

A CULTURAL WEALTH PERSPECTIVE ON SUCCESS AND PERSISTENCE IN
ENGINEERING FOR BLACK AND LATINO STUDENTS: EXPLORING
INTERACTIONS WITH FACULTY AND OTHER INSTITUTIONAL AGENTS

by

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A dissertation submitted to the faculty of
The University of North Carolina at Charlotte
in partial fulfillment of the requirements
for the degree of Doctor of Education in
Educational Leadership

Charlotte

2014

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ABSTRACT

KRYSTAL ALEXIS FOXX. A cultural wealth perspective on success and persistence in engineering for Black and Latino students: Exploring interactions with faculty and other institutional agents. (Under the direction of DR. SANDRA DIKA)

Diversity continues to influence the workforce demands and educational needs of the 21st century; however, there remains a significant underrepresentation of Black and Latino students in engineering programs at higher education institutions and in the engineering workforce. While there is a large body of literature that examines factors related to Black and Latino students' underrepresentation in engineering, many studies do not explore factors and means of empowerment that motivate these students to succeed. Therefore, this study was conducted through a federally-funded project on student-faculty interaction for underrepresented students in engineering to understand how Black and Latino engineering students interpret success through interactions with faculty members (non-engineering and engineering) and other institutional agents, and sociodemographic factors (race, ethnicity, and culture) to navigate at a higher education institution.

Using Yosso's community cultural wealth (CCW) framework, as well as critical race theory (CRT), this qualitative case study examines the experiences of eight successful Black and Latino engineering students at Southern Urban University (SUU). Through an online demographic questionnaire, individual semi-structured interviews, and contextual data related to the institution, four key themes indicated that Black and Latino engineering students perceived that: (1) Both typical measures of academic success and success outside of academic goals were important in ensuring their success; (2) Interactions with engineering faculty were generally indifferent (neither positive nor

negative) while interactions with non-engineering professors and other institutional agents were perceived as overall positive; (3) Sociodemographic factors (e.g., race, ethnicity, and culture) did not play as major of a role in their interactions with faculty members and institutional agents than they did in interactions with peers (gender also appeared as a major factor); and (4) Several forms of community cultural wealth (CCW) were evident in how students interacted with faculty, institutional agents, and peers.

In terms of CCW, participants relied on the social capital from faculty members, institutional agents, and family/peers to aid in their academic success. Additionally, students utilized resistant, familial, aspirational, and navigational capital to cope with challenges with the rigorous engineering coursework and their interactions with engineering faculty and peers. Overall, the findings of the study highlight that more research should be conducted to specifically understand the needs of Black and Latino engineering students as they interact with the faculty members, institutional agents, and their peers at various types of higher education institutions. Furthermore, research should be conducted that examines recruitment of underrepresented engineering faculty members of color (e.g., Black, Latino), and their roles in engineering education. Practical and research implications of the study's findings are considered and discussed as well as future research efforts.

DEDICATION

This work is dedicated to the loving memory of my grandmothers, Thelma and Gennell, and college friend Sequita. The encouragement and support provided by these individuals at various points in my life have been vital in my quest to accomplish major life goals and pursue my dreams. These three women are truly loved and missed. This dissertation is also dedicated to all of the college and college-bound students that I have come into contact with or mentored over the years and the young people that I will work with in the future. Anything is possible if you believe in yourself. Follow through and **BE GREAT LEADERS!**

ACKNOWLEDGMENTS

The completion of a doctorate is not an easy task and would not be possible without major support, encouragement, and guidance. With that being said, I am grateful for another opportunity to pursue a vital part of God's plan for my life. I have always believed in my skills and abilities and lived the motto that "I can do all things through Christ that strengthens me" (Philippians 4:13). God is undeniably my strength and the foundation of my faith as I live in this world. This opportunity would not have been made possible without God's provision. I am blessed beyond measure!

I would like to thank my greatest influencers, my immediate family, the Foxx's, for their unconditional love and encouragement as I accomplish all my goals in life. Brenda and Billy (Mom and Dad), thanks for always believing in me and pushing me to be the leader that you saw in me as a child. To my younger siblings, Shanae and Ricky, thanks for being my "sunshine" and providing the consistent comical relief needed, especially through my tougher days. A special thanks goes to my Wilkerson and Jesus World Soul Center families for their support and encouragement. I would also like to give special thanks to my sister-friends (especially Lori and Maysa), college friends (GO HEELS! GO EAGLES!), YO:Durham family, and all others who have impacted my life for your continued support and friendship. I would also like to say THANK YOU to all who have mentored me (special thanks to Ms. Norma Boone and Dr. Susan Blackmon) and provided guidance over the years.

A special thank you to my Sisters of the Academy (SOTA) family for your support and advocacy throughout this process. I would especially like to thank Dr. Beverly Bower, Dr. Virginia Tickles, and Dr. Tonya Perry for your mentorship and

support during the dissertation process. Additionally, many thanks to the NCCU-MPA program staff and faculty for their support over the years.

I would like to express my sincere appreciation to the Department of Educational Leadership for the opportunity to learn from professors and serve as a research assistant. Many thanks go to Dr. Dawson Hancock for his supervision and guidance while working in this department. I have met some wonderful colleagues at UNC-Charlotte and would like to thank them for their support during the last four years. A special thank you to my colleagues Janice, Cathy, Nachette, Tatia, Leann, Niesha, Kendra, and Tameka for your encouragement and support during this process.

I would also like to express my deepest appreciation to my dissertation committee members, which include: Dr. Sandra Dika (dissertation chair), Dr. Mark D'Amico, Dr. Miguel Pando, Dr. Elizabeth Stearns, and Dr. Brett Tempest. I would like to thank you all for your willingness to serve on my dissertation committee and for the knowledgeable feedback and advice provided during this process. This dissertation study is based upon work supported by the National Science Foundation under Grant No. (1240299). The opinions, findings, and conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the National Science Foundation.

Lastly, to the study participants, I am grateful that you offered your time to share your thoughts with me about how engineering education can be made better for all students, but especially Black and Latino students. This study would not have been possible without your help.

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CHAPTER 1: INTRODUCTION

A rising population of Black and Latino persons as well as increased access to higher education in the United States has led to growing numbers of students of color enrolled in higher education institutions (Anderson & Kim, 2006; Fry, 2011). The proportion of Black people in the United States population has increased by 2% since the 1970s, rising from 11% in 1970 to 13% in 2012 (Gibson & Jung, 2002; United States Census Bureau, 2012). The Latino population, which has surpassed the Black population, continues to be the fastest growing and diverse population of all the racial-ethnic minority groups and has increased from 4% to 17% from the 1970s to 2012 (Gibson & Jung, 2002; Oseguera, Locks, & Vega, 2009; San Miguel & Donato, 2010; United States Census Bureau, 2012). In addition to an increase of Black and Latino persons in the United States' population, there has been a shift in the number of students from these ethnic-racial groups that are attending higher education institutions. In the 1970s, there were only half a million Blacks pursuing higher education in comparison to less than a million Latinos that were attending postsecondary institutions in the 1980s (Anderson & Kim, 2006). Now, the enrollment numbers for Black and Latino students are almost two to three times higher than they were from the 1970s and 1980s (Anderson & Kim, 2006). The next section presents the historical context of how access to higher education has evolved over time for Black and Latino students.

Historical Context

Since the early 1800s, access to higher education for people of color in the United States has increased. In the early 1820s, Blacks were granted rights to attend and graduate from a few specific higher education institutions (Harper, Patton, & Wooden, 2009). Rights expanded to more persons of color with the passing of two acts, the Morrill Land Grant Act of 1862 and the Second Morrill Act of 1890. The Morrill Land Grant Act of 1862 was established to provide every state that remained in the Union a grant of 30,000 acres of public land to sell and utilize the proceeds to establish colleges that educate people in various professions such as agriculture and home economics (Christy & Williamson, 1992; Cross, 1999). This act was not beneficial to persons of color, especially under the conditions of legal separation of races in the South and the continued lack of funding to support colleges for Black students. Therefore, the Second Morrill Act of 1890 was created to establish equal division of funding for colleges that were separated by race (Christy & Williamson, 1992; Cross, 1999). The establishment of both Morrill acts created opportunity for all races to attend higher education institutions and especially provided funding for Black-supported institutions known as Historically Black Colleges and Universities (HBCUs) (Brazzell, 1996; Bowles & DeCosta, 1971; Nevins, 1962; Rudolph, 1990). The case of Plessy vs. Ferguson of 1896 ruled that racial segregation was appropriate as long as facilities and establishments were equal for all races (Anderson, 1988; Freehill, DiFabio, & Hill, 2008),

With the acquisition of Mexican territories in the 1840s and the conquest of Puerto Rico in the 1890s (Cuellar, 2012; MacDonald & Garcia, 2003), access to higher education for Latinos was also an issue during this timeframe. Prior to the 1890s, three

Latino groups resided in the United States; Mexicans, Cubans, and Puerto Ricans (San Miguel & Donato, 2010); of which only a few Latinos from privileged families, specifically those in the Southwest territory, were afforded a postsecondary education in the 1800s (Cuellar, 2012). Catholic educational institutions played a vital role in the history of Latino education in the United States by providing bilingual Spanish and English instruction as well as having grading systems for Latino students while American public schools rejected the Spanish language (San Miguel & Donato, 2010). The University of Puerto Rico was established in 1903 (Cuellar, 2012; MacDonald & Garcia, 2003) as part of a campaign for American values to prepare students for industrial work and establish exchange programs to educate future government leaders. A land grant campus of the institution was established in 1911 under the Second Morrill Act.

“Separate but equal” policies of education continued in the United States until the Supreme Court ruling of *Brown vs. Board of Education* in 1954 that ended racial segregation of public institutions (Brown, 2001; Freehill et al., 2008). In 1944, the Servicemen’s Readjustment Act (also known as the GI bill) was also created, which allowed veterans of color to benefit from enrolling in postsecondary institutions. The court cases along with the creation of federal policies such as The Civil Rights Act of 1964 and the Higher Education Act (HEA) of 1965 ended racial segregation and made higher education more accessible for students of color in the 1960s and 1970s (Allen, 1992; Laden, 1999; Swail, Redd, & Perna, 2003). Federal programs and other opportunities to receive additional academic and financial support were also made available for students of color. Some of those programs (e.g., Pell Grant program, Upward Bound, Talent Search, and other federal TRIO programs) were created to

provide academic, social, and financial support to students (Swail et al., 2003). Hispanic-serving institutions (HSIs) were recognized as a new type of institution under the HEA in 1992 as a result of increase growth of Latino students in higher education institutions in large states such as Texas and California (Cuellar, 2012; Santiago, 2006). The role of HSIs, institutions that enroll 25% or more full-time equivalent (FTE) Latino students, was later modified in 1998 to establish a distinction from other Minority-Serving Institutions (MSIs) (Cuellar, 2012; Santiago, 2006).

