do your homework”.

The interactions that Stormy had with his professors included asking questions in and outside of class to help him to learn complex engineering materials:

Some of the professors I did see in office hours and sometimes in the labs, you know we had some classes that required a lab [session]... It was more for the really challenging courses. Some of the courses… were easy enough… where I didn’t need to go see the professor. [You saw them as difficult subjects?] Yes! Or even for two or three subjects that were difficult, they weren’t really helpful or available.

**Redefining study habits and increasing disciplines.** All thirteen interviewees expressed the increasing rigor of their engineering studies at the university level and redefining their study habits. Chad stated clearly how his study habits were modified to better suit learning and keeping up with engineering classes at NCSU:

Before [at the CC], when I was a student, I studied the book before I came to the classroom. But now [at NCSU], I have to follow the teacher’s lecture and then study. It’s a different way of studying from Wake Tech.

Charles admitted that his engineering educational experience was influenced by his professors’ teaching styles and his own study habits:

I believe it does depend on the teacher but the material is very technical. You need to really be good with formulas and with math, it is a big part of it. I mean this material forces you to have good study habits in order to do well. You have to be able to come up with some study habits for yourself.
Jeff candidly admitted that “thinking outside the box” was what was required to excel as an engineering student and hoped that he would gain that knowledge and experience during his educational journey at NCSU:

Being able to solve problems and not relying on equations and repetitive procedures… make the difference. That’s an area that I struggle with… with process time and how long it takes me to get to a solution to a problem because it’s one of the things that is making my academics so difficult. It’s because I can get an assignment problem that the professor gives us and if it’s just math, [then] I can do it no problem. But if it’s a real-world situation, [that requires that I] think outside the box and apply the knowledge… that I struggle with.

**Experiencing positive reactions from social circles since transferring.** The majority of the study participants’ family and friends were all supportive and are proud of the students’ accomplishments since transferring into engineering. During the interviewing process, students shared those experiences with a smile on their faces. All the participants feel supported by their social circles.

**Proud and supportive family.** All thirteen students shared positive reactions from their family since they have transferred into their respective universities. For example, Sega received numerous positive reactions from his close family members:

Reaction wise, my father also went to A&T and got his master’s here in English. Also, my aunt, my father’s sister, worked here, in the career services center. Their reactions were positive, simply because of the engineering program here at A&T is just great. It just is excellent! They were pushing me forward and were happy for me. [Your father and your aunt?] Right!
Similar to Sega, Stormy’s family was “100% supportive” of his transfer into NCSU:

At first, they didn’t really like the community college idea because, they thought that I was getting distracted and that I would lose my focus and I won’t finish community college, and/or it just wouldn’t work! But since... I am going to State, that I am close to, you know, and I am about to graduate. They’re really supportive and want me to finish and make sure that I do everything that I need to do to graduate.

**Proud and supportive friends.** In addition to a supportive family, the participants expressed an abundance of support from their friends. For example, Carlos expressed the positive support from one of his mentors:

… From one of the people that matters the most to me. He’s one that motivates me. We had a big pep talk around Christmas time. He’s a big football fan. He talks like a football coach. He told me, look, man, this is a new beginning… planning and execution… and we had a long chat and he really got into my head. I really never expected that level of support from him. So I was like wow. He’s a good friend, I’ve seen how happy [he is] for me to get this! How he was proud of me, to like, you know, have this new beginning. [Uh huh.] And then, you know, there is less to be said about friends who somewhat feel that they are being left behind by your progress. And you know [silence] and it leaves a certain friction between people. It’s sort of like cutting the fat, right? Somehow seeing us succeed, it makes them feel less adequate, yeah. [But, that’s part of the plan] and it’s the least that you expect from them to be [less supportive and resentful of your success].

Like Carlos, Stormy’s response at first was indicative of positive support from his friends. However, as he went on with his reply, he expressed his frustration about his
cousin’s lack of support:

Friends, I’d say they’re pretty much supportive. It’s just, most of my friends that
don’t go here either are working or have already graduated. They are pretty much
[silence], ah, I guess they are neutral! I mean not really…if anything, they are
supportive, I just don’t really see it much, you know. But…I mean, I don’t know how
to answer that. I feel like…I mean I may feel that some are haters, but that might not
be necessarily the case. I did have a cousin who I kind of sense. We used to live
together, and I was like starting off at State. And, it seems like, you know, as I
continue to progress at State, we don’t communicate anymore. Because I feel like,
you know, I’m trying to do things in order to help grow and develop. That I can
become more independent, and you know, so that I can succeed in my career. And
it’s just showing that they are, I don’t know, it’s just, I am confused honestly. I feel
like they have something against me for trying to succeed and do this, but it’s not
really clear to me. Because I’m getting mixed signals. I mean, it’s things just
happened, that it got me thinking in that way. It’s just like, I have no idea.

**Becoming an engineering student.** Towards the end of the interview segment of
research question one, each student was asked to identify the most important aspects of
engineering from their perspective. The intent of this question was to challenge students to
share their own reflection on what it means to become an engineer and how they relate to
engineering as a profession in general. Many of the students expressed that the most
important aspects of engineering were developing an engineering identity, experiencing
inspiration and motivation, possessing confidence and pride, showing more independence,
and engaging in a research experience.
**Developing engineering identity.** The participants expressed a sense of belonging and development in their engineering identity. For example, Sully reflected on how his engineering identity was developing through his response to the question about the most important aspects of engineering: “the most important for me is that I can do… I can design my own stuff and create my own project and my own device”.

Mark also expressed his view about how his engineering identity has been developing over the years and how he foresees himself contributing as a professional engineer in the future:

I think the most important aspect for me becoming an engineering is…I probably would have to say finding a reason for why I wanted to become an engineering. And it’s something that constantly develops as time goes on. But I think having… an idea in mind is really helpful. Especially having to keep going through these tough courses. Right now, I’m probably would say… it’s closer to increasing access to technology. Specifically more so in third world countries… that’s my vision.

**Inspired and motivated.** Several students referred to themselves as individuals who were inspired and motivated to continue their educational journey in engineering on their respective campuses. For example, Charles believed that the most important aspect of becoming an engineer is his self-belief and perseverance. He also expressed that he is inspired and motivated to excel in his coursework. Below is an example of his experience at the CC, specifically with his math classes:

I started all the way back from pre-algebra and worked my way up all the way through calculus I...and then, mainly that’s because with that foundation I was able to get self-belief [increase self-efficacy]. Knowing that I am able to do something and
that teacher helped out a lot. That teacher, she was very instrumental in me, going
down this path.

**Confident and prideful.** The majority of participants expressed a level of confidence
and pride as current engineering students. During his later years at NCA&T, Sega
experienced a sense of pride through his interactions with faculty and fostering his
relationship with them along with his educational journey:

But back to your question, fostering those relationships [with faculty] and trying to
compensate with that, I did get a sense of pride, I was like ok, you know, I’m here at
A&T, a historically black university. I take pride in that now.

Matt was rather confident that he will be the first in his family to earn his engineering
degree. His accomplishments are the most important aspect of becoming an engineer:

The most important aspect I guess it’s just, I don’t know, it’s different things. One
would be… it’s nice to have that [degree]… because no one in my family has ever
been an engineer. So, it’s nice for me to be able to… have that achievement under
my belt… I don’t get that type of enjoyment out of doing other courses or something
like electrical [engineering] and all of the math.

**Engaging in a research experience for undergraduates.** According to the 2015 Hart
Research Associates’ report on “Falling Short? College Learning and Career Success”,
companies are more inclined to hire new college graduates who have finished and applied
learning or project-based solutions. In addition, the same report indicates that 82% of
students are more likely to be hired if they have completed a research project done
collaboratively with peers. Eighty-nine percent of students are more likely to be hired if they
have successfully finished a senior project or thesis in which they have demonstrated their
knowledge, research, problem-solving, and communication skills. The report also shows a staggering 91% of companies agree that for career success, “a candidate’s demonstrated capacity to think critically, communicate clearly, and solve complex problems is more important than his/her major.”

The undergraduate research that students undertake provides a launching pad for them to improve their critical thinking skills. In addition, the research environment allows the students to practice what they learned in the classroom and labs; applying their newly acquired knowledge in a hands-on learning environment. REUs serve as a platform for other great research opportunities. Students apply their knowledge in hands-on applications and develop strong social network circles with fellow students, researchers, and faculty that fosters mentorship. These fostered mentoring relationships empower the students to learn about real-world challenges outside the classroom, allowing them to contribute to the solutions of many NAE grand challenges (NAE, 2018). For example, Carlos is interested in becoming an electrical engineer and working on one of the listed NAE grand challenge to make solar energy economical.

Charles stated that the reason he transferred into his current university was due to the research opportunity that was presented to him. “The big thing was the fact that I got that research position before I even transferred over. That was, that was a big key”.

**Making dreams possible and improving the success rate in engineering.** Now that all thirteen participants made it to their four-year institution, they felt a step closer to achieving their dreams of becoming successful engineering professionals. At the end of the interview segment for research question one, each student was asked to answer the following prompt: “How did transferring into engineering change any of your dreams or plans for the
future?” For Carlos, NCA&T provides him with excellent electrical engineering education that moves him closer to achieving his dream and giving back to his home community in Africa:

   It’s one step closer to the dream. I highly doubt that it’s going to change. May be the department that I end up working for might change. But overall, in the next 10 year, my career is going to be in engineering. Whether on the field or a desk job somewhere.

Sega also described his academic journey as reaching the finish line:

   My dreams and plans are still the same. But I saw A&T as that gullet or goblet that I needed. This community college phase is done. I got what I needed from it, which was the transfer credits. In terms of social interactions, I also got what I needed from it. It’s just everything was there.

Jay’s specific dream was to pursue his doctoral education in engineering and founding his own business:

   Oh, well my plan for the future would be to go to graduate school, get my Ph.D., and I’d like to open up a Chick-Fil-a. Now, that I’m getting an engineering degree, I can go forward toward that plan that I always wanted. I had that plan from the beginning, I just didn’t know how to get there.

**Increasing professional development opportunities and networking.** Students who attended NCA&T all agreed that their university uniquely offered numerous professional development and networking opportunities on campus. During the interview, Adam raved about the opportunities for students to network with engineering firms:

   Transferring here, I definitely have more access to hiring companies that then I
thought I would have before. Like I said, the expectation is different than the other schools that I've been to. They shoot for the Google's and Microsoft's, the elite companies, or other peoples are just looking for jobs. And so that is, that is different. So I definitely have more of our set of higher standards. The type of work in the company I work for.

**Delaying graduation timeline.** None of the thirteen participants graduated in four years. The delay in their graduation timelines seems more likely to occur than not, as expressed in the students’ narratives. For example, Stormy wanted to complete his degree at NCSU within two years, however, that was not feasible:

> When I got to State, I wanted to finish within 2 years. But that wasn’t going to happen, because of [needed additional courses?] Exactly, and also I saw an opportunity where... When I transfer, I only wanted to do computer at first. But, I looked at doing dual degree program that NC State has for computer and electrical. And that’s just three more courses! Yeah, I’m doing the dual program right now. [computer and electrical?] Ah huh. And so that, you know, since its three more courses, you know, I’m already not going to get out in time. I might as well, you know, get both degrees. Become more versatile as I learn both the electrical and computer related stuff.

**Improving programming skills and ability.** The more advanced the students were in their engineering education, the more likely that they referred to their improved understanding, study habits, programming skills, and ability to overcome challenges in their classes and research endeavors. For example, Sully’s software coding and programming skills are more refined:
Before I used to think that programming was difficult. I also used to think that I had my challenge. But now I feel better about it. Like, I feel like I now have a better chance, if I want to go in that field. Like to succeed in that field. I am considering going into computer science for my masters.

Social and Academic Factors Shaping Transfer Experiences of Black Male Engineering Students

The next set of findings relates to the second research question and embodies the factors that influence the transfer experience of black male engineering students in the study. This section explores the three insightful themes that emerged from the interview data collected: social factors shaping engineering student success, enhancing knowledge through communities of practice interaction and applying knowledge to NAE grand challenges for engineering.

Social factors shaping engineering student success at a four-year institution are dependent on student involvement on campus. Numerous studies demonstrated that student involvement in college resulted in an abundance of benefits. Involved college students establish unshakable support networks, are more likely to graduate, develop a solid and multifaceted skill set, and are more sought-after by employers upon graduation. Most juniors and seniors valued the importance of their campus involvement and invested some of their free time at both at NCA&T and NC State by exploring the vast opportunities available for them to get involved.

Networking with professors and students. Chad referred to his positive interactions with NCSU students and collaborative engagements with peers in study groups:

For my classmates, sometimes we meet after the class, like 6 o’clock after work we
meet for group work. [Do you find that you’re helping others in the study groups?]

Oh, yes, yes, yes! Everybody that I work with, they realize that I am useful for that. Jay expressed his gratitude towards his research professor who helped him financially when he did not have enough to pay his rent:

I honestly, didn’t have enough for rent sometimes. I asked one of the research advisors if they could help me and they did give the time and gave me an RA position as an undergraduate to assist the struggles that I was having at the time. And I won’t forget it.

Utilizing resources available on campus. Jay valued the available resources on campus and expressed it during his interview:

The library, a common ground for everyone to meet. I like the resources it has. We are able to check out cameras, almost anything that you are looking for. On top of that, let’s see. Definitely, the faculty, they looked out when I had it rough.

Nelson raved about the resources that were available to him on the NC State campus, including state-of-the-art libraries:

I would say probably office hours and the huge libraries. There are a lot of places to study, a lot of options. At before, at both Central and Durham Tech, they didn’t have a very big library. So, it got a little boring studying in the same place. And sometimes, there wasn’t even room to study, so I opted to study in my dorm but it was distracting. But here, there are a lot of options that I can use.

Attending transfer orientation and office hours. When asked about the importance of transfer orientation and office hours, Nelson commented, “I would say probably office hours” are more important. Nelson concluded that office hours and the available libraries on
Enhancing knowledge through communities of practice interactions. Findings from the participant narratives overlapped during the discussion of the presence of communities of practice and if these communities played an influential role in their learning processes. As outlined by this study’s participants, communities of practice referred to individuals in the engineering department, specifically librarians, faculty, and other transfer and non-transfer students. The students were asked to share stories about their interactions with staff, professors, and students at the university level. Stories that described how their interactions and communications guided their developing engineering skills and perspectives in their classroom and research lab environmental settings.

This study’s participants acknowledged effective communication as key to improving understanding and application of their acquired engineering skills. These interpersonal engagements encouraged an inviting scholarship environment and weakened distress about comprehending complex engineering concepts and completing class assignments and group projects. Further, these interactions intensified technical-knowledge processing and the ability to understand challenging engineering material through critical thinking. This allowed for mentorship and personal growth. These collaborative interactions provided the platform to give constructive feedback to validate one another’s strengths and foster development opportunities to overcome weaknesses. Engaging with communities of practice was categorized into facilitated learning processes via interaction with staff, professors, and other engineering students.