Statement of the Problem

Although educational policies that promote racial diversity and access to higher education exist and have improved access for students of color to attend colleges and universities, Black and Latino students continue to struggle with college/university degree completion (Anderson & Kim, 2006; Burke & Mattis, 2007; Flores & Oseguera, 2013; Knapp, Kelly-Reid, & Ginder, 2011). Specifically, research suggests that Black and Latino students remain underrepresented at predominantly White institutions (PWIs), demonstrate lower persistence and degree attainment rates, and experience challenges with funding for college (Anderson & Kim, 2006; ASHA, 2012; Harper, 2006; Harper, Patton, & Wooden, 2009; Perna, Milem, Gerald, Baum, Rowan, & Hutchens, 2006). In general, students of color also encounter challenges such as inadequate pre-college preparation (e.g., lack of knowledge about college, minimal course preparation), financial barriers, and poor adjustment to campus climate (ASHA, 2012; Rodriguez & Wan, 2010).

Black and Latino students experience even more significant challenges to degree completion in engineering. Representation of Blacks among engineering degree recipients decreased from 2010 to 2011 (from 4.5% to 4%) while the proportion of Latino

engineering degree recipients increased by 1.5% (from 7% to 8.5%) during that timeframe (Yoder, 2011). These percentages of engineering degree recipients are low compared to the overall United States' population of Black and Latino persons, which are 13% and 17% respectively (United States Census Bureau, 2012). Research shows that Black and Latino students in engineering, compared to their peers in non-engineering majors, experience greater academic challenges in addition to dealing with barriers such as low persistence and graduation rates, less interaction with faculty, issues with isolation and racial climate, and lower GPAs and less academic preparation (Ankar, 2008; Anderson & Kim, 2006; Bernold, Spurlin, & Anson, 2007; Freehill, DiFabio, & Hill, 2008; Hurtado, Eagan, Tran, Newman, Chang, & Velasco, 2011). These challenges are linked to the underrepresentation of Black and Latino students in engineering and gaps remain in our understanding of how students of color in engineering can be supported to excel in both their higher education and the engineering profession. According to Martinez (2007), the missing elements around the discussion of the representation of students of color within higher education institutions are linked to both the emotional and intellectual connections that students establish while learning in the classroom that empower them to persist. Rather than continuing to highlight the issues that keep Black and Latino students from pursuing engineering degrees, a more critical approach is needed to understand and address the issue of underrepresentation of Black and Latino students in engineering education.

Diversity and Success in Engineering

Racial and ethnic diversities are major influences on the workforce demands and educational needs of the 21st century. Persons of color (e.g., Black, Latino, Asian

American, American Indian, and Two or More Races) currently make up roughly 40% of the United States population and are projected to comprise nearly 60% of the population in the year 2060 (United States Census Bureau, 2012). This projection includes dramatic growth of the Latino population (from 17% to 31% of the total) and modest growth of the Black population (from 13% to 15%) (United States Census Bureau, 2012). Chubin, May, and Babco (2005) argue that diversity is about recognizing the value of cultural differences, which contributes to the establishment of creative teams, generation of feasible solutions, and increase in knowledge and competency among citizens and professionals especially in engineering.

Thus, establishing diversity in engineering is not only vital for higher education institutions, but for the country. With at least 50% of the United States' economic growth for the past 50 years being contributed to STEM disciplines in areas such as education, research, and employment (Malcolm, Chubin, & Jesse, 2004), preparing Black and Latino students to pursue engineering is beneficial because they represent an untapped resource of innovative ideas and creativity (Burke & Mattis, 2007). There has been some recent discussion questioning and citing several arguments pertaining to shortages of STEM employees and the severity of racial gaps in STEM education and the workforce. These arguments are that students of color often become interested in other areas/disciplines, prefer higher wages, and are adequately or overrepresented in some STEM disciplines such as the biomedical sciences (e.g., Anft, 2013; Carnevale, Smith, & Melton, 2011; Economic Policy Institute, 2013; Lowell & Salzman, 2007; Malcom-Piqueux & Malcom, 2013; Xie & Killewald, 2012). However, the underrepresentation of certain groups (Black, Latino, and Native American) based on their proportion in the

population is irrefutable. The diverse experiences, viewpoints, and cultural values of persons of color (e.g., Blacks and Latinos) can add perspective to science-related disciplines, increase and improve STEM-related products and services, inform policies for decision-makers, and expand creativity and innovation in the United States (Burke & Mattis, 2007; Mitchell, 2011; Slaughter & McPhail, 2007).

Therefore, this study seeks to explore the perceptions of successful or high-achieving Black and Latino engineering students utilizing Yosso's (2005) concept called community cultural wealth (CCW). This framework identifies ways that Communities of Color can be empowered through their experiences and various forms of capital possessed that are continuously being shaped. Studying academically successful Black and Latino students can create a deeper appreciation for those specific students of color in disciplines like engineering because it negates the negative societal- and school-level beliefs about their abilities and motivations to persist in engineering education (McGee & Martin, 2011). Evaluating the perceptions of successful Black and Latino engineering students highlights factors that colleges of engineering need to know as they guide and teach students.

Purpose

Interactions with faculty have been linked to success of underrepresented student populations in engineering (Amelink & Meszaros, 2011; Camacho, Lord, Brawner, & Ohland, 2010; Newman, 2011). Alongside interactions with faculty, students' abilities to navigate and interact with institutional agents such as administrators, advisors, mentors/coaches, and other engineering professionals is also related to their success. To make progress towards eliminating the problem of underrepresentation of racial groups

such as Blacks and Latinos in engineering education, increased and positive interactions with faculty members and other agents such as advisors mentors, and other engineering professionals should be promoted (Camacho et al., 2010; Sharkness, Eagan, Hurtado, Figueroa, & Chang, 2010; Vogt, 2008). Furthermore, an understanding of students' interactions with faculty is necessary to develop effective teaching strategies and interventions and to increase access to the many resources that all students, especially Black and Latino engineering students, would be able to utilize as they pursue an undergraduate degree (Dyer-Barr, 2010).

While the literature explains that interactions with faculty and other institutional agents contribute to the overall academic success of students in engineering at higher education institutions, there is also research that suggests that Black and Latino students face other difficulties when it comes to these interactions. Specifically, research shows that the interactions between faculty and students of color may not function in the same ways due to differences in students' background or reluctance to initiate contact with predominantly White faculty (Mook, 2002; Noel & Smith, 1996; Schwitzer, Griffin, Ancis, & Thomas, 1999). Black students may hesitate in approaching White faculty because they fear that those faculty members may have negative perceptions of their race (Lundberg & Schreiner, 2004); and feel that all STEM faculty may not be as committed to spending time with them outside of the classroom (Williamson, 2010). However, Kim and Sax (2009) found that Black students frequently communicate or interact more with faculty than all other ethnic-racial groups (e.g., White, Latino, and Asian American). For Latino students, research-related interactions with faculty were found to be positively related to critical thinking and communication yet tended to decrease Latino students'

gains in cultural appreciation and social awareness possibly because the research experience replaced other areas of campus involvement that may be more enhancing culturally (e.g., student clubs and organizations) (Kim & Sax, 2009). Students of color in STEM not only encounter negative experiences with faculty, but also institutional agents. Research has found that advisors and active campus involvement outside of STEM may have a slightly negative effect on the persistence of STEM students of color because these interactions and activities lead to awareness and value of disciplines outside of STEM; which can influence these students to switch majors (Bonous-Hammarth, 2000; Cole & Espinoza, 2008; Grandy, 1998). Therefore, the ways in which Black and Latino students interact with faculty as well as other institutional agents should be further explored as well as the roles that sociodemographic factors (e.g., race, ethnicity, and culture) play in those interactions.

Another challenge to interactions with faculty that Black and Latino engineering students face is the lack of interactions with same-race engineering professors. Recent data indicate that Black and Latino professors each comprise less than 5% of engineering faculty (2.5% and 4%, respectively, in 2011) (Yoder, 2011). Because of the poor representation of faculty of color in engineering, students of color may not have and/or get discouraged by the lack of potential same-race role models (e.g., Black and Latino engineering professors) necessary to help them adjust while studying engineering (Freehill et al., 2008; Williamson, 2010). Some research suggests that having same-race faculty in engineering for students of color is vital (Leggon, 2010; Newman, 2011; Slaughter, 2009); but Anaya and Cole (2001) found that interracial interactions between students and faculty were positive and aided students in understanding how to work with

racially diverse people and identify and address racial issues. However, the issue of underrepresentation of faculty of color should not be ignored and same-race interactions between faculty and students may serve to motivate students and connect them to resources that account for social and cultural factors. Underrepresentation of faculty of color can be attributed to several factors including lack of students of color pursuing STEM doctoral degrees (Newman, 2011); and expectations for faculty members of color to participate in non-academic activities (e.g., mentoring obligations, participating as a member on various service committees) that take them away from the responsibilities of being a faculty member and put them at risk of not gaining tenure (Allen, Epps, Guillory, Suh, Bonous-Hammarth, & Stassen, 2002). The increase of persons of color pursuing doctoral degrees in STEM and becoming faculty members would possibly alleviate burdens (i.e., balancing multiple leadership roles directly or indirectly connected to diversity and intentionally mentoring or advising students of color because of the same-race connection) associated with being a faculty of color in STEM.

Therefore, taking into consideration the value of racial/ethnic diversity and the need to increase the numbers of students and potential same-race role models (e.g., Black and Latino faculty) in engineering, an understanding of the experiences of successful or high-achieving Black and Latino engineering students' interactions with faculty and other institutional agents should be explored through a lens that acknowledges the unique resources and capital that these students utilize to persist: Yosso's (2005) community cultural wealth framework. Hence, this study was conducted to understand student-faculty interactions for underrepresented students in engineering education. The purposes of this study were to explore: (1) the personal qualities or factors that Black and

Latino engineering students identify as important for persisting and succeeding in engineering studies; (2) the nature of Black and Latino engineering students' interactions with faculty (e.g., non-engineering and engineering) and other institutional agents (e.g., administrators, academic advisors, mentors/coaches, and other engineering professionals), and the role that those interactions play in their academic and social development; (3) the social differences such as race, ethnicity, and culture that underrepresented students of color in engineering suggest influence their interactions with faculty and other agents; and (4) the community cultural wealth (CCW) that establishes how various forms of capital such as aspirational, familial, social, navigational, resistant, and linguistic capital help Black and Latino engineering students navigate in the higher education institution.

Research Questions

The research questions that guided this study were:

1. What personal qualities and other factors do Black and Latino engineering students identify as important for their persistence and success in engineering studies?
2. How do Black and Latino engineering students interact with engineering and non-engineering faculty, and how do they perceive the role of these interactions in their academic and social development?
3. How do Black and Latino engineering students interact with institutional agents (e.g., administrators, advisors, mentors/coaches, and other engineering professionals), and how do they perceive the role of these interactions in their academic and social development?
4. How do Black and Latino engineering students describe the influence of

sociodemographic factors (e.g., race, ethnicity, and culture) on their interactions with faculty and institutional agents?

5. What forms of capital in the community cultural wealth (CCW) framework are apparent in the discussion of personal factors, sociodemographic factors, and interactions with faculty and other institutional agents that facilitate successful navigation in engineering studies among Black and Latino students?

Significance of the Study

Greater persistence and degree attainment in engineering among Black and Latino undergraduate students is important for increasing the number of persons of color in the engineering workforce. Using a novel theoretical lens called community cultural wealth (also referenced as cultural wealth) (Yosso, 2005), this study sought to understand the experiences of students of color in engineering education. While literature on underrepresented students of color in engineering addresses academic and social barriers, there is less focus on how these students utilize their experiences (e.g., academic, professional, social, cultural), skills, and abilities to overcome challenges and successfully persist. Therefore, this study focused on successful or high-achieving students, which allowed for the understanding of what factors, personal qualities, and forms of capital they have utilized to navigate the institution and interact with faculty and institutional agents. By introducing the main conceptual framework, community cultural wealth, and its foundational framework, critical race theory, the researcher takes a critical approach to understand the issue of underrepresentation in STEM education. The findings of this study may generate substantial information that:

- identifies key factors that Black and Latino undergraduate students recognize as vital to their the academic success in engineering;
- illustrates the utility of the CCW framework to understand the success of Black and Latino students in engineering and establishes the need for continued research to diversify engineering education and the workforce; and
- informs recommendations to engineering faculty, administrators, and other institutional agents (e.g., academic advisors, mentors) for the development of programs and activities that promote greater access and persistence for engineering students from underrepresented and marginalized groups.

Key Terms and Definitions

Researchers have utilized various definitions for the key terms mentioned in this study. For the purposes of this investigation, the following definitions apply:

Cultural Capital – This term refers to the accumulation of cultural knowledge, skills, and abilities (e.g., intellectual ability, exposure/access due to family name or wealth, style of speech) possessed and inherited by dominant groups of society (Bourdieu, 1977). This form of capital can be acquired through education and language. Cultural capital, as defined by Bourdieu (1977), plays a vital role in provoking Yosso's (2005) response to developing and describing community cultural wealth (CCW) and other forms of capital.

Community Cultural Wealth or Cultural Wealth – A theory that refers to an array of knowledge, skills, abilities, and contacts possessed and used by Communities of Color to survive and resist forms of oppression. It eliminates the thought that cultures of Communities of Color are deficit and explains how these cultures are empowered through

various forms of capital such as aspirational, familial, social, navigational, resistant, and linguistic capital (Yosso, 2005). The forms of capital will be further examined and described in Chapter Two.

Students of Color – According to Rendón, Garcia and Person (2004), a “student of color” is a socially constructed classification that describes underrepresented groups such as Blacks/African Americans, Latinos/Hispanics, Asians/Pacific Islanders, and Native Americans/Alaska Natives. It is often used in exchange with “minority”, but for this study, students of color will be used more than the term “minority” to reflect the importance of the community cultural wealth framework in eliminating deficiencies of Communities of Color even through use of certain terminology.

Black – According to the National Center for Education Statistics (2013), the Office of Management and Budget coined the term Black in 1997 as a person having origins in any of the Black racial groups of Africa. This term can be used to broadly categorize students who self-identify as any of the following ethnic origins: African American and African, as well as multiple ethnicities/races with one of them being Black, African, or African American and was chosen to provide consistency since the terms African American and Black are used interchangeably in previous research.

Latino –According to the National Center for Education Statistics (2013), the Office of Management and Budget coined the term Latino in 1997 as a person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin, regardless of race. This term broadly categorizes students who self-identify as being Hispanic or Latino/a or a specific ethnic origin, e.g., Mexican, Puerto Rican, Chicano, as well as multiple races with one of them being Latino. Latino and Hispanic are used

interchangeably in previous research, thus Latino was chosen to be clear and concise in this study.

STEM – This term refers to various disciplines in science, technology, engineering, and mathematics. These disciplines include: mathematics, statistics, computer/information science, computer programming, electrical, chemical, mechanical, civil, or other engineering; engineering technology; electronics, natural resources, forestry, biological science (including zoology), biophysics, geography, interdisciplinary studies including biopsychology, environmental studies, physical sciences including chemistry, and physics (Anderson & Kim, 2006).

Underrepresented Racial Minority (URM) – According to the National Science Foundation (2013), women, persons with disabilities, and three racial/ethnic groups—Blacks/African Americans, Latinos/Hispanic Americans, and American Indians/Native Americans—are underrepresented groups in science and engineering because they constitute smaller percentages of science and engineering degree recipients and employed scientists and engineers than they do of the population. The term underrepresented racial minority (URM) relates to Communities of Color that are not numerically represented in the STEM fields as proportioned to their composition in populations in the United States (Reif, 2010). Black/African Americans were 13% of population in the United States in 2012 compared to Latinos/Hispanics comprising 17% of U.S. population (United States Census Bureau, 2012). However, the percentage of engineering degree recipients who are Black is 4%, while 8.5% are Latino (Freehill et al., 2008; Yoder, 2011). Although Southeast Asians are considered an underrepresented group in STEM (Byars-Winston, Estrada, Howard, Davis, & Zalapa, 2010), Asian Americans are not cited as

underrepresented in this study because they represent a larger percentage (12.2%) of engineering degree recipients in comparison to their overall population in the United States (5.1%) (United States Census Bureau, 2012; Yoder, 2011).

Summary

The racial and ethnic diversities of the engineering workforce must be increased in order to keep the United States globally competitive with other parts of the world such as China and India (Martinez, 2007). Increased understanding of Black and Latino student perceptions and experiences of faculty-student interactions can help engineering faculty and administrators become more supportive of underrepresented groups in engineering. This research explores successful or high-achieving Black and Latino engineering students' attitudes toward their interactions with engineering faculty and other institutional agents. By examining successful Black and Latino engineering students and their perceptions of majoring in an engineering discipline, this study adds to the literature (e.g., McGee & Martin, 2011; Newman, 2011) that highlights means of empowerment for students and their interactions with others. Additionally, this study examines sociodemographic factors such as race, ethnicity, and culture; and the role that those differences play in the interactions that Black and Latino engineering students have with faculty and other agents such as academic advisors, mentors/coaches, and other engineering professionals.

Understanding what it means to be a successful or high-achieving Black or Latino student in engineering can be important for linking social differences such as ethnicity or race to a person's self-concept and consequent behavior (Cross, 1991; McGee & Martin, 2011). Research also shows that social factors such as socioeconomic status and ethnicity

have also been identified as predictors of significant achievement gaps in education (Cabrera & La Nasa, 2001; Freehill et al., 2008; Lee, 2011; Perna, 2002). Thus, an understanding of how Black and Latino engineering students perceive these social differences can be useful for explaining how they successfully persist in a challenging discipline through interactions with others (e.g., faculty and institutional agents). Also, the CCW framework can identify how students utilize their various forms of capital (aspirational, familial, social, navigational, resistant, and linguistic capital) through their involvement with faculty and other vital resources such as programs and/or student organizations, involvement with administrators and/or advisors, and mentoring opportunities on campus. The next chapter presents a comprehensive review of the literature, including the historical context of the theories to be explored, critical race theory (CRT) and community cultural wealth (CCW). The literature review also provides an understanding of success or high achievement in engineering and the interactions with faculty members and institutional agents as perceived by Black and Latino students.

Organization of Dissertation Proposal Chapters

The presentation of this dissertation includes five chapters. The introductory chapter (Chapter One) explores the purpose and significance of the study, and defines the research problem and questions to be addressed. Chapter Two, the literature review, highlights the research on student success for Black and Latino students in engineering. The literature review also explores the conceptual frameworks of critical race theory (CRT) and community cultural wealth (CCW) and evaluates Black and Latino students' interactions with engineering faculty members and institutional agents. Chapter Three, the methodology, provides a description of the institutional setting and participants,

identifies the plan for collecting and analyzing data, and addresses the role of the researcher as well as the limitations of conducting the study. Chapter Four describes the key thematic findings from the participants' data; including a demographic questionnaire and semi-structured interviews. The final section, Chapter Five, provides a summary of the findings in connection to CCW and offers practical and research implications for higher education institutions to consider in promoting the success and persistence of Black and Latino engineering students.

CHAPTER 2: REVIEW OF LITERATURE

Student success in higher education is defined from various perspectives. Success has been defined as students' abilities to persist or complete a degree, integrate into the community and demonstrate civic engagement, develop work and life skills, and reach desired career paths and employment goals and outcomes (Burtner, 2004; Kim, Newton, Downey, & Benton, 2010; Navarra-Madsen, Bales, & Hynds, 2010). Student success in engineering has been explained through factors such as pre-college preparation, academic performance (e.g., grades in courses), grade point averages (GPAs), college satisfaction, and student engagement and involvement in clubs/organizations (Bernold, Spurlin, & Anson, 2007; French, Immekus, & Oakes, 2005; Johnson, 2007; Ohland, 2011; Ohland, Sheppard, Lichtenstein, Eris, Chachra, & Layton, 2008; Sharkness et al., 2010). Support from family, peers, and others such as faculty members, mentors, advisors, or other higher education professionals are also vital to college students' success in engineering as they navigate through the higher education institution (Amelink & Meszaros, 2011; Camacho et al., 2010; Newman, 2011; Vogt, 2008).

The role of social and cultural factors must also be considered in determining academic success for students of color in engineering. An imbalance of ethnic-racial diversity in an engineering program can create hostile institutional climates, limit interactions with faculty and peers, and hinder student motivation, of which all affect

academic success (Anderson & Kim, 2009; Cole & Espinoza, 2008; McGee & Martin, 2011). Therefore, the purposes of the proposed study are to understand the personal qualities and factors to which Black and Latino engineering students attribute their success; and understand how sociodemographic factors (i.e., race, ethnicity, culture) and various forms of capital play a role in how Black and Latino students interact with engineering faculty and other institutional agents (e.g., advisors, mentors, administrators). The literature reviewed in this chapter informs the study by highlighting factors that contribute to the success of Black and Latino engineering students and identifying challenges that students face within engineering education. The literature emphasizes the importance of the role of higher education institutions including faculty and institutional agents in aiding in the academic and personal development of Black and Latino engineering students. The review of literature is also important in understanding the context of the importance of education in the United States for Black and Latino students given the increased ethnic-racial diversity that will shape the economic future of the United States.