Interacting with staff. At the end of the interview segment for research question two, each student was asked to describe in their own words the staff at their present university.
Staff etched positive impressions on most of the students. These types of relationships were open and uplifting to students and staff. For example, Jay experienced positive interactions with staff from the start of his academic journey at NCSU:

My relationship with faculty and staff is great. I know a lot of faculty and staff, not just from classes, but definitely personal, outside of class. Outside of the classrooms, I meet people [faculty and staff] through other professors. I just have an effervescent personality. I met them through research, mostly. If there is a question that I have, in terms of research or any material, I go to that professor. Then I start to build a one-on-one relationship with them. [Staff??] Yeah, they know that I’m very social!

Nearly every student-provided scenario referenced the role of staff as supportive. In the case of Mark’s interaction with staff technologist:

My experience with the staff also has been very positive. Whenever I have a problem with IT or if I have questions in regard to career development, they’ve been very helpful and encouraged me. Both make me feel confident and supported as said before.

Stormy vividly expressed his interaction with one of the staff and his academic advisor as:

Yeah. Ah, I didn’t really have much of a relationship with staff, other than, I guess if you’d count an academic adviser. I had a decent relationship with her. I know that I can go to her for any questions or concerns about grades and expected graduation, you know. Because, she was really helpful and help, you know, guide me through, you know stuff like that. Yeah, she’s definitely approachable, her office was always open whenever I went to see her. And if she wasn’t there, I’d give her an email saying ‘hey, can I see you for few minutes’ and she’ll always reply giving me a time
that’s both good for her and me.

**Interacting with professors.** As students journey through their unique engineering academic route, fostering relationships among their peers and professors is crucial to success and growth. The guidelines in the student storytelling and thin descriptive responses suggest that professors aid in improving confidence, lessening anxiety, stimulating curiosity in innovation, and grasping the engineering curriculum.

Students optimized interactions with faculty to enhance their learning. Participants accomplished this through proactive, classroom participation, which included asking questions and engaging in professors’ office hours. Openly communicating with faculty developed mentor relationships among faculty and students. And on occasions where miscommunications took place, various proactive responses were taken by students and/or faculty to revive those networks. The participants described those relationships in their narratives. For example, in addition to staff relationship, Jay also developed strong connections with faculty in the classroom and in research:

Great! It seems that no one wants to pretty much detriment or not to have any negative conduct. They just want to make sure that you’re going to be successful. And you actually know the knowledge not to just pass you, like other professors…My relationship with faculty and staff is great. I know a lot of faculty and staff, not just from classes, but definitely personal, outside of class. Outside of the classrooms, I meet people [faculty and staff] through other professors. I just have an effervescent personality. I met them through research, mostly. If there is a question that I have, in terms of research or any material, I go to that professor and then I start to build a one-on-one relationship with them.
Sega reflected upon his academic development at the university and how he evolved as an engineering student with respect to his relationship with faculty. Prior to his junior year at NCA&T, Sega isolated himself from peers:

When I first started, I did not have any relationships with my instructors and faculty members. I had that tunnel vision that I had battled with all the way up to my junior year. And that was really I had to do everything by myself. I don’t have an adviser. I don’t have somebody that I can talk to or a mentor. And even with the students. I really didn’t have peers to talk to. While my grades were good. While I did have focus. I felt isolated. I felt alone. And as I started to burn out from the pressures of missing opportunities, because I didn’t talk to this person, or I didn’t know that person. It is not about the greatest work, I think! It’s not about who has the best grade. It really is about, to a larger degree, who you know. And that was something that I struggled with. I really did.

Sega continued to explain how his loner mentality changed as an upper-class engineering student and he networked extensively with professors and other students:

And when graduation was coming closer and closer and closer, I was like what am I going to do? What do I have to show for it? All this time here, I still didn’t have connections that I thought that I would have. I don’t have the job that I thought I would have coming out of here. I was just like OK, I don’t want that to be my alley. Let me go ahead and try to compensate. Let me go ahead and try to mash and get to know people…talk to my instructors. I started to make friends and I started that during my junior year.

Sega then gave a very specific example of this transformative change in social networking
with professors. He pointed out that one of the professors that assisted him was “white”:

My statics teacher, she was the one that offered me a paid research position, here at the school… I was really thankful to her. Another instructor was my Material Science and another class teacher. She was influential and she was white too. She really helped stir the gears in terms of these are things or avenues or opportunities that I should look into. I didn’t have those relationships with any of my instructors beforehand because I was not interested at the time. I was shutting them off. I didn’t see the value. I used to regret that. But honestly, it’s part of my journey.

Sega described his learning process and shared his growth mindset mentality:

And even the faculty members, the instructors, secretaries, and staff, they didn’t always have the greatest dynamics either. There was always some kind of pull or some give and take. And that’s things that was noticeable that I have seen in many departments, from mechanical engineering department, the civil engineering department, all of the departments. Even the communication between registration and cashier’s office was not as orderly as it should have been. It’s called the aggie shuffle, going back and forth. And I certainly had my share of going back and forth between those offices.

On the other hand, Sully had a completely different interaction with engineering faculty at the university:

Faculty here are a little bit strict and they are not as readily available as Wake Tech’s. [faculty]. [How about staff?] Not really. The only staff person that I met with was to do my transfer process. [Do you go to any office hours? Or meet with your professors outside of class?] I’m sometimes but not really. My relationship with faculty is
most in the classroom [Silence].

Stormy had a fusion of positive and negative interactions with his professors in and outside of the classroom environment:

I guess, for the most part, most of my professors have been okay. There were a few that were I felt like they didn’t have time for students. [Unapproachable? Unavailable?] Yeah, for the most part. And their teaching styles were a bit difficult to understand and to follow. Because I’m the type of student, where if you have like lecture notes and slides that you’re going over, I need you like to do examples and explain things in details so that I can take good notes that I can understand it for myself.

Stormy’s expectations of professors did not match what he received in his engineering education at NCA&T:

I’ve had professors, where they would just read over the slides or read the book and not really do many examples. And even when they did examples, they weren’t helpful enough to like still understand what, you know, we needed to know for like the quizzes and the tests that we had in class. As far as that, I had trouble with professors who had that type of teaching style.

The interviewer probed Stormy by asking whether he attended office hours with the professors he described above. His response was:

Well, some of the professors, I did see them in office hours and sometimes in the labs, you know we had some classes that required a lab. Not too many of them, honestly. It was more for the really challenging courses. Cause, some of the courses, they were easy enough to where I didn’t need to go see the professor. [You perceived
them as difficult subjects?] Yes! Or even for two or three subjects that were difficult, they weren’t really helpful or available. In class, I’d ask as many questions that I could or see them right after class before they leave.

Contrary to Stormy, Mark was very appreciative of the faculty at his university, and stated that “the faculty here is approachable, relatable, very supportive and helpful”. Chad, a part-time student, found it difficult to interact with professors outside of class due to his demanding personal time constraints: “First, I can say that I don’t have much time other than the class hours! Which means, since I start[ed] with NC State, I never go to any office hours”.

**Interacting with engineering transfer and non-transfer students.** On multiple occasions, students interacted with peers while in class, in the lab, or while collaborating on group projects or assignments in study groups. Their interactions with fellow students seemed positive and influential in the development of their engineering identity and cognitive knowledge. Jay appeared to have expanded his circle of friends at NCSU. “A lot of students would wave at me. People know me… I’m very social”. Most of the students expressed a slightly different experience working with transfer versus non-transfer engineering students, especially while in study groups. Mark’s reflection summarizes this experience:

And as far as the students, it’s much easier to work with the transfer students, because we have a common background. I’ve been with a group of people from NC State and it’s a different group. You can still work well with them. But it’s a different way of getting there. What I mean by that is the work and study style is different. Whereas students that I study with that are transfer students we have a way, I don’t know how to exactly describe it to you. It’s just like where, you know, we have our homework
and we are going to get there. Like in the beginning, the deadline is next week, so let’s start now… let’s get it done.

Mark’s observation of the difference between working with transfer students at NCSU to working with non-transfer students was further developed during his interview:

With NC State students, there is a little bit of a procrastination period! They tend to wait until the last minute. So, that makes it a little harder to study with them for that reason! But, every now and then, you see some of them come over and say ok, let’s get this done and over with and move on. So the transfer students to be more like planners and start right away and not waiting until the last minute. I think part of that is we had to plan so much [at the CC] because we had to transfer in the first place.

Contrary to Mark, Carlos deliberately decided to limit his interactions with peers outside of the classroom to minimize distractions:

My student relation [is that I have] no friends [chuckle]. Yeah, yeah, it’s a self-imposed decision based on a bunch of restrictions I’ve placed on myself and who I decide to call a friend at this point in my life. And you know it does get harder to make friends as you get older. You know when you were younger you had friends just to have friends so you can have someone around to talk to. But now that I’m older, I feel like you know, when I call you a friend, then I’ve gained something from you and you’ve gained something from me!

Despite Chad’s limited free time as a full-time employee and a part-time student at NCSU, he dedicated time to collaborate with his peers on homework assignments and group projects:

For my classmates, sometimes we meet after the class, like 6 o’clock after work we meet for group work. [Do you find that you’re helping others in the study groups?]
Oh, yes, yes, yes! Everybody that I work with, they realize that I am useful for that. Stormy was grateful for establishing his first network of friends from an introductory course offered to NCSU engineering transfer students:

[Our professor] helped us find people [other students] who are in similar engineering disciplines. So that actually helped me meet two other people who transferred with me and we started with just three of us. And then it grew into like a big group of people and so, after meeting those two guys, I became friends with them and studied with them. Then our group kept on growing and growing. So, I’m still friends with them till this day. Even I have more friends, thanks to that class. It helped me navigate and networking, you know, being with groups of people, like study groups. [majority of group transfer students?] Not now.

Matt had a slightly different dynamic with his classmates, where he worked with both transfer and non-transfer students during study group interactions, “I have a friend here who started her freshman year. I met him this past semester, so yeah, both”. Matt was fortunate to begin his four-year institutional journey with a group of transfer students who also were majoring in electrical engineering:

When I transferred, it was me and probably five or six people that transferred too. And it just happened to be that we all were doing electrical and in the same classes when we started. You know we’ve been in the same classes ever since and even this semester, I got classes with all of them. There have been some classes where I didn’t really know too many people. I’d walk up at the end of class and, you know, introduce myself. And see if they’re like hey, you know, you want to study and do the homework sometime and exchange numbers. So I’ve met people doing
Charles clearly discussed both positive and negative engagements with fellow students:

Ah, students, the majority of them are…I feel like…we call it finessing. So, they try to find the easy way out. I don’t know how to describe that. But a lot of the students here they don’t put out their potential efforts. That’s the problem that I see here. We have so many opportunities here but we waste them! [Using his hands to illustrate the difference in distance between their potential and their work effort] Their potential is up here but then they are down here!

The interviewer probed Charles to elaborate on what he views as the factors that influence this “finessing” behavior he described above and whether technology shaped student success:

I think this school [NCA&T] is behind in technology. Technologically speaking, like at State [NCSU] their library is great! I love it. I went there all the time [while attending the CC in Raleigh]. But I am way up here [Greensboro] now, Yeah, definitely technology and the library itself. [So do you feel with students finessing they are looking up answers?] Do you know what I mean by that? Yeah, check is a big thing. Yeah, check study or whatever. Instead of actually trying to figure it out and understand it, they try to look up the answers and beat the system to pass grades, yeah. That’s probably a big problem!

Charles eventually described his relationship dynamic with fellow students as, “they [students] are great! I mean, people that I hang out with are great! Socially? Yeah, socially, everybody here is really good!” The researcher then probed Charles about his academic relationship with students and whether he engages in study groups, “Yes! Not often, but yes! People that I study with are that guy [pointing outside the window of the room towards
Lastly, Nelson had limited interactions with his peers, which may change as he continues his academic journey as an upperclassman, “Students I meet in class have been good. I have not had any study groups yet. I think it would be good. I was scared to ask someone if they have [formed] any [study] groups”.

**Applying knowledge to NAE grand challenges for engineering.** At the end of the interview segment for research question two, each student was asked to define their beliefs about engineering. This question provided an open space for students to describe their view about engineering as a field and how they visualized themselves contributing to it.

Their understanding and application of engineering can be simply defined as abilities and cerebral skills they must carry out as they solve engineering problems and complete their assignments and projects, from the simplest to the most complex. The application of engineering knowledge to NAE grand challenges for engineering encompasses the mechanisms of how students acquire knowledge, recall information, problem-solve, and concentrate on their engineering tasks.

Mark hesitantly expressed his beliefs about engineering as, “I’d say engineering is something that is essential and very necessary to improve life. I’ll probably leave it at that!” When the researcher probed him to elaborate, he quickly responded with, “I’d like to leave my thumbprint in engineering to improve access in third world countries to have the same technology that we have here in the United States”.

Stormy, on the other hand, described engineers as problem solvers. “They solve some of the world’s issues… like whether it’s the environment, technology, or even social issues”. He further described the influence of engineers in technology:
It’s very vast….I don’t how to answer that because technology is like has made a huge impact on society. Like some of the things that help people like…I’m sorry, I’m just stuck. [So technology have provided educational resources for folks learning?] Yeah, like improving their health and lifestyle. Ah huh.

Similar to Stormy’s point of view, Adam viewed engineers as the “thinkers and drivers and the fixers of society, all facets of society” and further described how he can contribute to this group in the future:

I would like to improve noble engineering processes and integrate them across the country. [And where would you like to work?] Ideally somewhere cold. Somewhere cold in the mountains, not too far. Not too rural, suburban, mountain life would be perfectly fine with me.

Charles referred to the engineering field as “lucrative” and “for the most part, well-paying. We, apply [engineering] to life, infrastructure, cell phones, medical devices. I mean that field is the most applicable field at all”. Meanwhile, Jay defined engineering as a humanitarian endeavor:

Like it’s a good aspect of human, humanity. In terms of improving but also destroying humanity. There are some fields that have a positive and a super negative impact on humanity. When it comes to technological majors, not civil or mechanical, but computer science and electrical engineering. There are some engineers that are using this technology to create devastation and to create weapons. They are there. I feel that this is a good thing, but not where you should take your talent to, in my opinion. I know some classmates who actually got into this field. It’s something that…it’s their opinion. But I’d like to go do something else. [What?]I’d like to
create a self-powered pacemaker, a self-powered and a sustainable device through your body heat.

Matt described engineering as a “big field” and further explained:

A lot of stuff we got today, you know, is from engineering. You know, so electrical, mechanical, civil, everything, all types of engineering. [So influencing everyday life, positively, negatively?] Both! I mean, you know, it just depends. As far as the positive and negatives, I feel that that depends on each individual person. You know some people, you know, like social media, you know, which you could say computer scientist did that. Which also engineers did too. You could use it [engineering] the good way, you know, and some people overuse it. Same with cars, some people crash cars, and some people will drive responsibly.