Chapter Two, the review of literature, is organized into three major sections. The review begins with an overview of understanding the factors that have been traditionally associated with success of students of color in STEM including engineering. Next, literature on the role of faculty-student interactions for Black and Latino engineering student success is reviewed. The search process and criteria for selection of studies is provided in each section. A matrix summarizing all of the studies reviewed (23 total) in both sections is provided in Table 1 (below), highlighting methodological characteristics, theoretical frameworks, and focus of study (success, interactions, or both). Finally, two

related conceptual frameworks that guide the study - critical race theory (CRT) and community cultural wealth (CCW) - are examined, with emphasis being focused on the main theoretical framework, CCW, as an alternative way to understand how Black and Latino students navigate, persist, and succeed in higher education engineering environments. This chapter will conclude with a brief summary of the literature review.

Table 1: Summary of studies exploring student success (SS) and faculty-student interaction (FSI) factors in for URM in engineering

Citation	Methodology	Sample	Data Sources	Theoretical Framework(s) Cited	Factors	
					SS	FSI
Amelink & Meszaros (2011)	Mixed-method	1629 engineering students and faculty at nine institutions; almost 10% URM	Questionnaires/individual and focus group interviews/site visits/institutional documents	Socio-motivational and Student Retention	X	X
Amenkhienan, Kogan, & Lori (2004)	Qualitative	34 engineering students (1 Black male and 2 Black female groups) at one Southeastern institution	Focus groups	Student Persistence/Engagement	X	X
Bernold, Spurlin, & Anson (2007)	Quantitative	1,022 engineering students; about 10% URM; single institution in Southeastern US	Questionnaires; GPA and SAT scores	Student Persistence	X	X
Byars-Winston, Estrada, Howard, Davis, & Zalapa (2010)	Quantitative	223 ALANA science and engineering students; over 50% Black and Latino; single Midwestern, research university	Questionnaires (including a demographic form)	Social Cognitive Career Theory (SCCT)	X	X
Chang, Sharkness, Newman, & Hurtado (2010)	Quantitative	3,670 students (science and engineering) from 217 different institutions; about 45% URM	Questionnaires/institutional data	Student Persistence and Degree Attainment	X	X
Cole & Espinoza (2008)	Quantitative	146 Latino STEM students at a single institution in Western region of U.S.	Questionnaire	Cultural Capital/Congruity and Institutional Climate	X	X
Crisp, Nora, & Taggart (2009)	Quantitative	1,925 STEM students at single HSI in Southern US; nearly 50% were Latino	Institutional data	Student/Institution Engagement Model	X	
Fleming, Smith, Williams, & Bliss (2013)	Mixed-method	200 Black and Latino engineering students at four MSIs	Questionnaire and individual semi-structured interviews	Social Cognitive Career Theory (SCCT)	X	X

Table 1: continued

Citation	Methodology	Sample	Data Sources	Theoretical Framework(s) Cited	Factors	
					SS	FSI
French, Immekus, & Oakes (2005)	Quantitative	Engineering students at a single Midwestern university; about 8% URM	Institutional data	Student Persistence/Attrition	X	
Griffith (2010)	Quantitative	Approximately 2000 STEM students from various institutions; 28% URM in NLSF data and 15% URM in NELS:88 data	Institutional data (NLSF/NELS)	Faculty Gender Outcomes and Student Persistence	X	X
Hurtado, Cabrera, Lin, Arellano, & Espinosa (2009)	Qualitative	65 STEM URM students from four institutions (three are MSIs); roughly 82% Black and Latino students	Site visits, student-level focus groups, and institutional documents	Science Identity and Self-Efficacy, Culture of Science	X	X
Johnson (2007)	Quantitative	77 URM science students from a single Western institution; nearly 80% Black and Latino students	Program/institutional data and questionnaire	Student Persistence/Attrition and Stereotype Threat	X	X
Kokkelenberg & Sinha (2010)	Quantitative	926,759 observations at the student course level for 176 variables and 44,045 students (STEM and non-STEM) at a single Northern university; almost 9% Black and Latino students	Institutional data	Several on Student/Institutional Characteristics and Outcomes	X	
Lord, Camacho, Layton, Long, Ohland, & Wasburn (2009)	Quantitative	79,417 engineering students (including engineering and other STM) at nine institutions; about 18% URM participants	Institutional data (MIDFIELD)	Student Persistence and Social Outcomes	X	

Table 1: continued

Citation	Methodology	Sample	Data Sources	Theoretical Framework(s) Cited	Factors	
					SS	FSI
Martin, Simmons, & Yu (2013)	Qualitative	Four Latina engineering students at a Southwestern institution	Individual semi-structured interviews	Lin's Network Theory of Social Capital	X	
McGee & Martin (2011)	Qualitative	23 high-achieving Black mathematics and engineering students from four Midwestern universities	Semi-structured interviews/demographic questionnaire	Stereotype Threat, Stereotype Management	X	X
Newman (2011)	Qualitative	12 Black engineering students at multiple institutions in the Western region of U.S.	Individual interviews/demographic questionnaire	Fiske's Social-Relational Model	X	X
Ohland (2011)	Quantitative	More than 75,000 engineering students at nine universities; almost 20% URM	Institutional data (MIDFIELD)	Student Persistence/Degree Attainment	X	
Ohland, Sheppard, Lichtenstein, Eris, Chachra, & Layton (2008)	Quantitative	143,160 STEM students from these databases; roughly 20-25% URM for two of three databases (MIDFIELD and APS)	Institutional data	Astin's Input-Environment-Outcome (I-E-O) model and Student Persistence/Engagement	X	
Sharkness, Eagan, Hurtado, Figueroa, & Chang (2010)	Quantitative	4,122 STEM students attending 224 institutions; almost 50% were Black and Latino students	Institutional data	Student/College Outcomes and Degree Completion	X	X
Vogt (2008)	Quantitative	713 engineering students at four west coast research universities; almost 7% URM	Questionnaires	Bandura's Social Cognitive Model	X	X
Williamson (2010)	Mixed-method	99 Black males (STEM students) at a single institution	Interviews/questionnaire	Cultural-Ecological Theory of Minority School Performance	X	X
Zhang, Anderson, Ohland, Carter, & Thorndyke (2004)	Quantitative	87,167 engineering students from nine institutions (URM% varies, two HBCUs)	Institutional data (SUCCEED)	Student Persistence	X	

Success Factors for Black and Latino Students in Engineering

Personal, institutional, and non-institutional factors shape student success and specifically affect Black and Latino students' abilities to succeed in engineering education. An initial literature search combining 'student success' with other keywords such as 'engineering education', 'STEM', 'underrepresented racial minority (URM) students', 'Black students' and 'Latino students' was conducted using both the Google Scholar and University of North Carolina at Charlotte (UNC Charlotte) library websites. Both search engines provided access to indexes of scholarly literature (i.e., peer reviewed and non-peer reviewed journal articles, technical reports, dissertations and theses, books, and other documents) from various databases. The search returned a total of 72 articles. However, in order for studies to be considered in the inclusion of this literature review, articles had to meet the following criteria:

- Peer-reviewed journal article or conference proceedings paper published in last 10 years (since 2004)
- Study participants included Black and/or Latino undergraduate engineering students or STEM students (with emphasis on engineering) as the entire sample or a proportion of sample as comparison groups
- Purpose of study focused on understanding nature or effects of student-faculty interaction or student success in STEM (with emphasis on engineering students) or engineering

Studies meeting these criteria were identified by searching general and subject-specific databases such as Educational Resources Information Center (ERIC), Education Research Complete (via EBSCO), and Academic Search (via EBSCO). A total of 23 empirical

studies published from 2004 to 2014 in peer-reviewed journals met the criteria and were examined (refer to Table 1 for summaries). Other techniques used to identify studies included citation searches of peer reviewed articles and recommendations of articles from experts in the field. The articles were published in various high impact journals such as the Journal of Engineering Education, Research in Higher Education, Journal of Women and Minorities in Science and Engineering, Journal of College Student Development, and the Journal of College Student Retention. Additional information pertaining to the articles can be summarized as follows:

- Methodology: 15 quantitative, five qualitative, three mixed methods
- Sample: 11 single institution; 12 multiple institutions
- Data sources: 12 studies involved a longitudinal data set/study
- Focus: 12 related to Science, Technology, Engineering, and Mathematics (STEM); 11 engineering only

While most of the articles focused on ethnicity/race (e.g., Black and Latino students) in STEM and/or engineering, only six articles focused on a single racial-ethnic group. The articles that focused on Black engineering or STEM students included Newman (2011), Williamson (2010), and McGee and Martin (2011). The articles that focused on Latino STEM or engineering students specifically included Cole and Espinoza (2008), Crisp, Nora, and Taggart (2009), and Martin, Simmons, and Yu (2013). Many studies do not disaggregate by race and gender, or include a small sample of students who are underrepresented in research studies (Newman, 2011; Sharkness et al., 2010). This may be reflective of the underrepresentation that exists in engineering when it comes to women and students of color (i.e., Black, Latino, and Native American students). The

literature on success of students of color in engineering can be grouped into personal factors; sociocognitive characteristics and support; and institutional factors, including institutional selectivity, college/university satisfaction, campus/university climate, and institutional support and programming.

Personal Factors

Personal factors that help Black and Latino engineering students succeed include academic motivation and self-efficacy for pursuing STEM disciplines; and social support from family, peers, and faculty (Hurtado et al., 2009; Martin et al., 2013; Sharkness et al., 2010). According to Amelink and Meszaros (2011), scientific motivation can be defined by four concepts, which include feelings of self-efficacy, self-determination, academic involvement, and commitment to the scientific community. There is a body of research (outside the scope of this review) that suggests that academic self-efficacy, which in engineering refers to a person's confidence in their abilities to complete all of the major engineering requirements of their program, is a strong indicator of student persistence and higher GPAs for engineering students (Concannon & Barrow, 2010; Hackett, Betz, Casas, & Rocha-Singh, 1992; Lent et al., 1984; Sharkness et al., 2010). There are various factors to consider when determining what motivates and boosts the confidence of Black and Latino engineering students. These factors include their study habits, ability to do the rigorous coursework, and encouragement from faculty members (Chang, Sharkness, Newman, & Hurtado, 2010; Hurtado et al., 2009; Sharkness et al., 2010).