David, an optimist, perceived a shift in engineering as a profession. He felt that the profession was evolving into a more inclusive field and not just available to elitist groups:

As a field I feel like it’s becoming more. Well I’m hoping that it’s becoming more open to the population as an interest. Since I feel most people are intimidated by engineering and it feels like it’s only reserved for certain people in the population. [Like elites, and people who are really good at math? So you hope that it’s more open and welcoming to other groups?] Yes!

Another optimist, Jeff admired engineers and believed that they serve a significant purpose:

I believe that engineers are special. That they fill a unique role. And that primary purpose is to make the lives of their fellow man better. And to do so in such a way that requires the utmost integrity and goodwill. Like you can’t cut corners. You can’t cheat. I mean and sometimes your only purpose is to make somebody else
comfortable.

**Providing a variety of options.** Engineering is a field that tremendously shapes the world by changing it and forcing change. Matt expressed the vastness of this field in his response to the question during his interview:

I mean it’s a big field. A lot of stuff we got today, you know, is from engineering. You know, so electrical, mechanical, civil, everything, all types of engineering.

Stormy described engineering as a field with endless possibilities:

Pretty much I feel like they just problem solvers. They solve some of the world’s issues like whether it’s the environment or technology related or even social issues like technology and how it helps [silence]. It’s very vast….I don’t how to answer that because technology is like has made a huge impact on society. Like some of the things that help people like. I’m sorry, I’m just stuck. [So technology have provided educational resources for folks learning and improving?] Yeah, like improving their health and lifestyle.

Mark candidly shared his view about engineering as, “something that is essential and very necessary to improve life… to improve access in third world countries to have the same technology that we have here in the United States”.

**Well-respected and prestigious career.** Engineering is a well-respected and prestigious field. Adam described engineers as, “They are the thinkers and the drivers and the fixers of society. All facets of society”. Charles defined the engineering field as a financially stable and prestigious career:

I think it’s a good field. Mm, one word that I can guess is that depending on what
field, and depending on where you go, it’s lucrative. Mm, for the most part, well-paying. We, apply [engineering] to life, infrastructure, cell phones, medical devices. I mean that field is the most applicable field at all, so.

Although uncertain about the different areas of engineering, Nelson identified engineers as builders and inventors:

At first, I thought that engineers designed buildings and technologies and all that stuff. And also built them. I just learned that they only do the design part and not build stuff. I’m not sure. I guess they do build. Not sure what other engineers do. I’m guessing they design and build pro-types and then other people build the final design.

**Serving dualistic purposes.** Engineering can serve dualistic purposes; altruistic and destructive. For example, technology can be used to improve or destroy humanity. Jay discussed this during his interview:

I feel like there, that’s a good question! Like it’s a good aspect of human, humanity. In terms of improving but also destroying humanity. There are some fields that have a positive and a super negative impact on humanity. When it comes to technological majors, not civil or mechanical, but computer science and electrical engineering. There are some engineers that are using this technology to create devastation and to create weapons… But, I’d like to go do something else… I’d like to create a self-powered pacemaker, a self-powered sustainable device through your body heat.

Like Jay, Matt expressed this dualistic purpose that engineering professions serve and stated his beliefs about engineering as a field in general:
As far as the positive and negatives, I feel that that depends on each individual person. You know some people like social media… which you could say computer scientist did that… which also engineers did too… you could use it the good way and some people overuse it. Same with cars, some people crash cars and some people will drive responsibly.

Technically challenging and only for elitists. Engineering is a professional field that requires math and a set of problem-solving skills. David referenced engineering as a field for the selected few:

As a field, I feel like it’s becoming more… well, I’m hoping that it’s becoming more open to the population as an interest. Since I feel most people are intimidated by engineering and it feels like it’s only reserved for certain people in the population. [Like elites and people who are really good at math? So you hope that it’s more open and welcoming to other groups?] Ah huh. Yes!

Jeff agreed that engineers have valuable skills:

I believe that engineers are special. That they fill a unique role. And that primary purpose is to make the lives of their fellow man better. And to do so in such a way that requires the utmost integrity and goodwill. Like you can’t cut corners. You can’t cheat. I mean and sometimes your only purpose is to make somebody else comfortable.

Racial and Mathematical Identities Shaping the Transfer Experiences of Black Engineering Students

The third research question examined the racial and mathematical identity of students who have transferred from CCs into engineering programs at four-year institutions. This
section encompasses the three ascertained themes that emerged from the interview data collected: racial identity development, developing engineering identity, and experiencing math and engineering classes.

**Racial identity development.** Racial identity serves as a very significant role in the psychological lives of blacks. Sega expressed his racial identity development as an upperclassman at NCA&T:

It’s no longer a stepping stone for me that changed my racial identity. It’s not just because I’m black. When you have that oppressive groups, there is a lot more commonality than differences, even in the major demographics. I saw that in one of your [online] questions. I do believe that there is more commonality than there are differences. So I was able to foster that. I was able to make friends from every culture and every race. And before that, I was very biased, I was very clear cut, ok I’m not going to have too much influence with you and you don’t have that much influence on me. That's what I grew up with. There were preconceived notions. There were just attitudes that I remember. All of that just dissolved and that mentality.

**Perceiving other students’ performance and success.** A sense of belonging or a lack of it was expressed by most participants. For example, David expressed the experience of exclusion among black males enrolled in engineering programs at a PWI. He referred to it as the imposter syndrome. In other words, the fear of disconnection or unworthiness of connection due to a hidden trait or characteristic about him. David shared his insight about what he perceived as a tremendous determinant of black male success:

When…if there is a period, where we can get really discouraged, like during a test or
something, I feel like it would hurt us even more. To think maybe this is not the right place for us, in general. And take it as a time for personal growth and betterment for the teacher. Like, I feel like it’s the imposter syndrome come out more frequently for African Americans in engineering. They do fall short doing the assignments and always like perfect in their classes.

Nelson, on the other hand, perceived the value of connection among other black males. He expressed his thoughts about fellow black students:

I think that often I see a lot of black people together. So, I guess knowing that they have someone and other races to support them and also help them out with both academics and socialize.

**Improving black male engineering students’ experiences.** When students were asked how to improve the college life for black male engineering students at their current university with a magic wand, a creative and insightful collection of responses were shared. For instance, Jeff referred to establishing a STEM learning center as a resource for science and engineering students, especially those attending advanced technical courses:

Some sort of resource center for coursework. Not a resource center for social issues or comradery. I am talking about for engineering specific coursework. I had one professor that made his TA give 3 to 4 office hours twice a week. And you can just go there and do your homework there and that was amazing! You were able to ask that guy any questions that you had. You were able to learn the material if you didn’t understand it. I feel if they make it a requirement for TAs, that would help, that would be a good start. But from my experience, the TAs are required to do an hour a week and may be two hours a week. And during that time, they are not really there to
help you with the materials so much as they are to be your buffer between you and
the professor if you had a complaint about your grade or something like that.

**Developing engineering identity.** Students who transferred into four-year
institutions arrive with background knowledge of math and engineering established from
their past academic background as CC students. Carlos eloquently expressed his
nontraditional route in developing his engineering identity as a young adult conducting
research at the university:

I worked at a biomedical engineering lab. I dabbled in it a little bit to see if that would
peak any interests but eventually, through their connections, I ended up getting a
research experience at a center. Working on developing smart grid technologies and
renewable energies products and systems. And I just fell in love with the whole
prospects of energy and future energy management and energy delivery. So that’s
where I decided electrical, is it. Cause I see an end game for it. It wasn’t because I
liked the classes or the process. It’s more like I see more ….. I chose my career before
I chose my major basically. This electrical engineering major sort of fit into the career
that I wanted to be in.

**A sense of belonging.** At the end of the interview segment for research question two,
each student was asked to complete a metaphor with the insightful prompt, “I feel ______ at
this university…?” The intent of this question was to challenge students to reflect on their
transfer experiences and present it in lay examples that non-engineers could relate to. As
engineering transfer students, the majority of participants expressed a sense of
belonging. This sense of belonging is defined as when students become accepted members
of the engineering cohort at their current institution. Chad expressed a sense of belonging:
I feel part of this university community. Okay! Everything is happening. I match it. The labs at NC State makes a difference. It makes me feeling like I am part of this community. The difference here than back home is the lab. The technology and access here at NC State is much better and more advanced.

Charles sensed belonging now that he was an engineering student at the university level at NCA&T:

I feel at home. Why? When I say home, I mean that I am around people a lot like myself. Ah, not only in terms of looks but sometimes, I guess, culture and whatnot or whatever you want to call it. It also is just a…I guess it’s just the interactions. Mm, I feel like I have a lot of a really good foundation here. I am able to gain a really good foundation here. That I may not be able to do at other universities and that is just through the class size. That was probably the big thing for me. [What about the class size here?] I mean most classes here [A&T] are may be 20 students, 30. It’s definitely smaller compared to other universities where you have 100 or 200. Wake Tech was about that size, may be a little bigger, but I mean anything under 50 is okay. I had a class at one time at UNC [Chapel Hill] that had 750 students! [In shock] 750 students? Yeah. It was biology and I dropped that class!

In addition, David became an integral part of the NCSU community, saying, “I feel great! Everybody is so nice and welcoming”. Expressing a strong sense of belonging within NC State campus influenced his perception, and he stated, “I feel like I can achieve whatever I want at this point. I worked really hard on things like that here”.

Similarly, Mark perceived a strong sense of belonging at NCA&T:

Being an engineering community college transfer student is like [silence] like part of
a smaller family. Because one thing [that] I’ve noticed since I’ve been here is that transfer students tend to find each other and stick with each other and definitely help each other! It’s definitely cool and I find that a lot easier than just trying to start a group with people that already started at NC State from the beginning. [Do you feel like it’s harder to click with the students that have already started as freshman?] In a way, yes, but in a way, I think it’s just harder because we have less to relate to as far as academic cultures in the beginning! But, it’s definitely possible to get around that!

In addition, Nelson also experienced a strong sense of belonging at NCSU:

I feel at home, I think. I think it’s mostly because I know people here. And State has a lot of things that are useful like labs and resources. I feel supported at State having these resources in comparison to the other schools that I’ve attended.

Sully also expressed a strong sense of belonging as an engineering transfer student at NCA&T University:

I feel like I am part of something. Yeah…A sense of belonging…yeah. Because before I came here, there were very few black people and there are a lot of stereotyping. But when I came here, I see a lot of smart black people that look like me.

**Out of place/Outsider.** Some of the participants in this study experienced a sense of being out of place or an outsider. This sense of being out of place or an outsider can be defined as the students experiencing alienation and not being an integral member of the engineering group at their current institution. Carlos chose to keep to himself while pursuing his engineering degree:

I was pretty much a loner. What made it more of a loner experience was that there
wasn’t a lot of people that I could relate to being a black engineer and a lot of the
courses or few of the courses that you took. Most of the people in those courses were
not engineering majors. I made a couple of friends in those courses. The reason is
that we already met through our Kenyan parents and became friends. I found more
friendship brotherhood through the Pathways program as opposed to people in class
or outside of class.

David had a less positive transfer experience and felt left behind in his academic background
knowledge:

I feel like… it’s playing catchup a little bit. [In what way? Are you referring to your
background knowledge?] Yeah, yeah, my background knowledge. Trying to merge
the learning tools that I had at my community college with new tools that I needed to
learn to be successful at NC State.

Sully also recognized that he did not have many black peers in his engineering programs at
Wake Tech CC:

Well, Wake Tech is small and I knew everyone in my class. In most of the cases,
there were only five black people. So in most cases, I was the only black guy in my
class. [How did that make you feel, being the only black student in your class?] How
did that make me feel? Sometimes it’s lonely. But sometimes you get mixed with
other people from other demographics [silence].

Jeff compared himself, as an engineering transfer student, to a stepchild:

Is being a stepchild. From my experience, the university seems to put the majority of
its attention on the new applicants versus the transfer applicants. The new applicants
get priority for spaces available for students. The orientation programs and events
were centered all around the new applicants. And the small group of us transfer kids was like you’re here too, well you don’t have to be here but you kind of do since you’re new here.

**Requiring endurance.** Many of the students expressed that they exerted more effort than fellow students to withstand their challenging courses, which require endurance. Sega was very specific about one of his interactions with a professor in an advanced engineering course and how that shaped his academic journey:

He [the professor] was very difficult in terms of grading and everybody [students] was scared of him, essentially. There was some agitation with the instructor. Definitely, there were lots of quiet moments, when he’d ask questions and nobody knew the answers. Because for one, they [students] didn’t understand what he was saying. And the speed of the teaching was a little too fast for a lot of people to catch on. So what does that create? That creates a whole atmosphere of people wanting to cheat, people not doing their own work. And so…they just wanted to get it done and get out of that class! And if you go for him for help, he just makes you feel stupid. Granted there are points in time when that it is needed because it does force you to learn things on your own. And that’s what I took away from him! I learned to become more independent from him! He was like you have your textbook here, you know how to read, let’s keep it moving!

Similar to Sega, Nelson had disappointments during his academic journey at NCSU. More specifically, Nelson was disappointed that he could not sustain his 17-credit course load, which resulted in him withdrawing from a Java class:

I was enrolled in CSC 216, which is Java. But there were some things in there that I
didn’t completely know. Because I took the pre-req. at Durham Tech. There were some things that I didn’t know about it. And it also went very fast. And, I never had such large projects for programming before. There were three guided projects and they were all due within a week of each other. They [professors] said it required 8-15 hours for the project. But since I didn’t know [the material well enough], it would take me 20 or so hours. And since I was taking 17 credits I dropped it.

Nelson did not allow dropping his Java class to define him, though. “My plan is to learn the concepts on my own and retake it”. He sought out help from his academic adviser who sent him a useful website link “to someone who teaches the pre-requisites here [at NCSU]”. Nelson understood the amount of rigor this class required of him and found a solution to overcome this challenge, stating, “so that I can make sure I learn everything that they taught so that I can be ready for the spring. I also only have 12 credits so it’s less workload”.

During his interview, Jeff clearly expressed his frustration with the amount of rigor and difficulty that he faced at NCSU in his engineering courses. He furthermore articulated that it required endurance and perseverance to make it:

I feel that they are very difficult. I want to say the math makes them difficult. Because it’s very math heavy. I expected that to a certain extent. I also expected that I wouldn’t have as much of a difficult time as I’m having grasping some of it. Some of the concepts are more theoretical.

**Intrinsically motivated and empowered.** The majority of the participants had a sense of empowerment and a strong internal drive that intrinsically motivated them to continue their engineering journey. Carlos was inspired and invigorated as an engineering student at NCA&T:
Definitely a lot of positives here. I feel like I am more motivated here. I see that I am a step closer to the dream of becoming an engineer. I’m taking Electrical away. I don’t want to limit myself to electrical. My curiosity and engineering mindset, exactly, like people.

Charles’ confidence level was amplified by witnessing other black students succeed in engineering endeavors:

How, how I think about myself? I think that I have a chance, that’s probably the biggest thing, I think that the institution gives you. The biggest thing definitely that my confidence level has gotten better. That’s the biggest thing that I can take away from here. Just self-confidence and seeing some of my peers, they happen to be my skin color or what not, actually get somewhere and then seeing people come back and give back to the community and school at the career fair.

In contrast to Charles’ perspective on motivation and empowerment, Sega’s drive to succeed as an engineering transfer student was ignited by the negative environment he faced while at the CC. Sega mentioned several times during his interview that his “drive” was what sustained him in his engineering educational journey:

What helped me take the step? It was really just the drive to want to better. I saw community college as stagnant and stale. People are there because they are comfortable with the next step after high school. If they are not ready to go straight to the university.

**Overcoming external barriers.** Each student was asked the question, “What external barriers have you faced during your transfer process?” The intent of this question was to probe the students to express any obstacles that they have faced while transferring and to
offer solutions to future generations of black male transfer students in engineering programs. Some students experienced more challenges with coursework in their four-year university than their CC. In addition to Sega’s struggle with math, despite his positive identity with this subject, he found it taxing to grasp physics and thermodynamics as convoluted engineering concepts:

There were definitely problems with math. I would not say that I was the most studious or the greatest student ever [Big grin], honestly. But I had a positive identity with math and I stuck to it. I did struggle with physics. I did struggle with thermodynamics [Chuckle]. It really wasn’t such a smooth transition as I thought it would be, transferring from the community college. I might have been a little naïve because I had this idea that somebody was going to come out to me and tell me or at least give me guidance.

Sega continued with a deep reflection about these difficult moments during his engineering education and how they transformed him into a mature engineering student with a budding, professional engineering identity:

Sometimes, you have to internalize all of your frustrations and your anger, or just all that. If you want to get something, you just have to do it yourself. Because I didn’t really do that, that really set into the mentality that I have to do everything on my own. So that transitions from CC to A&T had its rough points. But I made it.

**Experiencing math and engineering classes.** Engineering is a scientific and technological major that requires students to master the design, build, and use of engines, machines, and other technical structures. Engineers in the real-world apply science and math to solve complex problems. They decipher how things operate and discover hands-on
applications for scientific discoveries. They are instrumental in making innovations that further develop the human condition. To gain a better understanding of the thirteen participants’ journeys with math and engineering classes, students were asked to share individual stories from middle school until the present day.

**Middle school academic experiences in math.** Once in middle school, it is expected that students can perform basic mathematical procedures. Adam felt a natural gravitation towards mathematics:

In sixth grade, I had a teacher who was a really great teacher. And she sent an email to my house saying that he is failing the class! And so my mother comes in the class and she actually has a conversation with the teacher, and they say why are you failing? And he says he does well, aces all the tests, [he] just does not turn in work, like homework or anything that he does, all the classwork, but he doesn't turn in any homework. My mom says that doesn't make any sense… He does his homework every night… They looked at me and asked where is your homework? I go to my locker, and there is a tall locker piled up with papers that just fall out on your face. Adam did not believe in turning in his homework for a grade. He still believes that homework should only be utilized to solidify students’ knowledge and not as part of the grading process:

Even to this day I just don't believe in like doing homework! I do not like turning in homework for a grade! I like doing [homework]… I think you should do problems on your own. But I never really grasped the concept of homework for a grade.

Charles considered himself a natural in math. He reflected on his middle school math achievements and struggles:
I was considered to be an advanced student, in math. Mm, so, during middle school, I really didn’t run into many issues. Except when I got to 8th grade. It was the geometry that I struggled with. But looking back at it, it wasn’t the material that was hard. It was just because I and the teacher didn’t see eye to eye. And from that point on, I was like having a good relationship with a teacher is critical! But in 8th grade, my teacher relationship wasn’t that great.

The interviewer probed Charles by asking, “So this teacher relationship shaped your success in geometry?” Charles was quick to respond, “Oh, yes… I got a C”. He continued to explain that his relationship with his geometry instructor influenced his motivation and drive to learn math:

> It made me not want to go to class. So, if I don’t want to go there, then I don’t want to invest in the material too. So, that was basically it. [So what was it that you didn’t see an eye to eye with the teacher? Was it a personality clash?] That and more so…I really didn’t like his breath! It smelt like cigarettes. It was just little things like that… Calling you the wrong… I was like dude my name is [Charles]… and that’s when I was young too. Back then I couldn’t stand up for myself as much. It was different and I didn’t agree to it at that time and took it personally [nodding his head].

David offered more details and insight into his scenario. As he told the story, his hand gestures ‘ticked’ off each step as he described his middle school experience with race:

> I don’t have like a specific [experience]. I remember all of my math teachers in middle school. I had…It was definitely a positive experience… most of the friendships that I had during middle school and high school. We were all in the higher-level math classes. And even though we were in the higher-level math
classes, most of my friends were African American people. Which was really reassuring. It’s not reserved for other groups. I definitely appreciated seeing how people like me in all the math classes that I’ve taken and right through.

Jeff expressed how he had a positive mathematical identity in middle and high school. Mathematical concepts came naturally to him, with very little effort. Despite excelling in math in high school, he chose not to enroll in advanced math classes. This set him behind in terms of his academic outcome in college:

I was very good at math. I had a natural talent for it as a kid. I remember being put in advanced math classes in those schools. I’d ask questions that none of the other kids would ask or I was able to see patterns and figure stuff. [High School?] Yeah, high school math was easy for me. I remember not ever studying or doing homework. I would just take the test and I would get A on the tests. In high school, the highest level of math was in algebra, no geometry or calculus. It did impact my math experience at the community college. I was behind.

**High school academic experiences in math.** The majority of participants gladly shared memorable stories about their high school math education. Some were positive and some were negative. For example, Adam did not have a positive experience with his high school math teacher as he described in detail during his interview:

Once again, I have way too many. High school ones were much better though. I have one I want to do, which one do I want to do? High school, I have, I had a teacher who was... so, this was my senior year, I was in calculus BC, AP calculus BC. and so we were... The teacher and I did not see eye to eye on a lot of things. Mainly I felt like she was targeting me for things outside of common decency. It was me and another
student… yeah, we were just the escape goat. When something happened while she's up on the board, she will turn around and… it's my fault or this other student's fault. But the other student can stand up in class and sing Disney music but if I yawned then I get sent down [to the principal’s office].

Adam made it clear that he did not think the teacher was “racist” nor “sexist” despite the fact that other students in his math class thought so. He was quick to blame himself for her unacceptable behavior:

Some people thought she was racist. I don't think she was racist at all. I don't think she was sexist. I don't think she was. I was probably… especially at that time… I was very openly arrogant. I was quick to tell her that she was wrong. Yeah, it was just two people who wanted to always have the last word… and I was very smart-mouthed. And even when it wasn't my fault and I didn't argue with her, it still was my fault. She was very open that she didn't like me. So a lot of teachers told me that she didn't like me.

Despite Charles’s challenge with geometry in middle school, he continued to excel in math during his high school years:

Well, 12th-grade year, I was in pre-calc. I took algebra II in 9th-grade! So, typically, you’re supposed to do algebra II and then you start hitting pre-calc. Yeah, but I had a 3-year gap! So, when I got to pre-calc., I didn’t do too well. And it wasn’t because of the teacher. I liked the teacher. He was a pretty cool guy. It was just…that’s another thing that I realized, math, you got to stay on it. You need to practice it. So, I didn’t do too well in that class… Honestly, I would’ve failed that class, but he just gave me a D. So, that would’ve held me back from graduating high school. [So,
that’s why you had to take all of those remedial classes?] Yes, that’s part of it too! I had to… I had to refresh all that [math concepts].

Nelson, on the other hand, had a slightly different background with mathematics in high school. His first two years in math were manageable and straightforward. However, with a heavy load schedule and advanced mathematics classes, he recognized the rigor and time commitment that it required of him to succeed:

In 11th-grade, I took on too much, so I didn’t do well as I should’ve in pre-calc. But even after that, I still took calculus. In 12th-grade is when I started to study for math more. Because I didn’t do too well on the first test, so after that, I started to study more. That’s when I started to study for math and it was fun. I took AP calculus BC in high school.

**Post-secondary academic experiences in math.** In addition to sharing their stories of middle and high school, all thirteen participants had a plethora to share about their math during CC. For instance, Carlos had a rocky start that later was overcome with supportive individuals and mentors that guided him to excellence:

It was difficult at first, [I am] speaking of pre-calculus. I failed both pre-calculus sections (algebra and trigonometry). I failed both sections at first. But it was ok because I bounced back for most of them when I retook them.

Carlos credits his success in advanced math classes to one of his community college professor’s dedication and amazing teaching style that turned his world around:

I did well in calc. II because my professor was so awesome. I had the same professor for calc. II, calc. III, and linear algebra… three straight semesters. But what I really liked about him was what I really like about any good quality teacher. He was VERY
passionate about mathematics! And it radiated from him. You could tell that this guy is not just here because he has to just get paid. His excitement to do math was infectious… He was very like corky and dare I say a goofy character. He was a very light-hearted guy. I’d never forgotten him. Today, he’s still one of my favorite professors by far… Yeah, his passion for math rubbed off on me a little bit and I like that!

A handful of participants did not take any math classes in university. The few that did take math classes at the university shared many positive experiences. For example, Carlos expressed the level of difficulty the advanced math courses consisted of:

I had to adapt my way of learning during lecture, especially for this math class. Mathematical methods for physics… Thoughtful!!! Mathematical methods for physics and it’s basically all the math component that you need for physics. Broken down into three sections: complex variables, linear algebra, and differential equations.

Nelson shared a different experience in his discrete math class, “It’s been one of the most interesting ones. It requires a lot of proofs, which I thought I would hate”. However, he experienced the value that his professor brought into the classroom:

The professor makes it interesting in the way he presents proofs. But it is also hard for me because I am used to doing the math and not having to prove anything. So, I don’t know if there is a specific experience since I just started. I think it’s just a new way of math that I really like.

Sully compared learning advanced math concepts to an exponential graph. In the beginning, grasping the concept is rather slow but, with time and effort, concepts are understood at a
rapid pace. “When you are learning a new concept, it’s the most difficult. But once you figure it out, you actually enjoy it”.

**Post-secondary academic experiences in engineering.** Engineering is one of the cornerstones of STEM education; an interdisciplinary curriculum designed to motivate students to learn about science, technology, engineering, and mathematics. The thirteen students interviewed in this study all strive to apply their knowledge from engineering classes into their future professions. All are potentially successful professional engineers that will create, assess, develop, install, and maintain a widespread array of devices, products, and systems. In addition, they will consult and identify materials and processes, manage manufacturing and construction, perform failure analysis, and strengthen engineering education in industry and academia.

Charles recalled an engineering class where the instructor applied real-life concepts to explain the topic. He enjoyed that style of teaching:

> There is a class called ergonomics and that would be my best case. The teacher took a lot of the outside concepts and applied it to outside theories. That class was tough but he made you [critically think]. One of his requirement was to make you think outside the box. [For example,] take something that we learned in class and actually apply it. Because of that [and] because of him doing that. I haven’t taken that class in like a year but I still remember all of the concepts though because he made us apply them. So yes, [It is] different things like perception.

Sega faced challenges with his professor in one of his computer aided design engineering classes at NCA&T:

> He was very difficult in terms of grading. And everybody was scared of him. He
was like if you don’t get this concept, then you are wasting your time. He is the one that believed there are stupid questions. The speed of his teaching was a little too fast for a lot of [students]. Granted there are points in time when that it is needed because it does force you to learn things on your own. That’s what I took away from him… I learned to become more independent. He was like you have your textbook here… you know how to read… let’s keep it moving.

Sully’s relationship with the same professor grew over time and he became more appreciative towards him. “Another thing that I am gracious for him is that he opted to do group projects a lot. And I guess that leads to my story”. This group assignment was the turning point in Sully’s social and academic experience where he developed a close network with two fellow engineering students:

Because two of my good friends, who also end up working with me on my senior design, they were in my class. So that is how I definitely developed that connection with them in order to work on our senior design in the future.

Sully’s experience with his two good friends was not always positive. They had moments at the beginning of their interactions working on the assigned group projects that forced Sully to set definite boundaries:

And then we can go into the whole dynamic of workloads… We had to figure out our roles… Ok who has this responsibility and who’s got this and that. So I did find myself sometimes having to overextend myself and you know that was something that I really never had at the community college. But even then, it was a really good experience. Because I was able to see some of these people grow. After we went through this whole turmoil that ok you need to get your work done and you can’t
always rely on me. This is a group effort! I really started to see the benefit of working with people. To see them develop. To see them grow. Because you now have a new resource, a new friend, to talk to… so it was a very rewarding experience and relationship to be in group projects in his class.

Similar to Sully, Stormy recalled a transformative event in an engineering class. A new professor took over the class during the semester. This event influenced the overall student learning outcome in the classroom:

Last semester, we were supposed to have a teacher for our microelectronics class. Unfortunately, she had gotten into an accident and she wasn’t able to teach for that semester. So the first three to four weeks, we had a different professor who has taught this course before but wasn’t teaching it this semester. And she was a really great teacher and I was able to follow her notes and I was able to understand how to do her homework, thanks to her notes.

However, Stormy’s professor was replaced with a new professor which changed the direction of this class:

It just went horrible! His notes style was different. He would just read from the book. Nobody was really understanding well and that class was really important because you need the class in order to take senior design for this year! And it was just an ugly semester because I didn’t do too well on my test but luckily I was able to make it up on my final and was able to pass the class. It was horrible and stressful.

**Chapter Summary**

In summary, this chapter presented study data of thirteen narratives that were captured via semi-structured interviews at NCSU and NCA&T. All participants were black
males who transferred from community colleges and are currently enrolled in engineering programs at their respective universities. Students were interviewed once for a collective total of 20 contact hours.

The collected data were then divided into themes and sub-themes that relate to the three research questions that guided this research study. Further, the data findings support the stated purpose of the study; to explore the social and academic experiences of black males who have transferred from CCs into engineering programs at four-year institutions and to understand how racial and mathematical identities influenced their experiences.

First, the participants’ overview, interviews, and profiles. Two metaphors were self-identified to describe their academic and social journeys as transfer students. Metaphors captured their impression of being current engineering community college transfer students.

Then, an overview of the study design led to data findings defined as navigating the transfer process, learning complex coursework, experiencing positive reactions from social circles since transferring, becoming an engineering student, making dreams possible, and improving the success rate in engineering.

Next, when investigating factors that shape the transfer process, the findings demonstrated what the participants found to be integral to success. The major factors were developing engineering identities, building cognitive knowledge through community of practice interactions, and understanding engineering cognitively as a field.