Another factor that is vital to the success of Black and Latino engineering students is social support from family, peers, and faculty. Williamson (2010) examined how familial and institutional factors interacted with the academic experiences of 99

Black males in a STEM discipline at a single institution and found that Black male STEM students saw their families as a pivotal force in their education. Although Williamson (2010) found that family promoted the success of Black males, another study conducted by Martin et al. (2013) found that Latina women had low levels of family social capital and relied on the social support from peers, faculty, and other institutional agents to be successful. Similarly, students who engage in quality relationships with others tend to perform better academically while students who do not engage in social activity, or who worked more, had lower GPAs (Sharkness et al., 2010). The development of relationships with peers and faculty and continued support from family members ensures that students are able to better adapt to the college life and find balance between social and academic endeavors.

Institutional Factors

Institutional factors, such as institutional selectivity; college/university satisfaction; campus/university climate; and institutional support and programming, play a vital role in the success of underrepresented engineering students (Cole & Espinoza, 2008; Griffith, 2010; Johnson, 2007; Ohland, 2008). According to Ohland et al. (2008), institutional structures, programs, and policies have a major influence on persistence of engineering (labeled as “E” in study) and science, technology, and mathematics (STM) students. Ohland et al. (2008) found that 34% of both engineering and other STM students were more likely to participate in at least five hours of activities outside of the classroom such as student organizations, campus publications, and other student-led activities. In a research article consulted for this study (not reviewed), it was found that participation in STEM-focused academic support programs has been associated with

higher predicted grades (Navarra-Madsen et al., 2010) and it has been suggested that participation in these programs partially compensates for inadequate preparation for rigorous college coursework in STEM disciplines; which tends to be more prevalent among underrepresented students of color (Sharkness et al., 2010). Institutional programs that incorporate non-academic support are also important for success among students of color. Johnson (2007) conducted a longitudinal study that evaluated an institutional support program for students in the Minority Arts and Science Program (MASP) and found that MASP participants who were Black, Latino, and American Indian were 49% more likely to graduate in science fields in comparison to 30% of students of color who were not in the MASP program. Students who participated in this study strongly valued the financial and academic support, as well as relationships that formed with faculty members.

Institutional emphasis on research and undergraduate programs may also play a role in student success. According to Griffith (2010), increased expenditures on research in less selective institutions along with institutions with more focus on undergraduate programs have been closely associated with higher persistence rates for undergraduate students of color in STEM disciplines. Griffith (2010) suggests that the emphasis on institutional programming for undergraduate STEM students creates a more welcoming environment. Additionally, increased efforts to serve STEM students of color (especially at minority-serving institutions such as HBCUs) tend to draw more students of color to both undergraduate and graduate STEM programs (Hurtado et al., 2011). Institutional support and programs reinforce persistence for underrepresented students such as Black

and Latino students in STEM disciplines and should be utilized to provide both academic and social balance for students.

Institutional selectivity is another major factor that contributes to student success for Black and Latino engineering students. High institutional selectivity is associated with decreased retention in the STEM fields across all students; however, selectivity may be positively associated with increased retention of underrepresented students of color in STEM disciplines at HBCUs (Chang et al., 2008). In consulting an article by Chubin and colleagues (2005), it was found that HBCUs significantly contribute to the number of engineering degrees completed by Black students, but show that there is no major indication that HBCUs have higher or lower persistence rates than predominantly White institutions. However, Chang et al. (2008) found that students have a higher chance of persisting in the sciences by attending an HBCU. Crisp et al. (2009) found that HSIs may be an important point of access and opportunity for Latino students, but that the role of HSIs was unclear based on their analysis of the data. The Crisp et al. (2009) article was limited to one single institution and did not consider key factors related to STEM outcomes such as racial climate, students' self-efficacy, and mentoring support from family and peers (all which can affect environmental variables).

Similarly, Chang et al. (2008) found that PWIs and HSIs have higher levels of selectivity than HBCUs; thus, persistence rates decrease. However, Cole and Espinoza (2008) found that positive interpretations of the campus climate came from support from faculty rather than support from studying with peers and that Latino students were represented in high numbers at HSIs. Cole and Espinoza (2008) suggest that these positive interpretations allow for cultural congruity, which leads to higher GPAs for

Latino students. These findings support that persistence and retention can vary by institution and the available support at that particular institution can determine how students of color succeed in engineering (Cole & Espinoza, 2008; Lord et al., 2009; Ohland, 2011).

In analyzing reviewed studies and consulting additional literature, it was found that campus/university climate and satisfaction can be very beneficial to underrepresented students of color in engineering and has been regarded as an important factor in student success (Brown, Morning, & Watkins, 2005; Cole & Espinoza, 2008; Trenor, Yu, Sha, Zerda, & Waight, 2008). It was also found that adapting to the college climate could be beneficial and improve academic performance as well as students' sense of belonging (Foor, Walden, & Trytten, 2007; Miller, Pyke, Wintrow, Schrader, & Callahan, 2009; Sharkness et al., 2010). A student's positive sense of belonging can deter any feelings of isolation from a hostile climate (Foor et al., 2007). This is especially important for underrepresented students of color in engineering at predominantly White institutions because research shows that they may feel alienated due to the lack of diversity with peers and faculty members in their engineering programs or hostile campus climates they may experience (Cole & Espinoza, 2008; Foor et al., 2007; Strayhorn, Long III, Kitchen, Williams, & Stentz, 2013).

In consulting an article by Griffin and Hurtado (2011), engineering students of color who attended minority-serving institutions were usually highly supported in their environments. This is because they tended to feel culturally accepted and validated. Research on institutional factors that influence academic showed that Black and Latino STEM/engineering students who attended MSIs and join programs focused on students of

color tended to have higher academic performance than their peers who attended predominantly White institutions or who did not participate in programs centered around students of color (PWIs) (Brown et al., 2005; Chang et al., 2008; Cole & Espinoza, 2008; Crisp et al., 2009; Johnson, 2007). Therefore, it is important for underrepresented students in engineering to be connected to resources and programming that emphasize cultural factors at all institutions (e.g., PWIs, MSIs) so that students can successfully adapt to the environment and have a higher academic performance.

Theoretical Perspectives

Various theoretical perspectives have been utilized to explain how Black and Latino students successfully navigate through a higher education institution. Based on the review of the 23 articles, theoretical models used to explain student success and/or faculty-student interactions in engineering ranged from social models (e.g., stereotype threat, social cognitive/social cognitive career models, social-relational models, cultural congruence/capital) to models of student persistence and retention, and student engagement. Specifically, some studies focused on social and cultural models and how these models impact the success of engineering students of color (e.g., Amelink & Meszaros, 2011; Byars-Winston, Estrada, Howard, Davis, & Zalapa, 2010; Cole & Espinoza, 2008; Fleming et al., 2013; Martin et al., 2013; McGee & Martin, 2011; Newman, 2011; Williamson, 2010; Vogt, 2008).

However, some of the classic theories or studies that serve as key models in student success for engineering students include: Tinto's models (1975, 1982, 1987, 1993), Seymour and Hewitt's study of *Talking About Leaving: Why Undergraduates Leave the Sciences* (1997), Astin's models (1970a, 1970b, 1975, 1984, 1993, 1999), and

Scientific and Engineering Self-Efficacy (Bandura, 1997; Concannon & Barrow, 2010). It is important to examine these theories not only to understand how they are validated through the research, but also to provide an understanding of why they are necessary in studying student success of Black and Latino engineering students.

Tinto's Models. Theoretical models of academic success are useful to the degree in which they can investigate how outcomes are predicted by factors related to students (e.g., previous academic attainment and academic involvement on campus) and institutions. (French et al., 2005). French et al. (2005) describes Tinto's model of integration as being important for understanding the degree to which a student identifies with an institution and providing measures of academic outcomes at both the student and institutional level. Other models developed by Tinto such as the model of attrition, student retention, institutional departure, and student engagement have also been vital in understanding how to retain students of color who are often underrepresented in engineering. Various reviewed articles mentioned at least one of Tinto's models as vital to determining success outcomes for Black and Latino engineering students (Amenkheinen, Kogan, & Lori, 2004; Bernold, Spurlin, & Anson, 2007; French et al., 2005; Kokkelenberg & Sinha, 2010). A longitudinal study by Bernold et al. (2007) highlighted that success means evaluating external factors (curricular and pedagogical experiences establish by faculty and administrators at the institution) and internal factors (students' attitudes in the learning experience). It was found that alternative pedagogical models may aid in the retention of engineering students of color and that faculty-student mentorships were helpful in helping students adjust to the learning process in an engineering program. While there is a critique of Tinto's models related to not

understanding the experiences of students of color (Rendón, 2006), these models should be considered in how Black and Latino engineering students' needs are met while pursuing engineering.

Seymour and Hewitt's Study. In the study by Seymour and Hewitt (1997) entitled *Talking about Leaving*, they interviewed 425 STEM undergraduate students and found that their experiences in STEM education along with the culture of the discipline had a great impact on attrition. This study has been used to understand the unique experiences of engineering students of color in STEM (Chang et al., 2010). There are seven articles that highlight Seymour and Hewitt (1997) as being a theoretical framework to help define success for Black and Latino engineering students of color (Hurtado et al., 2009; Johnson, 2007; Lord et al., 2009; Ohland, 2011; Ohland et al., 2008; Vogt, 2008; Zhang, Anderson, Ohland, Carter, & Thorndyke, 2004). Zhang et al. (2004) identified factors that influenced graduation and retention for 87,167 engineering students over a 15-year period (1987-2002). Six predictors (ethnicity, gender, high school grade point average, SAT math score, SAT verbal score, and citizenship status) and their dependence on graduation were studied. It was found that high school GPA and math SAT scores were positively correlated with graduation rates; ethnicity was also significant, but gender did not play a role in graduation rates. This study highlights that pre-existing factors such as high school GPA and math SAT scores along with the ethnicity of an engineering student can be important in predicting their overall academic success (Zhang et al., 2004). The academic merit (e.g., GPA and SAT scores) is usually examined when understanding why students stay or leave engineering. However, the background of students of color including access to quality teachers, curriculum, and resources that are vital to building

their confidence and identity in engineering should also be considered. Vogt (2008) found that positive faculty-student relationships were important to the success and retention of engineering students and that faculty should pay more attention to how they avail themselves to students to increase students' self-efficacy.

Astin's Models. Astin's theoretical models (1970a, 1970b, 1975, 1984, 1993, 1999) have been used to evaluate student involvement, college impact, and student retention. Specifically, Astin's Theory of Student Involvement (1984) emphasizes the importance of students' engagement and participation in various clubs/student organizations and other non-academic activities while on campus as they integrate into the institution. Astin's longitudinal study sample included 25,000 students who attended more than 200 four-year colleges and universities during the time period 1985 – 1989. Results showed that involvement with faculty, peers, and academic work had a positive impact on student retention while the variables that had negative relationships with retention were linked to isolation or disconnection (Dika & Lim, 2012).