Then, findings indicated that participants’ racial and mathematical identities shape their transfer experiences through: 1) racial identity development, 2) various social and academic, and 3) mathematics and engineering classroom experiences.
CHAPTER FIVE: CONCLUSION

This narrative study is intended to understand the culmination of the experiences of thirteen black male students who have transferred from community colleges into four-year engineering institutions in the southeast region of the U.S. This research explored the student participants’ viewpoints based on how they were perceiving their social and academic experiences at the time of the data collection. The purpose of this research was to explore how community college transfer students’ academic and social experiences are shaped by their racial and mathematical identities. Three research questions guided this study:

1. What are the experiences of black male engineering students who transfer from community colleges to four-year institutions?
2. How do personal, social, and environmental factors shape the transfer experiences of black male engineering students who attend four-year institutions?
3. How do racial and mathematical identities shape the transfer experiences of black male engineering students who attend four-year institutions?

This chapter summarizes the study findings and presents three conclusions, implications for methods, implications for engineering education, implications for engineering profession, and recommendations for future research.

Summary of Study Findings

A basic narrative inquiry guided the research design of this work and attempted to answer the presented research questions. Using purposeful sampling, thirteen black male students were interviewed. The participants comprised of eight students who were attending NCSU and five students who were attending NCA&T. All thirteen students transferred from community colleges and were engineering students at their respective
universities. Participants’ ages ranged from 21 to over 50 years of age, with twelve students categorized as full-time students and only one as a part-time student.

All participants were interviewed over the course of six months, requiring a cumulative total of 20 hours of field work. Data analysis of the participants’ interviews consisted of an inductive approach and a constant comparative method. In conjunction with primary data, secondary data were analyzed from a demographic online survey that included MIBI, the two universities’ websites, and engineering transfer pamphlets. The researcher used an observation guide to capture the nonverbal communication of the participants during interviews. This writing process gave the researcher important insight into participant responses. Later, the researcher documented her data analysis process through memos in a reflective journal. To ensure trustworthiness of the research process, the researcher utilized data triangulation, investigator bracketing, and member checks.

Research question one investigated the experiences of participating students. When digging into the data, five themes surfaced with many associated sub-themes. The first theme that emerged was how participants navigated the transfer process. Learning complex coursework and managing the rigor of engineering education was the second major theme. The third theme represented the positive reactions that participants received from social circles since transferring into four-year engineering programs. The fourth theme that developed from the data pointed to their process of becoming an engineering student. The final theme was the students’ perspectives on making dreams possible in engineering.

The second research question examined the factors that influence the transfer experiences of participants. Three insightful themes surfaced from the collective interviews, each with supporting sub-themes. The first theme examined the social and academic factors
that shape students’ success at four-year universities. Theme two was the use of communities of practice to build cognitive knowledge. The third theme was the application of cognitive knowledge to solve complex engineering problems through communities of practice.

The final research question addressed the racial and mathematical identities that influenced the outcome of the transfer experiences of the participants. Racial identity development was the first theme. The next theme examined the process that students used to develop their engineering identity. The third emergent theme captured participants’ narratives that they recollected during math and engineering classes from middle school until the present day.

Conclusions

The research findings of this study led to three main conclusions about the engineering transfer experience processes of black male students. First, a key conclusion is that academic and social experiences revolve around the professional socialization process that leads to the development of engineering mindsets. Second, collaborative and mentor interactions within engineering communities of practice foster the development of engineering mindsets and complex problem-solving skills. Third, racial and mathematical identities directly shape the educational participation of engineering transfer students in a positive and/or negative way.

Conclusion one: Academic and social experiences revolve around the professional socialization process of black male transfer students and lead to the development of their engineering mindsets. The academic and social experiences of black male students define their transfer experiences. Each student’s path takes different turns,
detours, and makes impactful stops. This professional socialization process is fostered by their involvement in lab work, study groups, research experience, and internship environments.

Through this process, students learn different values. They learn to continue in pursuit of maturing practice epistemologies and the prospect of developing their professional identities. Students can practice constants and norms associated with the engineering profession. According to Schön (1987), this socialization is not an independent one-time event but rather a perpetual process that begins from the first group interaction that engineering students embark on, whether in- or outside of the classroom, and continues from there. Thus, this qualitative research extends the findings of Schön’s work by applying the socialization process to black male transfer students in engineering programs at four-year institutions.

According to Halsmer (2008), it is understood by the engineering community that most of engineering education is based on mathematical systems or scientific concepts. To succeed as engineers, it is important that these systems be logically consistent. Therefore, many professional engineers appreciate and value the use of logically consistent systems (Halsmer, 2008). The research findings of this work support and extend the scholarship of Halsmer (2008) to black male transfers.

In this study, the development of black male engineering mindsets of CC transfers is an essential process in maturing students. Through that developmental process, they are challenged to apply their knowledge and skill-set in their field to solve large, systemic problems in the form of NAE grand challenges for engineering. This is recognized at the university level in the maturation process of engineering students who may have disliked
mathematics in middle and high schools, and later recognized its inherent value, power, and beauty in describing complex systems in the physical world.

This research supports the importance of the roles of universities like NCA&T and NCSU in the development of engineering mindsets of maturing students who are intricate members of society. Research universities like the abovementioned have inspired these students to pursue endeavors to change the world and address society’s most difficult challenges. This can be accomplished through engineering innovation, cutting-edge technology, and research. Hands-on academic experiences and integrating research into education equips the students to be future leaders. These potential engineers will provide outstanding services, products and solutions in advanced technology and innovation of North Carolina and beyond.

Research universities are offering formal and informal opportunities for their students to participate in knowledge building, networking, and professional development activities. Faculty and staff share research opportunities which grant students hands-on learning experiences. When students are engaged in research, then their higher educational journeys are enriched. Furthermore, students do express an academic confidence in their abilities to perform engineering tasks as a result of their participations in research experiences. This support’s Wood’s (2010) psychological factor of academic success. Students that believe they are capable in academically achieving their goals are more likely to succeed (Wood, 2010). All of these activities and initiatives not only facilitate the development of the engineering mindsets but also promote the retention of underrepresented minorities in engineering and science majors. Thus, they are prepared for continued success in graduate studies and engineering careers.
Conclusion two: Collaborative and mentoring experiences within engineering communities of practice foster development of their engineering mindsets and complex problem-solving skills. Engineering concepts taught in the classroom are better understood when applied and discussed by students in communities of practice. Communities of practice are groups of individuals who share a common interest or express concern for a set of specific challenges. This group of students interactively engages with one another to improve and apply their knowledge and understanding (Wenger, 1998).

When students gather together in a study group, collaborate on assigned group projects, or engage in co-op/internship teams and/or in an academic research environment, then communities of practice are formed. Further, these communities of practice may include faculty, staff, students, mentors, families, colleagues, and other engineering professionals. From this research, student participants illustrated the connection of communities of practice to the development of their identities, engineering mindsets, and problem-solving skills.

This research suggests a direct connection to the CRT and racial and mathematical identities literature. Conclusion two findings link CRT to racial and mathematical identities literature in the way that 1) communities of practice present professional norms and beliefs that students must understand to become professional engineers; 2) student participants’ shared social and academic experiences within communities of practices that offer a social context to learning mathematics and engineering concepts from peers, mentors, and faculty in a group setting; 3) student autonomy and sense of belonging are strengthened by their interactions within a safe environment. This optimal environment is provided through their enhanced participation in communities of practice that listen to their voice. These mutually
supportive groups often manifest in study groups, research lab groups, or industry co-op/internship teams. Additionally, they host shared goals and activities that provide constructive feedback of the students’ performances.

Technical knowledge is shared and developed within engineering study groups, research lab groups, and/or engineering co-op/internship teams. Members of these teams or groups offer unique skill sets and necessary knowledge that benefit the group as they work together to solve specific engineering problems. Student-participant learning within these communities of practice is directly influenced by dynamic learning situations that are entrenched in the realism of engineering grand challenges.

According to Figure 2 in chapter 2, only certain personal factors from Wood’s model apply to the success of the transfer experience of black males into four-year engineering institutions. For example, family support and peer support were two pronounced themes that support this conclusion. Family support greatly influenced the students’ academic success. Similarly, peer interactions also personally influenced the students’ academic success. External peers are encouraging support systems to students’ academic success. They assist potential transfer students with navigating the transfer application process, as well as mastering mathematics and engineering course material at the two- and four-year institutional level.

In addition to personal factors, there are also institutional factors that shaped the success of black male transfer students. As illustrated in Figure 2, the faculty and student interaction as a community of practice is one of the ways that two- and four-year institutions can meet underrepresented students’ needs (Wood, 2010). This work supports the need for students to feel a strong sense of belonging on campus to persist in their learning and to
succeed academically and professionally (Strayhorn, 2008). This institutional support is represented in mentoring programs and initiatives.

However, not all team interactions are positive. This study found that “certain underrepresented students tended to study alone with detrimental outcomes, while majority students benefited from regular study group sessions which they practice problem-solving” (Packard, 2016, p. 68). The term community refers to a sense of warmth and comfort that fosters a positive and nurturing experience; yet, participant stories presented a series of communities of practice contexts and collaborations that were not entirely positive. Some hinder the student’s ability to obtain new knowledge and practice in specific math, software programming, or engineering skills. Recently transferred engineering students are influenced by their collective experiences as they develop their professional engineering identities.

Most participating students took part in positive collaborative learning experiences. Student-learning within various communities of practice foster numerous situations for knowledge application and definition from interacting with peers at events. The fundamental effort put into developing mathematical and engineering identities enhances learning and influences professional responsibilities that students encounter including accountability, autonomy, and responsibilities. This complex learning process is further enhanced when circumstances challenge student engineering practice and critical thinking to new levels beyond their comfort zone. This places the students into situations that cannot be resolved independently. Engineering students value teamwork through small group projects, study groups, and capstone projects (ABET, 2017).

This study agrees with the work of Packard (2016), where collaborative learning and problem-solving were presented as habits of the mind and led to successful transfer
experiences of black males. Thus, in study groups and group projects, students with academic strengths can mentor other students. This interaction not only helped students with their academic journey but also provided socioemotional support. This work extends existing literature to illustrate that study groups serve as outlets for all students to excel and cooperatively practice difficult skills during their engineering educational journeys.

Conclusion three: Racial and mathematical identities contribute to shaping the educational experiences of engineering transfer students. The third conclusion to be drawn from this narrative qualitative study is the influence of developing racial and mathematical identities on individuals’ educational experiences. The development of positive mathematical and racial identities is a protective factor towards black male students’ persistence in engineering education. Research shows that a less prominent racial identity is related to a weaker academic performance, and a strong salient racial identity is linked to a stronger academic performance (Chavous et al., 2008; Harper 2007; McGee, 2009; Oyserman, 2008; Sellers, 1993).

Many black male transfer students’ identities are shaped by their academic and social experiences. Research shows that AA students who have a strong racial identity are better equipped to navigate negative climates, deal with racism, and tend to have strong self-esteem (Bowman & Howard, 1985; McGee, 2009; Rowley & Moore, 2002; Sanders, 1997). During their academic journeys, students refine their mathematical and racial identity development. For example, students that are at the earlier stages of their transfer years at four-year institutions tend to carry on the same study habits and strategies that they utilized at the community college. Some students begin their four-year transfer experience protective of their alone study time while others rely on peer study groups to excel in their mathematics
and engineering classes.

This research concludes that many black male transfer students begin with an academic, tunnel-vision focus and very little social involvement. This supports McGee’s (2009) findings that many black students who carry realistic beliefs about their race tend to be protective in their thinking and actions (McGee, 2009). The majority of newly transferred students value their study time and perceive social engagements as distractions from excelling in their engineering education.

This work supports the academic factors from Wood’s (2010) model that include successful study habits, and taking advantage of the campus resources that are readily available to students. This research demonstrated that black male transfer students who spent time studying before and after each class on a regular basis and who solved assignments with peers in study groups performed better in their math and engineering classes. In addition, students who utilized academic services on campus such as tutoring centers, libraries, and computer labs felt supported in their academic transfer progress.

Studying alone and limiting peer interactions may be a defense mechanism that newly transferred students utilize. This mechanism seemed to have served them well at the CC. Arriving at a four-year institution and feeling out of place, they tend to continue their old habits that have worked to protect them at the CC. These academic and social strategies soon become stagnant. Students quickly learn that with increasing rigor and coursework load at the university, they must expand their social network with peers and mentors.

As they become acclimated and more comfortable with their new environment and social interactions, this results in a sense of belonging. This sense of belonging shapes their racial identity development (Strayhorn, 2008). Their racial identity development better
equips them to navigate negative climates, deal with racism, and have strong self-esteem as illustrated in this study and other research (Bowman & Howard, 1985; McGee, 2009; Rowley & Moore, 2002; Sanders, 1997).

Where students are in their identity development reflects on how they perceive themselves with respect to other black males. Some participants feel a strong sense of belonging, while others experience exclusion (Strayhorn, 2008). For students to feel connected, they must be seen and involved socially on campus. A student must transition from an individualistic approach of tunnel vision to involvement within communities of practice to facilitate identity development.

There is a sense of vulnerability that takes place. Students that have a strong sense of belonging seem to have a self-believe that they are worthy of this sense of belonging. They seem to have the courage to be imperfect in their ways. They let go of who they should be for connection and choose to be themselves. Thus they fully embrace their transfer experiences academically and socially. They express a sense of willingness to do something when there are no guarantees. Examples of this include students who applied to transfer into a university despite their rejection as freshmen applicants; or their willingness to retake a calculus course for the third time and succeeding.

This conclusion points to the maturing process of black male transfers as they navigate engineering programs as juniors and seniors. A shift in their racial and mathematical identity development occurs around this time in their studies. They begin to recognize the value of social capital and the value of the intersectionality between academics and social engagements. As engineering curricula advances so do their mathematical and racial identities. At this point in their academic careers, students recognize that they are unable to
excel academically on their own. Rather, they witness firsthand the value in collaboration and discussions with other engineering minds. Junior and senior engineering transfer students realize that they must work together with transfer and non-transfer engineering students to solve NAE grand challenges for engineering.

Due to peer collaboration, this research concludes that black male transfer students not only grow in their racial identities but also grow in their mathematical identities. Their mathematical understanding of complex concepts is shaped through study groups, office hours, and lab experiences. Students are able to share knowledge with others and ask critical questions in a safe environment. Moreover, according to mathematical identity literature, math educators guide their students in shifting their viewpoints of mathematics learning from seeing it as simply mastering a set of rules and procedures, to visualizing mathematical activities as meaningful, flexible, productive, and relevant to solving NAE grand challenges for engineering (Boaler, 2002; Edwards, 2010; Kaefle, 2009).

In this work, it can be concluded that students’ mathematical identities are not only influenced by positive mathematics and engineering educators, but also shaped by their interactions with peers and mentors outside of classrooms. This research expands the mathematical identities literature to not only support positive mathematics and engineering educators’ interactions but also interactions with peers and mentors outside of the classroom. These are all key contributing factors in the development of transfer students’ mathematical identities.

On the other hand, there are some CC transfer students who begin their educational journey at the four-year institutions with a cohort of peers that they studied with at the CC. These students have already experienced the social capital value and networking early on in
their academic career at the CC and tend to be more involved socially early on in their academic careers. From this research, it can be concluded that newly transferred students who started their study group collaborations at the CC and continued this collaboration at the university tended to have a more optimistic outlook on their transfer experience than those who did not participate in study groups at the CC.

As the black male transfer students experience the development of their racial and mathematical identities along with social capital through faculty and peer collaborations, students develop a sense of belonging and become part of the engineering professional group. This research conclusion supports the research findings of Strayhorn (2008) that illustrates that sense of belonging, while critical for all students, proved to be significantly more important for black male students at PWIs. Thus, their engineering identity is refined and shaped into professional engineers the closer they are to earning their bachelor’s degrees.

As students advance through these rigorous courses together, they, in turn, inspire and empower one another to succeed. Observing other black students succeeding in their engineering courses and internship motivates others that are at an earlier stage in their educational career. This, in turn, inspires them to give back to the community and they get more involved with national organizations such as the national society of black engineers, engineering fraternities, and other professional engineering organizations.

Students are motivated, empowered, and supported by their engineering department when faculty and peers guide them to better understand how to construct their questions or how to identify individuals to help them in answering these questions. In other words, demonstrating resourcefulness equips students with a positive sense of belonging and support rather than rejection; even when they are referred to someone else to answer their questions.
These social and academic involvements influence the students and their engineering identity development as they approach the completion of their engineering education and enter the engineering workforce.

The following section provides implications for this study. The findings of this work offer implications for research, methods, engineering education, and the engineering profession. These implications support the original purpose of the research which was to critically explore the social and academic experiences of black male students who have transferred from community colleges into engineering programs at four-year institutions.

Implications for Research

The current study findings have implications for research. When reviewing the available scholarship for the intersectionality of CRT and identities in relation to black male engineering transfer students, it was evident that very limited qualitative literature has been published on this topic. Narrative inquiry usage, especially with semi-structured interviews, evoked detailed viewpoints of student social and academic transfer experiences that would have been overlooked in engineering education practice. Additionally, the use of metaphors with this inquiry demonstrated to be an effective mechanism of unlatching dialogues with this generation of students and contributed a showcase of counterstories. Hence, this research study provides increased means to qualitative research to support significant findings that influence the engineering profession and enhance engineering education curricula development and delivery.

The findings of this research could be used to explore other participant demographics, other geographical regions, or to confirm the findings in this study. Knowing the demographics found in this study allows a future line of inquiry to investigate the social and
academic factors and conduct similar online survey and in-person semi-structured interviews to validate these findings.

**Implications for Methods**

This research study is unique to the topic of racial and mathematical identities in community college transfer experiences, especially as it involves black males. Limited qualitative literature has been published on this topic, and specifically the influence of identities on the social and academic experiences and outcomes of black male students who have transferred from community colleges. Qualitative literature is also limited in regards to the ways that CCs have facilitated the development of students’ engineering mindsets as a facet of a maturing engineering education epistemology. This narrative study presents added support of qualitative research to convey significant findings that have a bearing on the engineering profession. In addition, it serves to heighten understanding and application in academic curricula and professional engineering continuing education development.

The use of narrative inquiry, specifically with semi-structured interviews, brings to the surface rich details of students’ social and academic experiences that may not have been reviewed in academic or professional endeavors. The use of metaphors and open-ended questions with narrative inquiry proved to be a highly effective way of unlocking conversation with this specific generation of students and truly contributed a wealth of information. Thus, this research presents added support of qualitative research to convey significant findings that have a bearing on the engineering profession and serve to heighten understanding and application in engineering education.

Additional research is necessary to fully engage this topic. First, future recommendations should explore the influence of the transfer process on setting the stage for
a smooth transition into four-year engineering programs at the collegiate level. Second, past formal and informal mathematical and engineering educational experiences of students, specifically black males, have heightened their racial and mathematical identities and complex problem-solving abilities and aided in the development of their engineering mindsets and identities. Thus, black males need a firmly rooted personal epistemology that bolsters their engineering practice epistemology and engineering skills. Lastly, to further explore the correlation of epistemological development to maturing engineering practice skills, a qualitative, longitudinal study would be an effective means to investigate the development of students’ sophisticated problem-solving techniques and matured engineering identities.

**Implications for STEM Institutions**

From this research, it can be concluded that there is a plethora of ways to practice engineering skills and link tacit knowledge with critical thinking to make informed decisions when attempting to solve NAE grand challenges for engineering. By developing and applying engineering identities that are unique to each student and influenced by the setting and context of the event or challenge, engineering instructors and mentors become the mechanism for classroom introduction to engineering practice. They have unique opportunities to convey the importance of real-world expertise and to motivate students to actively engage in these positive learning environments.

Establishing learning environments both in two- and four-year institutions within engineering communities of practice, such as implementing STEM tutoring centers, can provide additional resources for students struggling to grasp advanced engineering and mathematical concepts. These on-campus centers assume that mentoring or formal tutoring
processes are shared and ensure student learning. Upper classmen or teaching assistants are exemplary role models for maturing undergraduate student epistemologies as well, presenting individual opportunities for role modeling, discussion, and team collaboration.

These STEM centers can offer orientation sessions for undergraduate and graduate students not only in engineering but also in science, technology, and mathematics to introduce the research and academic expectations of all students. They can also strengthen student decision-making abilities and designated mentors model important roles in developing the newest generation of engineering professionals. In turn, it is imperative that both two- and four-year institutions support students and faculty in prioritizing both informal and formal mentoring roles that facilitate the teaching of developing engineers.

Supportive environments positively influence transfer students’ academic and social experiences on campus. This finding suggests that the need for and the influence of community college assistance and support programs is necessary, along with assistance provided from outside of the CC and support that may come from the receiving four-year institution and from other sources including student’s social circle. The transfer success and STEM literature support this type of support including programs that involve the four-year institutions (ABET, 2017; Gilory, 2013; Tinto, 1993; Wood, 2010; Wolf-Wendel et al, 2004).

Specific program examples include:

- A program that is offered through the University of Maryland provides incoming transfer students with a road map and tailored support to success (Gilroy, 2013).
- Programs that provide underrepresented community college students with early access to orientation programs, academic advising, and a step-by-step process to ease credit transfer (Wolf-Wendel et al, 2004).
• Capitol Technology University’s hands-on electrical engineering program provides a collaborative environment where students work in interdisciplinary groups. Students retain knowledge of new concepts through hands-on applications. This cross-disciplinary culture keeps institutions connected with local industry and gearing their student projects to meet their needs when necessary (ABET, 2017).

• Project-based learning at Worcester Polytechnic Institute promotes peer learning and collaboration. Students are immediately immersed in experiential learning from the first day of engineering coursework. This institution values interdisciplinary approach; for example, electrical engineering students take classes with computer science students to work robotic applications and devices. Outside of the classrooms, students are encouraged to work together on high-level, hands-on assignments and capstone projects and are encouraged to collaborate with graduate students and postdoctoral fellows in research laboratories. This project-based approach has been in existence in this institutions since the 1970’s and provide robust platforms for future engineers and scientists (ABET, 2017).

Implications for Engineering Educators and Administrators

A STEM established center will assist students with difficult mathematical and engineering concepts and the requisite skills to such a degree that they can fully participate in their engineering education (Packard, 2016). “Departments may turn instead to creating modules that boost requisite skills rather than turning students away from their majors or enrolling them in core courses they are likely to fail” (Packard, 2016, p. 69).

Additionally, mathematics and engineering faculty must implement structured peer study groups to assist not only newly transferred students but also all new students. These
structured study groups provide a safe environment where communities of practice are formed and will assist in student’s navigation throughout their engineering education as they undertake difficult mathematics and engineering courses. Establishing these groups will discourage students from experiencing alienation while studying alone and carrying on a tunnel vision in terms of their academic and social experience. As students advance in their academic journey, they then have built networks and other relationships with fellow students and faculty. They are able to experience a sense of belonging as they give back to the next group of newly transferred students and/or freshmen classmates.

Educators, mentors, and staff need to consider the influence that their actions, values, and work ethic have on students. Thus, it is imperative to comprehend the detriment to student learning that is conveyed when students are marginalized or underappreciated in the engineering and mathematical context. Both CC and university educators and mentors have great responsibilities to motivate, educate, and inspire their students, including black male students, to achieve their greatest potential academically and personally (Kaefele, 2009). It is their attitude that assists black students in successfully achieving academic excellence under their guidance. Effective educators and mentors keep their students motivated and inspired about learning from the way they teach. The passion, energy, and enthusiasm that educators bring into their lesson daily keeps their students excited about learning regardless of the subject (Kaefele, 2009).

Additionally, administrators can transform the appearance of community college and university campuses by presenting signs of positive affirmation and posters of noteworthy black historical leaders. This exposes students to positive messages and images. Creating a positive campus atmosphere, ensures student’s academic success. Administrators can also
focus on the quality of the educator-student interactions in the classrooms.

Educators are motivators, cheerleaders, and inspirers that empower all students. Every student must be told that they are the most brilliant and most highly capable of achieving academic success in community colleges and beyond. After all, human beings are born with a purpose in life and possess the potential to achieve excellence and greatness in life. Educators must be mindful of the power and influence that they possess through means of written and verbal communication with students. They must actively engage students by posing questions and encouraging them to self-reflect. By asking these critical questions, all stakeholders deeply reflect on already accomplished tasks and on adjustments to improve their current practice. Educators and administrators must trust that they already have answers to many of the questions to meet the classroom needs of underrepresented students and close this gap (Kafele, 2009).

Both CC and four-year educators support student autonomy by enhancing motivational elements that, even if they do not directly affect the academic outcome, are important to the student’s later success in life. Educators motivate their students by sharing their enthusiasm for mathematics and engineering, expressing patience and compassion within mathematical and engineering classrooms, posing integrative questions, facilitating hands-on and engaging discussions, learning students’ names, developing rapport with students, and teaching in a way to inspire students’ desires to learn. Keeping in mind that there is a boundary that educators must be diligent with, to not encroach on students’ decision-making processes, remembering that they do not know their student’s life or true needs (George, 2010).

Diversity in the STEM field is essential. “It has been argued that science-related
fields have historically operated from a standpoint of selectivity and exclusion” (Packard, 2016, p. 4). The weed-out process is described as selectively excluding students that struggle with difficult engineering and mathematics concepts. This practice is absolutely unacceptable, and educators are slowly shifting away from it, “recognizing that diversity and excellence can coexist” (Packard, 2016, p. 4). To make STEM education more inclusive, STEM educators can maintain firm and rigorous teaching styles, however, they also need to address STEM students as humans and not robots, who may experience distress and concerns outside of the classrooms. This research supports the work of Packard (2016) in keeping high standards while supporting and benefiting students from a diverse background through innovation and human capital.

The STEM fields are missing out when they do not include a diverse population. In the context of engineering education, human capital describes the collective tactile skills and knowledge and other intangible assets of students that can be used to create engineering value for the students, their educators, their future employers, or engineering profession. This is a call for involving as many individuals from a diverse population in STEM as possible (Packard, 2016).

This research presents specific implications for not only engineering but also for STEM educators and mentors, at both CCs and four-year institutions. It directly relates the social and academic experiences of diverse students who are actively engaged, included, and provided for with multi-faceted hands-on learning experiences in and outside of the classroom. These opportunities would provide a mechanism for increasing their presence and retention in the STEM higher education.
**Implications for Engineering Profession**

As part of engineering practice, engineers evaluate the use of numerous scientific truths for potential use in the design and development of new systems and technologies (Halsmer, 2008). Engineers analyze natural resources and determine their best uses for the good of humanity. Additionally, individuals’ desire and pursuit of purpose and significance may explain why individuals are the way they are.

Development of an engineering identity is the accumulation and application of a rich knowledge base, mastered technical skill sets, development of strong mathematical and engineering identities, ability to analyze and integrate high-level information, and a firm understanding of NAE grand challenges’ engineering concepts. Engineering students who are nurtured and guided to be an integral part of engineering communities of practice must develop and foster their engineering identity in their own practice, both automatically and deliberately. This process mandates attention to detailed reasoning, critical thinking, problem-solving skill sets, and evaluation. It is this process that challenges their professional scope of practice and actively questions actions based on valid decision-making and solving hands-on and problem-based projects.

As students become more comfortable and knowledgeable in engineering concepts and problem-solving, they develop a firm engineering mindset that, in turn, becomes second nature to them. Students must be confident enough to communicate the technical knowledge and informed judgments that support their decisions within each community of practice. This will help establish their professional engineering identity and reduce any costly errors in application designs.

This research further identifies the importance of communities of practice, the
socialization process, and the important roles that other engineers play in developing the student’s engineering identity. Different research and co-op/internship experiences present communities of practice. These interactions cultivate opportunities for student participation, discussion, and assessment that shapes their professional trajectories. Highly supportive learning environments outside of classrooms should support developing engineering students in their chosen career path.

If presented the opportunity, students and faculty could benefit from shared learning opportunities, specifically mentoring workshops or seminars. Facilitating a shared learning environment would offer scholarship opportunities from multiple participant perspectives, fostering greater discussion and insight of the topic. Ultimately, students and faculty share the occasion to learn not only from the instructor but from one another as professionals advancing their practice epistemology.

In a profession challenged regularly with the demands of new and advanced technology and ever-increasing NAE grand challenges for engineering, students, as well as faculty, must first be technically adept professionals. Then, they must fearlessly learn to act inquisitively, build collaborative relationships, and negotiate the meaning of professional practice necessary to communicate critically and reflectively in context. Case study analysis could easily be adapted into mentoring workshops to challenge both students and faculty in the classroom and laboratory environment. Workshops would engage participants in a discourse on past events and lessons learned. This reflective modeling tool facilitates participants’ growth in their racial, mathematical, and engineering identities via reflection on action. It displaces complacency of actions through reflexive activities and provides varied practical perspectives.
Lastly, an engineer must reflect habitually to grow his/her practice epistemology via authentic, problem-solving skills and collaborative projects with peers. With expertise and maturity comes a more holistic and profound understanding of the profession. Thus, engineers need to be practicing professionals for a period of time before they truly glean the nuances of the profession and develop respect for its complexity and dynamic existence.

Engineering curricula are not tasked with teaching creative engineering classes that offer realistic insight, practice wisdom, and epiphanies that inherently develop with time and expertise. Instead, it behooves the profession to engage the practicing engineer in activities that foster reflection on action, that dissect hands-on engineering practice intricacies for broadened application, and serves as an ongoing reminder that learning never ends. This is achieved through hands-on laboratory sessions, co-op, and internships at engineering firms, and/or research opportunities at the university.