This theory along with Astin's other models are important to the success of students of color (especially in a field such as engineering where they are often underrepresented) because they provide useful suggestions for how Black and Latino engineering students should be engaged when it comes to interactions with their professors, peers, and other institutional offerings on campus. Articles that utilized Astin's models to describe factors of success for engineering students of color (Amenkheinen et al., 2004; Kokkelenberg & Sinha, 2010; Ohland, 2011; Ohland et al., 2008; Zhang et al., 2004). In a study by Ohland et al. (2008), factors of engagement and educational outcomes were explored. It was found that engineering students are similar

to other non-engineering students in relation to institutional and classroom engagement (e.g., on-campus employment, time spent commuting to class, or relaxing and socializing and faculty interactions).

Scientific and Engineering Self-Efficacy

Academic self-efficacy is conceptualized as a predictor of student success especially for engineering students (Concannon & Barrow, 2010). Self-efficacy develops through exchange of individual perceptions, behaviors, and environmental factors (Bandura, 1997). Bandura (1997) highlights that when negativity becomes the focus of a group that the group members start to believe that those characteristics are associated with them, which can affect academic outcomes. Hurtado et al. (2009) suggest that science identity and scientific self-efficacy are strong theories that highlight the influence of social structures while also valuing the importance of individual beliefs and behaviors.

Similar to scientific self-efficacy, engineering self-efficacy looks at how engineering students maintain their confidence as they endure challenges of completing their engineering programs (Concannon & Barrow, 2012). Two studies (Hurtado et al., 2009; Sharkness et al., 2010) consider academic self-efficacy as a theoretical framework for evaluating student success while a study by Vogt (2008) highlighted the role of engineering self-efficacy. Vogt (2008) conducted a study consisting of 713 students who were members of either the Institute of Electronic and Electrical Engineers or the Society of Women Engineers (SWE). The purpose of the study was to examine the influence of environmental factors and evaluate how faculty distance affected students' self-efficacy, academic confidence, academic performance (e.g., GPA), and learning behaviors. Vogt

(2008) found that students who had felt that faculty members were approachable and supported them had higher levels of self-efficacy. A study by Hurtado et al. (2009) focused on how underrepresented students of color from four different institutions experienced science and found that conducting research increased students' confidence and that students experienced racial and social stigmas from participating in structured research programs for students of color. Although academic self-efficacy can enhance student success, structured research programs can hinder success through the stigmas that come from being an engineering student of color.

Summary

The literature on student success factors in engineering for students of color can be categorized into personal and institutional factors. There are several personal factors such as self-efficacy, academic motivation, and support socially from family and peers; on the other hand, there are also institutional factors that are vital to the academic and social success of Black and Latino engineering students including campus climate, institutional satisfaction, and both academic and non-academic institutional programming. The research has been primarily quantitative in nature, including the use of longitudinal data sets. Classic higher education theories are prevalent (e.g., Tinto, Astin); however, theories are more specific theories related to STEM that have also emerged to explain and understand success in engineering.

Faculty-Student Interaction for Black and Latino Engineering Students

Faculty-student interactions are vital to the success of all students, but especially underrepresented students of color in disciplines such as engineering. In this study, faculty-student interactions are defined as contact between faculty members and

underrepresented students of color in engineering. Contact between faculty members and underrepresented students of color in engineering may include face-to-face meetings during office hours, email communication, phone calls, contact during campus and off-campus events that are both engineering or non-engineering related, and contact through research and internship opportunities with faculty members.

The review of studies that included faculty-student interactions in engineering presented herein includes 15 studies that were found as the result of searching additional keywords along with those described in the previous section, such as ‘faculty-student interaction’ and ‘interaction with faculty’ through the Google scholar and UNC Charlotte library search engines. The articles included were published since 2004 in peer-reviewed journals including the Journal of Engineering Education and the Journal of Women and Minorities in Science and Engineering and were selected based on the criteria mentioned above. Methodological characteristics of the studies included:

- Methodology: Eight quantitative, four qualitative, three mixed methods
- Sample: Six single institution; Nine multiple institutions
- Data sources: Nine studies involved a longitudinal data set/study
- Focus: Nine related to Science, Technology, Engineering, and Mathematics (STEM); six engineering only

While most of the articles focused on ethnicity/race (e.g., Black and Latino students) in STEM and/or engineering, only four articles focused on a single racial-ethnic group. Several of the 15 studies focused on social theories (e.g., stereotype threat, cultural ecological theory, cultural capital, cultural congruency, social cognitive theory, social-

relational) while others focused on Astin's and Tinto's models, and academic self-efficacy (refer to Table 1).

In consulting literature outside of the reviewed studies, research shows that faculty-student interactions can generally be beneficial in looking at various student factors such as academic performance, persistence, retention, institutional commitment, and intellectual development (Astin, 1993; Carini et al., 2006; Cole, 2010; Eimers, 2001; Kim & Sax, 2009; Pascarella & Terenzini, 2005; Tinto, 1994). This section of the review of previous literature examines those factors and looks at how various aspects of faculty-student interactions promote success for underrepresented students of color in engineering especially Black students.

Academic Performance

Faculty-student interactions are vital to academic success, especially for underrepresented students of color who are pursuing a science or engineering degree (Cole & Espinoza, 2008; Leslie, McClure, & Oaxaca, 1998; Sharkness et al., 2010). For underrepresented students of color (i.e., Black, Latino, Native American) in STEM disciplines, frequent interactions with faculty and support from faculty is associated with higher grades (Cole & Espinoza, 2008). Additionally, Carini et al. (2006) suggests that there is ample research on URM students' interactions with faculty that suggest that positive quality relationships are highly linked with students' academic performance and that faculty mentorship can lead to higher academic performance for students even if they entered with low SAT scores from high school. Specifically, Cole and colleagues found that perceived support from faculty members contributed to better grades for Black and Latino students (Cole, 2008). In contrast, negative feedback and study assistance from

faculty members as well as students' distance from faculty led to lower grades or GPA, and indicated challenges with self-efficacy and confidence (Cole, 2008). Some researchers have found that students who enter with lower SAT scores, but develop strong relationships with faculty, are more than likely to improve their academic performance (Carini et al., 2006).

There have been some conflicting results based on race/ethnicity. While higher grades and improved academic performance have been linked to conducting research with a faculty member (Barlow & Villarejo, 2004) especially for Black students (Kim & Sax, 2009), one study found that Black students' interactions with faculty members related to courses did not predict higher GPAs for them (Kim & Sax, 2009). However, Cole and Espinoza (2008) found that support and interactions with faculty were very beneficial for Latino STEM students and improved their academic performance. Overall, the quality of interactions with faculty members for underrepresented students of color is positively connected to their academic performance and success; however, some literature suggests that URM students receiving criticism from faculty or interacting with faculty to discuss course materials did not increase students' academic performance.

Retention and Persistence

Support from faculty and a conducive learning environment provided by faculty members are critical to the retention and persistence of students in engineering (Amelink & Meszaros, 2011). In fact, cultural atmosphere has been positively associated with academic grade performance and retention of engineering undergraduate students (French et al., 2005; Vogt, 2008). According to Ohland et al. (2008), the persistence rates of engineering students are higher than students in other majors; however, research

demonstrates that Black and Latino engineering students are underrepresented and have lower persistence rates. Additionally, underrepresented students of color may hesitate in interacting with predominantly White faculty out of fear that those faculty members have negative perceptions of them and prefer to disclose more information to faculty that are of the same race/ethnicity (Noel & Smith, 1996; Schwitzer et al., 1999). However, in a study conducted by Byars-Winston and colleagues (2010) that investigated the academic interests and goals of 223 African American, Latino, Southeast Asian, and Native American undergraduate students, it was found that students' interactions with peers, staff, and faculty outside of their ethnicity increased their confidence and success in STEM undergraduate education. Despite the challenges of Black and Latino engineering students approaching non-minority faculty, interactions with institutional agents such as faculty, staff, and administrators are important to students successfully maneuvering through the institution and making valuable connections (Amelink & Meszaros, 2011; Newman, 2011).

Institutional Commitment

Institutional commitment such as students' sense of belonging or connectedness to a college/university campus and overall satisfaction and adjust to campus/university climate are important. According to Camacho et al. (2010), faculty members have major influence over students and the opportunity to change the climate and social structure of their institutions. Support from faculty and peers are important to the success of URM engineering students and can lead to a better developed sense of belonging and engineering identity especially for students who attend HBCUs or HSIs (Fleming, Smith, Williams, & Bliss, 2013). Institutional commitments also include the institution's role in

ensuring diversity and engagement for underrepresented students of color in engineering. According to Davis and Finelli (2007), service-learning courses and undergraduate research programs that provide a connection between academic coursework and real-world experience are an important step in promoting diversity and ultimately retention in engineering. Additionally, Hurtado and colleagues (2009) found that taking engineering courses and conducting research increases underrepresented students' sense of independence and confidence in their science inquiries and reinforces engagement and collaboration between those students and their peers or faculty members. Overall, institutional commitment serves as a key factor in examining the academic success of underrepresented students of color in engineering and leads to promising retention efforts for students of color nationwide.

Personal and Intellectual Development

Personal and intellectual development are important for students because it allows them to become more knowledgeable and be able to make decisions not only at higher education institutions, but as they pursue their career paths. According to Pascarella and Terenzini (1991), students' interactions with faculty members significantly affect their intellectual development. Specifically, higher levels of satisfaction with faculty interaction increased students' scientific reasoning, career development, intellectual development, and problem solving; but problem solving and intellectual development significantly increased for students of color (Eimers, 2001). Vogt (2008) found that the more faculty members showed interest in the engineering students who participated in the study, the higher the student's self-efficacy. This highlights that faculty members play a major role in building students' confidence and self-efficacy (Amelink & Meszaros,

2011; Vogt, 2008).

In consulting an article by Bonous-Hammarth (2000), it was found that students' interactions with STEM faculty on research projects can encourage critical thinking. Additionally, participation in research with faculty members can lead to increased knowledge of STEM fields, more exposure to what a scientific career may look like, and better performance in science classes for students of color (Hurtado et al., 2009). Exposure and access to resources and knowledge through faculty members can develop engineering students' intellectual thinking and personal development. Personal and intellectual development are vital to the success of Black and Latino students in engineering because it allows students to critically think more about various research and engineering-related projects, but also increases their self-efficacy and promotes a greater confidence in their interactions with faculty members.

Summary

Faculty-student interactions in engineering are essential for the academic and personal success of students of color and can be grouped into factors such as academic performance, retention and persistence, students' intellectual and personal development, and the commitment of the institution. Most literature studies found on faculty-student interactions in engineering and STEM have been primarily quantitative and only half of them included the use of longitudinal data sets. Theories provided to understand faculty-student interactions included social theories (e.g., stereotype threat, cultural ecological theory, cultural capital, cultural congruency, social cognitive theory, social-relational) and the customary models used to characterize student-faculty interactions such as Tinto's models, Astin's models, and academic self-efficacy.

What's Missing in the Literature?

Although there are numerous research studies that explore factors that contribute to student success in engineering and the factors that affect the retention and persistence of engineering students of color, our current understanding is limited since much of the existing literature does not evaluate specifically how Black and Latino engineering students can utilize their racial and cultural differences to succeed in and out of the classroom as they interact with engineering faculty and other agents. Many studies focus on how underrepresented students of color can academically or socially integrate into the pre-existing culture that exists at the institution as well as in engineering and STEM programs. Martin et al. (2013) suggests that although Latina engineering students had low social capital, it was still vital to their persistence and success in engineering. However, further examination of the wealth of knowledge and personal and cultural experiences of Black and Latino engineering students can be explored to understand how those experiences and values shape their educational outcomes.

This study is unique because it seeks to understand the educational experiences of high-achieving or successful Black and Latino engineering students. In particular, the success factor, faculty-student interactions, and how they benefit Black and Latino engineering students both in and out of the classroom is observed. One way to examine faculty-student interactions and how they can support Black and Latino engineering students in the successful pursuit of their engineering studies is through an understanding of how their personal qualities, cultural experiences, and interactions with others add to their educational experience. One way to understand this phenomenon is through the conceptual framework of community cultural wealth (CCW). Community cultural

wealth, a framework that derives from the critical race theory (CRT), highlights the need to understand students of color's personal experiences including racial and cultural diversity and examine how engineering students of color navigate in and out of the classroom. By evaluating faculty-student interactions through the various forms of capital utilized by Black and Latino engineering students, ways to improve student persistence in engineering programs can be identified.

Conceptual Frameworks as a Guide for Empowering Students of Color

There are two conceptual frameworks that guide this study, which are critical race theory and community cultural wealth. Community cultural wealth was developed through the lens of critical race theory. Therefore, critical race theory is briefly discussed in this section while most emphasis is focused on the main conceptual framework, community cultural wealth. Community cultural wealth is examined theoretically and analyzed through the research study in the subsequent chapters.

Critical Race Theory (CRT)

Legal scholars who sought to challenge racism in the judicial system originally established critical race theory (CRT) in the mid-1970s (Bell, 2005). Under the leadership of Derrick Bell, who is known as the father of CRT, critical race theory was introduced in 1995. CRT focuses on the role that race and racism play in the educational system and shows how social constructs such as race, gender, and class overlap to impact students/Communities of Color (Collins, 2000; Ladson-Billings & Tate, 1995; Solorzano, 1997; Solorzano, Ceja, & Yosso, 2000). According to Solorzano, Ceja, and Yosso (2000), CRT establishes that racism has been permanently embedded in American society and must be addressed because it will continue to remain an issue. Critical race theory (CRT)

explores inequalities that students face in their educational experiences and challenges students as well as institutional members (faculty, advisors, and other staff/personnel) to understand how all parties should work together to eliminate social barriers in promoting academic success. Specifically, CRT can be used in higher education to deal with racial micro-aggressions, which are subtle or nonverbal exchanges that can be used to oppress or insult students of color (Solórzano et al., 2000).

According to McGee and Martin (2011), students of color in predominantly White institutions experience racial micro-aggressions, such as exclusion from study groups or low expectations from faculty members, which may alienate them academically or socially. Five tenets of CRT should be explored and utilized to explain how theory, research, and pedagogy inform educational practices (Solórzano, 1997; 1998). These tenets include: the intercentricity of race and racism; the challenge to dominant ideology; the commitment to social justice; the centrality of experiential knowledge; and the utilization of interdisciplinary approaches.

Intercentricity of Race and Racism. This tenet states that there is an intercentricity of race and racism with various forms of subordination (Yosso, 2005). Challenges with race and racism can have a negative impact on society, but are central and permanent to explaining how the United States society functions (Bell, 1992; Ladson-Billings & Tate, 1995; Russell, 1992; Solorzano, 1998; Yosso, 2005). According to Ladson-Billings and Tate (1995), racial background would not be linked to educational outcomes if racism did not influence educational achievement. Therefore, utilizing CRT is necessary to understand how racial background is linked to the education of Black and Latino students and highlight how social differences such as race, ethnicity, and culture can explain

various levels of racialized subordination in educational experiences (Solorzano, 1998; Valdes, McCristal, Culp, & Harris, 2002; Yosso, 2005). According to Cuellar (2012), CRT also emphasizes how race and racism intersect with other social identities and marginalized experiences. Therefore, race/ethnicity and culture will be of great consideration when exploring how Black and Latino students have successfully navigated through their engineering programs despite challenges with social differences.

Challenge to Dominant Ideology. This tenet challenges notions of neutral research and claims that educational institutions provide equal opportunity and are objective, colorblind, and meritocratic in nature (Ladson-Billings & Tate, 1995; Solorzano, 1998; Yosso, 2005). CRT defines neutral and objective research as deficit-informed research that ignores and misrepresents epistemologies of People of Color (Delgado Bernal, 1998; Ladson-Billings, 2000; Yosso, 2005). Throughout the history of higher education, equal opportunity and access for Black and Latino students to all higher education institutions has been limited due to exclusiveness in certain elite institutions and limited resources because of socioeconomic disadvantages (Anderson & Kim, 2006; Cuellar, 2012; Freehill et al., 2008; Harper, 2006; Harper, Patton, & Wooden, 2009; Karabel, 2005; Perna et al., 2006; Santiago, 2006). Furthermore, the underrepresentation of Black and Latino students of color in engineering programs at higher education institutions have been linked to academic challenges due to being underprepared prior to attending college or having a non-existent or minimal support network to help students navigate through their engineering program. These examples represent how privilege of dominant-culture groups or institutions can be disempowering for Communities of Color and limit opportunities for an equal advantage in education.

Commitment to Social Justice. This tenet in CRT focuses on a commitment to social justice and works toward eliminating issues of racism, poverty, and sexism, as well as disempowerment of Communities of Color by exposing interest convergence (Solórzano & Delgado Bernal, 2001; Yosso, 2005). This commitment exposes the idea of an interest convergence of civil rights in education, which refers to Communities of Color benefitting from changes as long as they benefit the dominant group of Whites (Bell, 1987; Yosso, 2005), and offers transformative responses to racial, gender, and class oppression (Matsuda, 1991; Yosso, 2005). In higher education, this commitment is especially vital for Black and Latino engineering students because it works to eradicate any challenges with campus climate or environment that may limit students' interactions with faculty or create a less conducive learning environment, which might hinder academic success.

Centrality of Experiential Knowledge. This commitment in CRT recognizes that the experiential knowledge or lived experiences such as storytelling, history of family and culture, or certain scenarios of People/Communities of Color is appropriate and critical to understanding the subordination of race (Bell, 1987; Delgado Bernal, 2002; Solórzano & Delgado Bernal, 2001; Yosso, 2005). Storytelling and counter storytelling can be used in CRT as ways to address negative stereotypes of certain groups and provide an understanding of why People/Communities of Color feel that educational opportunities are not created as equal for all students (Cuellar, 2012; Ladson-Billings & Tate, 1995; Yosso, 2005; Yosso, 2006). Through this commitment, Black and Latino engineering students in higher education are provided an opportunity to share their experiences and add to scholarly research to address racial inequalities in educational

institutions and help CRT scholars understand what challenges should be addressed to improve representation of Black and Latino students in engineering disciplines and the engineering workforce.

Utilization of Interdisciplinary Approaches. This tenet suggests that CRT exceeds disciplinary boundaries to analyze race and racism from both a modern and historical perspective (Yosso, 2005). The research and scholarship for this context comes from various areas such as ethnic studies, history, women's studies, and other disciplines (Cuellar, 2012; Delgado, 1984; 1992; Gutiérrez-Jones, 2001; Yosso, 2005). The utilization of an interdisciplinary approach can be very beneficial for students of color. According to Yosso (2005), this tenet highlights the opportunity for educational institutions to liberate and empower students rather than oppress and marginalize them. For Black and Latino students in engineering, this approach is vital to encourage more participation from students of color. Colleges of Engineering in higher education institutions must continue to raise awareness to challenges unique to Black and Latino engineering students through research, institutional programming and policies, and intentional efforts that occur in and out of the classroom (i.e., increased faculty-student interactions, more research opportunities and internships targeted towards students of color, and mentoring efforts).

Community Cultural Wealth (CCW)

According to Yosso (2005), CRT's five tenets provide useful information in guiding how Communities of Color are studied and the framework allows researchers to emphasize the voices of People of Color by critically examining deficit theories.

Community cultural wealth (CCW), derived from CRT, provides a critique of cultural

capital; which according to Yosso (2005) seeks to highlight the deficiencies of cultures that are not part of the dominant culture. By the definition of Bourdieu (1977), cultural capital is an accumulation of cultural knowledge, and skills and abilities that are possessed by the privilege groups of the society. Families with a higher socioeconomic status are more likely to promote higher education because they connect the educational value with economic status (Bourdieu, 1977). However, Yosso (2005) argues that cultural capital creates a division of wealth making some cultures look poorer than others and without significant value. CCW takes into account an accumulation of cultural values and experiences from various groups that can eradicate classism and show balance amongst cultures and how each culture benefits from one another.

Bourdieu (1986) suggests that there are three forms of cultural capital, which are embodied, objectified, and institutionalized. In the embodied state, there are physical and mental attributes to consider, such as parental educational level of students. The objectified state looks at how cultural capital can be transformed into material goods such as books and instruments. Finally, the institutionalized state, which observes the cultural capital of recognition from the institution (i.e., academic qualifications) by an individual. According to Stanton-Salazar (1997), when the values associated with higher socioeconomic classes are seen as the norm, there is no value placed on groups that are not in the dominant culture because they don't have the necessary cultural capital to maneuver through an educational system. According to Lee (2011), students are challenged with connecting their home/cultural environments to their academic success. In particular, students of color may deal with issues related to identity development and adaptation of the institutional climate, especially if in a predominantly White institution.

Specifically, Black and Latino engineering students may have a hard time adjusting to the climate or may feel isolated when it comes to relationships with faculty and peers (Foor et al., 2007). Community cultural wealth, an alternative to cultural capital, provides a holistic approach to understand how students can use their cultural experiences and background to motivate their educational experiences in their pursuit to be academically successful.