**Recommendations for Further Research**

This research contributes to the body of literature present on Critical Race Theory and mathematical and racial identities. To address the conclusions presented and to foster an effective development of black male engineering transfer students, the following recommendations are made:

1) Through continued use of qualitative research design, additional research studies should be completed on black male engineering student transfer experience, understanding, and application; as well as comparison of the findings to the results presented in this study;

2) Academic curricula must adopt a stronger stance on explicitly including collaborative learning and assigned study groups as an articulated skill that students must master
before assuming the role of a professional engineer. Purposeful activities must be
developed and conveyed so that reflection in and on action is not assumed but
critically challenged in academics;

3) Synergistic education opportunities should be developed between two- and four-year
engineering programs for both faculty and students; building a positive, rewarding
relationship full of open communication will better serve the students in their
engineering academics by bolstering their comfort, building their personal confidence
through engagement, and offering a better venue for constructive criticism;

4) Develop formal mentoring opportunities for students and faculty in different
communities of practice, including reverse-mentoring activities. Building a new form
of communication that dispels the socio-political and clinical context hierarchy will
not only bolster student engagement with faculty and graduate students in a different
light but will also stress the importance of student’s soft or people skills;

5) Focus more research on the role of mentors in different learning communities, or the
lack thereof, and the influence of surface learning on the overall student development
of critical engineering practice.

In summary, it is exciting to share the voice of engineering students who express their
knowledge and development on their journeys in becoming engineering professionals. In the
future, they will contribute engineering solutions to challenges in specific human concerns
like sustainability and health. These engineers will cleverly apply their knowledge to practice
and to solve these NAE grand challenges for engineering. Engineers are equipped with an
army of tools to continue the long tradition of forging a better future by practicing logical
reasoning, scientific discovery, and innovation.
Chapter Summary

This chapter consisted of a concise overview of the research methodology utilized to attempt to answer three guided research questions. The study data analyzed led to three conclusions: 1) academic and social experiences revolve around the professional socialization process of black male transfer students and lead to the development of their engineering mindsets; 2) experiences within engineering communities of practice foster the development of an engineering mindset and complex problem-solving; and 3) racial and mathematical identities contribute to shaping educational experiences of engineering transfer students. Finally, a discussion of these conclusions and their implication to research and practice and recommendations for future endeavors was presented.
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APPENDICES
APPENDIX A: PARTICIPANT INVITATION LETTER

*Black Male Engineering Transfer Students: A Critical Exploration of Their Pathways, Racial Identities, and Mathematical Identities*

My name is Olgha B. Qaqish and I am a doctoral candidate at North Carolina State University in the Leadership, Policy, and Adult & Higher Education under the direction of Dr. Tuere Bowles and Dr. Christine Grant. I am conducting a research study to investigate factors of engineering transfer success for black males in four-year Institutions.

I am inviting your participation, which will involve an interview lasting no more than one hour in length. During the interview, I will ask you a series of questions that focus on your experiences as a black male in your current institution. For your participation, you will receive a $25 gift card to Target. You have the right not to answer any question, and to stop the interview at any time.

Your participation in this research study is completely voluntary. If you choose not to participate or to withdraw from the study at any time, there will be no penalty and you will still receive your $25 gift card. To participate in this interview, you must: a) have transferred from a community college into a four-year university in the last two years; b) have completed a minimum of one semester your current university; c) be at least 18 years old; and d) be enrolled (full-time/part-time) at your institution.

Your participation in this study may lead to findings which can be used to improve the engineering transfer success of black males at southeastern universities. There are minimal risks for participating in this study.

Please note that data collected in this study may be published and presented at professional and research conferences; this may include quotes from your interview. However, your responses and perspectives will remain confidential. As such, no identifying information will be reported. Additionally, your recorded interview will be destroyed upon the completion of this work. I would like to audiotape this interview with your permission. Please let me know if you do not want the interview to be digitally recorded; you also can change your mind after the interview begins. Your digitally recorded interview will be stored under password protected files and password protected laptop.

If you have any questions concerning this research study, please feel free to contact me at Olgha B. Qaqish at xxx-xxx.xxxx. If you have any concerns or questions about your rights as a participant in this research, or if you feel you have been placed at risk, you can contact the North Carolina State University Sponsored Programs & Regulatory Compliance Services at xxx-xxx.xxxx.
APPENDIX B: PARTICIPANT RECRUITMENT MATERIAL

(Updated & Original)

Students are needed for a study of Black males who transferred from a community college in the last two years and are majoring in engineering. Those who volunteer to participate in this study will receive a **$25 Target gift card**.

Students will be asked to participate in a face-to-face interview lasting no more than one hour. You qualify for this study if you meeting the following requirements:

1. You are currently enrolled (full-time or part-time) at North Carolina State University or NCA&T.
2. You are at least 18 years old.
3. You transferred from a community college in the past two years.
4. You have completed at least one semester in engineering at your current university.
5. You are willing to talk candidly about your personal and academic experience.

If you are interested in participating in this study, please contact...

**THANK YOU!!!**
Are You a Black Male Engineering Student? Have You Recently Transferred From a Community College?

Students are needed for a study of Black males who transferred from a community college in the last two years and are majoring in engineering. Those who volunteer to participate in this study will receive $25 Target gift card. Students will be asked to participate in a face-to-face interview lasting no more than one hour. You qualify for this study if you meet the following requirements:

1. You are currently enrolled (full-time or part-time) at North Carolina State University or NCA&T.
2. You are at least 18 years old.
3. You transferred from a community college in the past two years.
4. You have completed at least one semester in engineering at your current university.
5. You are willing to talk candidly about your personal and academic experience.

If you are interested in participating in this study, please contact Olgha B. Qaqish at xxx.xxx.xxxx.

THANK YOU!!!
APPENDIX C: CONSENT FORMS

Minority Male Participant Interview and Data Procedures Consent Form
INFORMED CONSENT FORM for RESEARCH
Title of Study: Black Male Engineering Transfer Students: A Critical Exploration of Their Pathways, Racial Identities, and Mathematical Identities

Principal Investigator: Olgha Qaqish  Faculty Sponsors: Dr. Tuere Bowles and Dr. Christine Grant

You are invited to participate in a research study designed to describe the experiences of black male transfer students. Additionally, this research will also seek to learn about your perceptions of cultural and mathematical identity that contributed to your academic transfer success.

INFORMATION
If you agree to participate in this study you will be asked to participate in one in-depth, face to face interview, complete a demographic and MIBI survey and, and to take photographs of meaningful transfer engineering experiences. If more information is needed after the interviews, I may ask you for a follow-up interview. After the interviews have been transcribed, I will ask you to review the transcripts (which will be sent to you via US Postal Service, along with a postage-paid envelope for its return) for accuracy. The interviews will be conducted during the Winter and Summer 2016 semesters.

- **Interview** – The interview will take an hour. Review of transcripts post interview may take an additional hour total.
- **Demographic Survey** – The demographic survey consists of basic demographic questions about you. It will take approximately 10 minutes or less to complete this survey.
- **MIBI Survey** – The MIBI survey consists of multiple questions about your racial identity. It will take approximately 15 minutes or less to complete this survey.

RISKS
I anticipate potential risks for you to be minimal as a participant in this study. I am aware that during the interview, some sensitive information may be revealed. Your name and any other identifiers associated with you personally will not be used, only a self-selected pseudonym. I will remind you before we begin the interview that you can stop at any time or skip a question you do not want to answer. As stated before you will have the opportunity to review the transcripts to ensure your thoughts and words express your intent.

BENEFITS
Although there may be no direct benefit for your participating in this study, it will document your experiences as a transfer engineering student. Your insights will broaden our understanding of the ways in which participation and your cultural and mathematical identities influence your overall educational journey.
CONFIDENTIALITY
Transcripts will not contain your actual name, only your self-selected pseudonym. Only my faculty dissertation advisory members and myself may participate in a review of these transcripts and my initial coding structure to ensure the accuracy of the findings.

COMPENSATION
At the conclusion of the one-hour interview and completion of the demographic survey, participants will be given a $25 gift card to Target. Participants not completing each aspect of the research will not receive any compensation.

CONTACT
If you have questions at any time about the study or the procedures, you may contact the researcher, Olgha B Qaqish, at xxx.xxx.xxxx
If you feel that 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, NC State University’s Regulatory Compliance Administrator, Box 7514, NCSU Campus (919) 515-4514 or Carol Mickelson, IRB Coordinator, Box 7514, NCSU Campus, (919) 515-7515.

PARTICIPATION
Your participation in this study is voluntary; you may decline to participate without penalty. If you decide to participate, you may withdraw from the study at any time without penalty. If you withdraw from the study before data collection is completed your data will be returned to you or destroyed.

CONSENT
I have read and understood the above information. I have received a copy of this form. I agree to participate in this study.

Participant’s signature________________________ Date________________________

Investigator’s signature________________________ Date________________________
Thank you for participating in this research! We would like to ask you to complete the following demographic questions and the MIBI survey. Note that your answers to these questions will remain confidential and will not be used as part of this research work.

1. My age is ______________.

2. Number of semesters attended in community college ______________.

3. If graduated from community college, what degree did you earn? (AA or AS)

4. Were you part of the Minority Male Mentoring Program (3MP) at your community college? (Yes or No).

5. Declared major at the community college was ______________.

6. GPA from community college was ______________.

7. Which of the following courses have you taken at ANY community college?
   ___ MA 271 Calculus I       ___ MA 280 Linear Algebra
   ___ MA 271 Calculus II      ___ MA 285 Differential Equations
   ___ MA 271 Calculus III     ___ ECO 251 Principles of Microeconomics
   ___ EGR 150 Introduction to Engineering
   ___ EGR 220 Engineering Statistics
   ___ PHY 251 General Physics I ___ CSC 134 C++ Programming
   ___ PHY 252 General Physics II ___ CSC 136 FORTRAN Programming
   ___ PHY 253 General Physics III ___ CSC 148 or CSC 151 JAVA

8. My average grade in community college for the above courses was ______________.
9. What has been the most helpful source of transfer information you have used at the community college?
   ___ An academic advisor
   ___ A success coach
   ___ An instructor
   ___ A staff member
   ___ A Transfer student success course
   ___ A friend or family member
   ___ A representative from a four-year school
   ___ A transfer information website
   ___ A transfer information brochure
   ___ A Transfer fair
   ___ I have not used any of the listed transfer resources
   ___ Other (please specify) __________________________

10. The name of my four-year university is _______________(NCSU or NCA&T).
11. I am currently a member of ________________ (National Society of Black Engineers (NSBE, mentoring program, NCSU AYA, or any other clubs or organizations).
12. Number of semesters attending this four-year university _____________________.
13. I am currently enrolled______________ (full-time or part-time).
14. My current overall GPA is _______________.
15. My current declared major is _______________.

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APPENDIX D CONTINUED

16. Main goal for enrolling in college is ________________________________.

17. What are your future plans in engineering?

18. Do you see yourself graduating in engineering?

19. Do you plan to continue with your declared major or are you thinking of switching majors?

20. If you consider switching out of engineering, what major will you consider instead?

*I will contact you shortly with the possible dates to schedule your interview and determine times you would be available to attend. In addition, I will also email you directions to the location.*

*Let me know if you have any questions at obdavis@ncsu.edu or at xxx-xxx-xxxx!*

Again, thank you for your willingness to participate in this important research. This research study will help in our understanding of the experiences of community college students who successfully transferred into four-year universities while majoring in engineering.

*Adapted from Survey for Demographic Data found in Bloomberg and Volpe, 2008, p. 202.*

**In conclusion, I ask that to you fill-out the following survey:**

**Multidimensional Inventory of Black Identity (MIBI)**

<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Neutral</th>
<th>Strongly Agree</th>
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<tbody>
<tr>
<td>1.</td>
<td>Overall, being Black has very little to do with how I feel about myself.</td>
<td>1 2 3 4 5 6 7</td>
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<tr>
<td>2.</td>
<td>It is important for Black people to surround their children with Black art, music and literature.</td>
<td>1 2 3 4 5 6 7</td>
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<td>3.</td>
<td>Black people should not marry interracially.</td>
<td>1 2 3 4 5 6 7</td>
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<td>4.</td>
<td>I feel good about Black people.</td>
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<td>5. Overall, Blacks are considered good by others.</td>
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<td>6. In general, being Black is an important part of my self-image.</td>
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<td>7. I am happy that I am Black.</td>
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<td>8. I feel that Blacks have made major accomplishments and advancements.</td>
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<td>9. My destiny is tied to the destiny of other Black people.</td>
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<td>10. Blacks who espouse separatism are as racist as White people who also espouse separatism.</td>
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<td>11. Blacks would be better off if they adopted Afrocentric values.</td>
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<td>12. Black students are better off going to schools that are controlled and organized by Blacks.</td>
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<td>13. Being Black is unimportant to my sense of what kind of person I am.</td>
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<td>14. Black people must organize themselves into a separate Black political force.</td>
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<td>15. In general, others respect Black people.</td>
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<td>16. Whenever possible, Blacks should buy from other Black businesses.</td>
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<td>17. Most people consider Blacks, on the average, to be more ineffective than other racial groups.</td>
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<td></td>
<td>Strongly Disagree</td>
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<td>Strongly Agree</td>
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<td>18. A sign of progress is that Blacks are in the mainstream of America more than ever before.</td>
<td>1 2 3 4 5 6 7</td>
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<td>19. I have a strong sense of belonging to Black people.</td>
<td>1 2 3 4 5 6 7</td>
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<tr>
<td>20. The same forces which have led to the oppression of Blacks have also led to the oppression of other groups.</td>
<td>1 2 3 4 5 6 7</td>
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<td>21. A thorough knowledge of Black history is very important for Blacks today.</td>
<td>1 2 3 4 5 6 7</td>
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<tr>
<td>22. Blacks and Whites can never live in true harmony because of racial differences.</td>
<td>1 2 3 4 5 6 7</td>
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<td>23. Black values should not be inconsistent with human values.</td>
<td>1 2 3 4 5 6 7</td>
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<td>24. I often regret that I am Black.</td>
<td>1 2 3 4 5 6 7</td>
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<td>25. White people can never be trusted where Blacks are concerned.</td>
<td>1 2 3 4 5 6 7</td>
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<tr>
<td>26. Blacks should have the choice to marry interracially.</td>
<td>1 2 3 4 5 6 7</td>
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<tr>
<td>27. Blacks and Whites have more commonalities than differences.</td>
<td>1 2 3 4 5 6 7</td>
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<tr>
<td>28. Black people should not consider race when buying art or selecting a book to read.</td>
<td>1 2 3 4 5 6 7</td>
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<tr>
<td>29. Blacks would be better off if they were more concerned with the problems facing all people than just focusing on Black issues.</td>
<td>1 2 3 4 5 6 7</td>
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<tr>
<td>30. Being an individual is more important than identifying oneself as Black.</td>
<td>1 2 3 4 5 6 7</td>
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### APPENDIX D CONTINUED

<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Neutral</th>
<th>Strongly Agree</th>
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</thead>
<tbody>
<tr>
<td>31.</td>
<td>We are all children of a higher being, therefore, we should love people of all races.</td>
<td>1 2 3</td>
<td>4 5 6 7</td>
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<tr>
<td>32.</td>
<td>Blacks should judge Whites as individuals and not as members of the White race.</td>
<td>1 2 3</td>
<td>4 5 6 7</td>
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<tr>
<td>33.</td>
<td>I have a strong attachment to other Black people.</td>
<td>1 2 3</td>
<td>4 5 6 7</td>
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<tr>
<td>34.</td>
<td>The struggle for Black liberation in America should be closely related to the struggle of other oppressed groups.</td>
<td>1 2 3</td>
<td>4 5 6 7</td>
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<tr>
<td>35.</td>
<td>People regardless of their race have strengths and limitations.</td>
<td>1 2 3</td>
<td>4 5 6 7</td>
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<td>36.</td>
<td>Blacks should learn about the oppression of other groups.</td>
<td>1 2 3</td>
<td>4 5 6 7</td>
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<td>37.</td>
<td>Because America is predominantly white, it is important that Blacks go to White schools so that they can gain experience interacting with Whites.</td>
<td>1 2 3</td>
<td>4 5 6 7</td>
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<tr>
<td>38.</td>
<td>Black people should treat other oppressed people as allies.</td>
<td>1 2 3</td>
<td>4 5 6 7</td>
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<td>39.</td>
<td>Blacks should strive to be full members of the American political system.</td>
<td>1 2 3</td>
<td>4 5 6 7</td>
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<tr>
<td>40.</td>
<td>Blacks should try to work within the system to achieve their political and economic goals.</td>
<td>1 2 3</td>
<td>4 5 6 7</td>
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<tr>
<td>41.</td>
<td>Blacks should strive to integrate all institutions which are segregated.</td>
<td>1 2 3</td>
<td>4 5 6 7</td>
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<tr>
<td>42.</td>
<td>The racism Blacks have experienced is similar to that of other minority groups.</td>
<td>1 2 3</td>
<td>4 5 6 7</td>
</tr>
<tr>
<td>43.</td>
<td>Blacks should feel free to interact socially with White people.</td>
<td>1 2 3</td>
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<td></td>
<td></td>
<td>Strongly Disagree</td>
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<td>44.</td>
<td>Blacks should view themselves as being Americans first and foremost.</td>
<td>1</td>
<td>2</td>
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<tr>
<td>45.</td>
<td>There are other people who experience racial injustice and indignities similar to Black Americans.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>46.</td>
<td>The plight of Blacks in America will improve only when Blacks are in important positions within the system.</td>
<td>1</td>
<td>2</td>
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<tr>
<td>47.</td>
<td>Blacks will be more successful in achieving their goals if they form coalitions with other oppressed groups.</td>
<td>1</td>
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<tr>
<td>48.</td>
<td>Being Black is an important reflection of who I am.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>49.</td>
<td>Blacks should try to become friends with people from other oppressed groups.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>50.</td>
<td>The dominant society devalues anything not White male oriented.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>51.</td>
<td>Being Black is not a major factor in my social relationships.</td>
<td>1</td>
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</tr>
<tr>
<td>52.</td>
<td>Blacks are not respected by the broader society.</td>
<td>1</td>
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<tr>
<td>53.</td>
<td>In general, other groups view Blacks in a positive manner.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>54.</td>
<td>I am proud to be Black.</td>
<td>1</td>
<td>2</td>
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<tr>
<td>55.</td>
<td>I feel that the Black community has made valuable contributions to this society.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>56.</td>
<td>Society views Black people as an asset.</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

*Adapted from Sellers, Smith, Shelton, Rowley, & Chavous (1998).*
APPENDIX D CONTINUED

Scales and Subscales of the Multidimensional Inventory of Black Identity (MIBI)

**Centrality Scale**

1. Overall, being Black has very little to do with how I feel about myself. (R)
2. In general, being Black is an important part of my self-image.
3. My destiny is tied to the destiny of other Black people.
4. Being Black is unimportant to my sense of what kind of person I am. (R)
5. I have a strong sense of belonging to Black people.
6. I have a strong attachment to other Black people.
7. Being Black is an important reflection of who I am.
8. Being Black is not a major factor in my social relationships. (R)

**Regard Scale**

**Private Regard Subscale**

1. I feel good about Black people.
2. I am happy that I am Black.
3. I feel that Blacks have made major accomplishments and advancements.
4. I often regret that I am Black. (R)
5. I am proud to be Black.
6. I feel that the Black community has made valuable contributions to this society

**Public Regard Subscale**

1. Overall, Blacks are considered good by others.
2. In general, others respect Black people.
3. Most people consider Blacks, on the average, to be more ineffective than other racial groups (R)
4. Blacks are not respected by the broader society. (R)
5. In general, other groups view Blacks in a positive manner.

(R) items should be reverse coded.
APPENDIX D CONTINUED

Ideology Scale

Assimilation Subscale
1. Blacks who espouse separatism are as racist as White people who also espouse separatism.
2. A sign of progress is that Blacks are in the mainstream of America more than ever before.
3. Because America is predominantly white, it is important that Blacks go to White schools so that they can gain experience interacting with Whites.
4. Blacks should strive to be full members of the American political system.
5. Blacks should try to work within the system to achieve their political and economic goals.
6. Blacks should strive to integrate all institutions which are segregated.
7. Blacks should feel free to interact socially with White people.
8. Blacks should view themselves as being Americans first and foremost.
9. The plight of Blacks in America will improve only when Blacks are in important positions within the system.

Humanist Subscale
1. Black values should not be inconsistent with human values.
2. Blacks should have the choice to marry interracially.
3. Blacks and Whites have more commonalities than differences.
4. Black people should not consider race when buying art or selecting a book to read.
5. Blacks would be better off if they were more concerned with the problems facing all people than just focusing on Black issues.
6. Being an individual is more important than identifying oneself as Black.
7. We are all children of a higher being, therefore, we should love people of all races.
8. Blacks should judge Whites as individuals and not as members of the White race.
9. People regardless of their race have strengths and limitations.

Oppressed Minority Subscale
1. The same forces which have led to the oppression of Blacks have also led to the oppression of other groups.
2. The struggle for Black liberation in America should be closely related to the struggle of other oppressed groups.
3. Blacks should learn about the oppression of other groups.
4. Black people should treat other oppressed people as allies.
5. The racism Blacks have experienced is similar to that of other minority groups.
6. There are other people who experience racial injustice and indignities similar to Black Americans.
APPENDIX D CONTINUED

7. Blacks will be more successful in achieving their goals if they form coalitions with other oppressed groups.
8. Blacks should try to become friends with people from other oppressed groups.
9. The dominant society devalues anything not White male oriented.

**Nationalist Subscale**

1. It is important for Black people to surround their children with Black art, music and literature.
2. Black people should not marry interracially.
3. Blacks would be better off if they adopted Afrocentric values.
4. Black students are better off going to schools that are controlled and organized by Blacks.
5. Black people must organize themselves into a separate Black political force.
6. Whenever possible, Blacks should buy from other Black businesses.
7. A thorough knowledge of Black history is very important for Blacks today.
8. Blacks and Whites can never live in true harmony because of racial differences.
9. White people can never be trusted where Blacks are concerned.
APPENDIX E: PARTICIPANT INTERVIEW PROTOCOLS

Participant’s Pseudonym: __________________
Date: __________________
Place: __________________
Scheduled time: __________________
Start time __________ End time __________

Thank you for your willingness to talk with us. First, we’d like to ask you a few questions about your experience of transferring from a community college to this university. Remember answer only what you want to answer and if you don’t want to talk about something, just say so.

Background and Opening Questions

1. Please tell me about your story to pursue engineering.

2. Why did you decide to major in engineering?
   a. Growing up, did you know a family member, friend, or a role model who was an engineer? If so, did they have any influence on your decision in becoming an engineer?
   b. Do you recall an incident that you’ve experienced that shaped your decision?
   c. How do you feel about engineering courses?
   d. What would you say is the most important aspect of becoming an engineer for you?

Research Question 1: What are the experiences of black male engineering students who transfer from community colleges to four-year institutions?

3. Prior to transfer, as a community college student, what were your experiences (academic and social experiences) like?

4. What did you understand about transferring to this university?

5. Overall, tell me about any challenges that you faced during your transfer experience?
6. What if anything about your everyday life has changed since you transferred to this university?
   
a. Probe for major events
   
b. Attitudes about being in the university.

7. What kind of reactions have you gotten from others in your life since you transferred?

8. How do you think about yourself since you have become an engineering student at this university?

9. How did transferring into engineering change any of your dreams or plans for the future?

Now we’re going to talk about your decision to become an engineer, what you did about that decision, and what the journey to become an engineering student was like.

Research Question 2: How do personal, social, and environmental factors shape the transfer experiences of black male engineering students who attend four-year institutions?

10. What helped you take the step to apply for engineering?
   
a. What are your beliefs about engineering?
   
b. What external barriers have you faced? (if prompting is needed—costs, time, schedule, problems with math).

11. Complete this sentence “Overall, being an engineering community college transfer student is like…”

12. Complete this sentence “I feel ______ at this university”. Why did you choose to say that?

13. Please describe to me the faculty and staff at this university.

   PROBES: What about the campus environment or culture like? What about academically? What about your background (i.e. family or school related)? What about with respect to relationships with faculty, staff, or other students? How does this make you feel?
APPENDIX E CONTINUED

We are almost finished with the questions. Now I’d like to ask a few questions about how you feel about your identity with math and your life since you have transferred into this university.

Research Question 3: How do racial and mathematical identities shape the transfer experiences of black male engineering students who attend four-year institutions?

14. Tell me a story about your math experience during middle school and high school.

15. How about during your community college time, what was your math experience like in the classroom?

16. Tell me a memorable story (best and worst) that comes to mind about one of your math classes at this university.

17. Tell me a memorable story (best and worst) that comes to mind about one of your engineering classes at this university.

18. What has helped you to be successful as an engineering student at this university?

PROBES: Tell me why.

19. How well do you think black male engineering students are performing on this campus?

20. What do you think influences the success of black male engineering students at this university?

21. If you have a magic wand and you are able to change anything at this university that would help black male engineering students. What would it be?

PROBES: If I told you that many black males were dropping out of college and asked you why, what would you say? What do you think would support black male students to stay and finish college?

Final Words and Closing Questions

Thank you for your feedback and I hope I didn’t ask too many questions today.

22. What else would you like to mention that hasn’t been covered during this interview?
The following are probes that will be employed as suggested by Bogdan and Biklen (2003):

What do you mean?
I’m not sure that I am following you.
Would you explain that?
What did you say then?
What were you thinking at the time?
Give me an example.
Tell me about it.
Take me through the experience.

*Adapted from Eaton, Horn, Liston, Oldham & O’reilly (2013) and Senegal (2011).
APPENDIX F: OBSERVATION GUIDE

Observer: Olgha Qaqish
Date of Observation: _______________
Time: ____
Place: ___________________________
Purpose of Observation: ___________________________
Participants Present and How Many: ___________________________

Activities: **Face to Face Interview**

1. What were the main issues or themes that struck me in my observations at this setting?
2. What questions could be asked concerning the place I observed?
3. What questions could be asked concerning the participants I observed?
4. What questions could be asked concerning the activities I observed?
5. For each of the elements of the interview I observed, identify the main information I acquired (or failed to acquire) for the questions above.
6. Was there anything else that struck me as salient, interesting, illuminating or important?
7. If I were to undertake another observation in this setting, what new questions would I consider?

APPENDIX G: SCORING MIBI

Racial identity is one of the most greatly studied facets of blacks’ lives. It has been associated with numerous phenomena pertaining to self-confidence, academic performance, preference for same-race academic advisors, and career ambitions (Sellers et al, 1997). Racial identity serves as a very significant role in the psychological lives of blacks. Some research scholars have made the argument that “Strong identification with their racial group can place blacks at risk for adverse effects associated with the stigma attached to being black, whereas others have argued that a strong identification with being black is a protective factor against racism.” (Sellers et al, 1997, p. 805).

The MIBI instrument attempts to resolve the discrepancies in the racial identity research and to account for the diversity and variety of AA with respect to their identity. Rather than delineating a particular set of attitudes and behaviors that define AA’s meaning of being, the model's approach attempts to determine whether they identify with being AA and represents their attitudes and behaviors towards their identity. More importantly, this phenomenological approach focuses on AA’s beliefs around the significance of race in:

1) How they describe themselves

2) The significance they credit to being members of a racial group.

In other words, the phenomena that this instrument describes are attitudes and beliefs that may influence behaviors or be products of behaviors. The instrument has four distinct scales: identity salience, the centrality of the identity, the identity ideology, and the person’s public and private regards. Salience and centrality ascribe to the significance of race, where identity ideology and public and private regards refer to the meaning that individuals define
APPENDIX G CONTINUED

as members in their AA community. All scales are believed to be stable and rather independent of the individual’s experience in situations and only salience scale is thought to be contextually influenced by the situation (Shelton & Sellers, 1996).

All thirteen participants filled out an MIBI instrument online that is based on multidimensional conceptualization of racial identity, an average score for each of the items within a particular subscale is summarized in Table 4. It is inappropriate to create a sum score for the entire scale. There were eight subscales for centrality items scale, six subscales for private regard items scales and public regard items, nine subscales for ideologies such as assimilation, humanist, oppressed minority, and nationalist. Each subscale was a Likert scale ranging from one to seven. Table 4 is a summary of the average scale for the thirteen samples for all six scales and is organized based on the full sample and by school.

Table 4

Descriptive Statistics for the Multidimensional Inventory of Black Identity (MIBI) by School and for the Full Sample

<table>
<thead>
<tr>
<th>Scale</th>
<th>Full Sample (n=13) Mean</th>
<th>PWI (n=8) Mean</th>
<th>HBCU (n=5) Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centrality</td>
<td>4.91</td>
<td>4.77</td>
<td>5.15</td>
</tr>
<tr>
<td>Regard-Private</td>
<td>6.13</td>
<td>6.40</td>
<td>5.70</td>
</tr>
<tr>
<td>Regard-Public</td>
<td>3.81</td>
<td>3.65</td>
<td>4.07</td>
</tr>
<tr>
<td>Assimilation</td>
<td>4.88</td>
<td>4.89</td>
<td>4.87</td>
</tr>
<tr>
<td>Humanist</td>
<td>5.25</td>
<td>5.32</td>
<td>5.13</td>
</tr>
<tr>
<td>Minority</td>
<td>4.55</td>
<td>4.40</td>
<td>4.78</td>
</tr>
<tr>
<td>Nationalist</td>
<td>3.68</td>
<td>3.49</td>
<td>3.98</td>
</tr>
</tbody>
</table>