Why CCW as a Framework for Faculty-Student Interactions?

With the question still being raised as to how Black and Latino engineering students can be empowered to graduate from college and pursue engineering careers, community cultural wealth (CCW) is explored as a possible route to the solution through faculty-student interactions. Currently, dissertations that explore CCW focus on topics such as the resiliency of Latino students, women of color in graduate programs, students of color in K-12 education, and students of color in medical school education (Brown, 2012; Butler, 2009; Perez, 2012; Reyes, 2012; Ugalde, 2012). However, there is an absence of studies that explore CCW in the context of engineering education. The issues of underrepresentation and lack of persistence in engineering education for specific Communities of Color (such as Black, Latino, and Native American students) continue to exist, which establishes a need to explore the role that sociodemographic factors play in their academic pursuits.

Community cultural wealth, an alternative approach to cultural capital, can be used to provide ways that Black and Latino engineering students utilize their personal qualities and racial/cultural backgrounds as empowerment tools while seeking an undergraduate education. Tara Yosso (2005) developed the framework CCW as a critical

response to Bourdieu’s idea of cultural capital. Deriving from critical race theory (which involves exploring race and racism and addressing forms of oppression within an educational context), CCW is defined as “an array of knowledge, skills, abilities, and contacts possessed and utilized by Communities of Color to survive and resist macro and microforms of oppression” (Yosso, 2005, p. 77). In other words, Communities of Color can use the knowledge and experiences that they have encountered to challenge both macro- (institutional) and micro- (individual) forms of oppression that they may have experienced. Yosso (2005) used this model as a way to understand how Communities of Color see their cultural wealth and embrace positive and nurturing structures throughout processes such as seeking higher education.

Community cultural wealth (CCW) eliminates the deficit perspective regarding forms of capital for Communities of Color and shows the accumulation of various forms of capital that make up CCW (see Figure 1) (Yosso, 2005). CCW consists of several forms of capital (that can overlap), which include: aspirational, familial, social, navigational, resistant, and linguistic capital (Yosso, 2005).

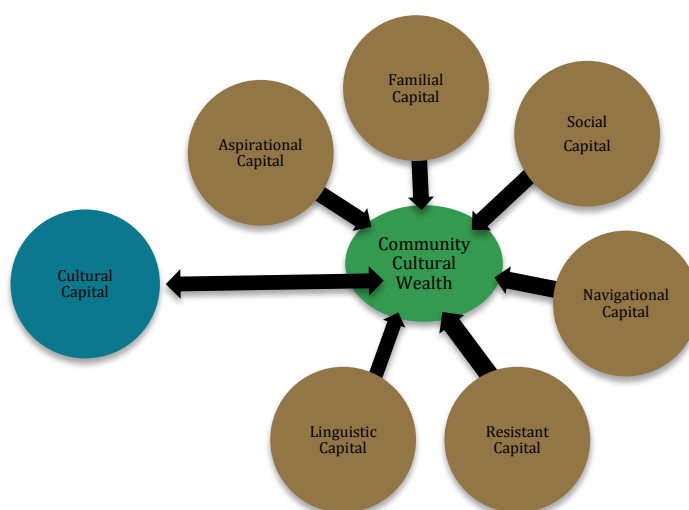


Figure 1: Schematic diagram of CCW framework (adapted from Yosso, 2005)

These forms of capital are described as the following:

Aspirational. Aspirational capital refers to the ability of an individual to maintain their future hopes and dreams while faced with barriers and challenges in real life (Yosso, 2005). This form of capital encourages underrepresented students of color in engineering and first-generation engineering students to deal with life with a positive view to overcome any real or perceived barriers dealing with academic preparation (e.g., homework assistance programming or study groups for rigorous engineering courses), school climate, interactions with faculty members, and finances. This form of capital is closely related to resilience, which allows students to develop coping skills to persist while seeking higher education. Suresh (2006) looked at the link between student performance in barrier courses to persistence in engineering, and found that the use of coping strategies (i.e., figuring out where they went wrong and fixing the challenges) had a positive impact on student grades. This is a prime example of how underrepresented students of color who deal with issues centered on academic preparation or rigorous science courses can utilize coping to increase their aspirational capital.

Familial. Familial capital supports the cultural and family knowledge of an individual and acknowledges one's community history and commitment to community cultural intuition (Yosso, 2005). This form of capital gives a sense of importance to both family and community and benefits URM engineering students by allowing them to share their cultural knowledge and sense of family in their school environments and through participation in engineering-related opportunities and local community projects occurring outside of the classroom. As mentioned previously, family ties and support are pivotal to the education of underrepresented students of color, especially Black STEM male

students (Williamson, 2010). This form of capital explores ways in which family and culture support the academic pursuits of successful Black and Latino students in engineering.

Social. Social capital addresses networks and community resources that students utilize to maneuver through colleges and universities (Yosso, 2005). Students receive both instrumental and emotional support and this form of capital allows URM students to connect with diverse peers and organizations, both engineering-related and non-engineering-related. For underrepresented students of color in engineering, forms of social capital such as engaging with or receiving mentoring from faculty members and other institutional agents, and participating in structured research programs or other STEM-related organizations are vital to their academic success as they navigate through the higher education institution (Chang et al., 2010; Navarra-Madsen et al., 2010; Sharkness et al., 2010).

Navigational. Navigational capital includes students' ability to maneuver through social institutions such as higher education institutions that were not created with communities/students of color in mind (Yosso, 2005). This form of capital encourages students to push beyond a hostile school climate and may include initiatives such as joining student assistance or mentoring programs or working with faculty or other agents, in an environment outside of the classroom to ensure academic success while studying engineering. For example, engineering students of color may join organizations such as the National Society of Black Engineers (NSBE) and the Society of Professional Hispanic Engineers (SHPE) or even other student organizations such as multicultural organizations, fraternities, and sororities as additional support as they navigate through

higher education institutions. Racially-composed organizations can create a sense of belonging and allow students of color to better integrate to the campus/university climate. This form of capital is vital in identifying how successful Black and Latino engineering students navigate through a predominantly White institution and in an academic program where they are underrepresented.

Resistant. Resistant capital refers to the knowledge and skills fostered through oppositional behavior that challenges the issue of inequality (Yosso, 2005). This form of capital, in which this study frames within the context of higher education, may look at how underrepresented students of color interact with professors outside the classroom despite any possible cultural barriers or challenges with school climate. It may also include first-generation students asserting themselves so that they provide a counter story to the statistics and research (Reyes, 2012). This form of capital allows Black and Latino engineering students to examine their current environment; address inequalities that may have affected their academic experience; and share how they overcame their challenges. The reflection on this form of capital can identify ways that students can cope and deal with barriers that may occur.

Linguistic. Finally, linguistic capital covers the intellectual and social skills attained through communication experiences in more than one language and/or style (Yosso, 2005). This form of capital can benefit students of color because it takes into consideration that these students have multiple ways of communicating such as speaking different languages other than English, utilizing storytelling and incorporating various styles of communication (e.g., voice tones, dramatic pauses, comedic timing), and using their artistic abilities through popular culture and mainstream media (e.g., music and

poetry). Students' multiple communication outlets can be viewed as being a gift or skill rather than a barrier or deficiency. This form of capital is important because it can identify other forms of diversity that may be useful in structuring additional support programs for students or developing engineering-related service projects in the local community. Exploring students' abilities to speak multiple languages or creatively express themselves can innovate institutions and colleges of engineering in the ways that they structure programming and connections to other organizations, businesses, and the community at-large.

This conceptual framework is valuable to educational research because it eliminates the idea that one culture is more dominant than another and finds value in every culture. Rather than putting focus on deficiencies of specific cultures (Yosso, 2005) or emphasizing that students should fix issues to be better students (Newman, 2011), CCW highlights the contributions of all communities and suggests that there is information to be learned and shared among all cultures. Martin (1998) suggests that it is dangerous to reduce the wealth of all cultures to a high or dominant culture because no one group or institution is the conservator of all cultures' wealth. Cultural wealth, a framework that originated from research that solely focused on Latino students, is useful in this study because it will provide valuable insight on how to best serve other Communities of Color such as Black students.

Summary

This review of literature illustrates that personal and institutional factors and interaction with faculty and other institutional agents play a role in the academic success of Black and Latino engineering students in higher education. It is necessary to

understand these factors in order for higher education institutions to move forward in promoting diversity in engineering disciplines. One way to work towards eliminating the critical factors that affect Black and Latino students' ability to persist, graduate, and be successful in an engineering discipline is to examine their perceptions of personal qualities and forms of capital that are used to navigate the higher education institution. The main conceptual framework, community cultural wealth (CCW), which derived from critical race theory (CRT), was utilized for this study.

The CCW framework provides an alternative to deficit theories that allows faculty members, engineering agents, and the students to critically examine the roles that both race/ethnicity and culture play in students' attainment of an engineering degree. The conceptual frameworks allow students of color to understand as well as create additional ways that they can interact with faculty and get the support that they may need from their peers, faculty, engineering agents, and in general from their institutions. These frameworks are empowering for Communities of Color because they eliminate the deficit perspective that one dominant culture should be the model culture or standard of wealth and capital for all cultures. In order to address the challenges with diversity in engineering and develop an understanding of how racial and cultural factors of students should be explored, a more critical approach is needed. Chapter Three describes the design of a qualitative case study to understand Black and Latino engineering students' perceptions of success, their interactions with faculty, and how the CCW framework can be used to interpret students' experiences and identified factors.

CHAPTER 3: METHODOLOGY

As indicated in the review of literature in Chapter Two, a more critical understanding of Black and Latino engineering students' successful experiences is needed. Specifically, Black and Latino students' interactions with engineering faculty members and other institutional agents were explored to identify what tools are necessary for underrepresented groups as they navigate both academically and socially at higher education institutions. The literature suggests that positive and quality faculty-student interactions can improve representation of Black and Latino students in engineering education through academic support and outside opportunities (e.g., research and mentorship) (Amenkheinen, Kogan, & Lori, 2004; McGee & Martin, 2011; Sharkness et al., 2010; Vogt, 2008) and lead to higher numbers of diverse professionals in the engineering workforce. Therefore, the purposes of this study were to explore what personal qualities or other factors are important to Black and Latino students while they successfully pursue their engineering studies; and understand the nature of the role that successful Black and Latino students' interactions with engineering faculty and other institutional agents such as advisors, mentors/coaches, and other professionals play in their academic and social development as they navigate through the higher education institution.

Additional purposes included identifying how social differences (e.g., race, ethnicity, and culture) influence Black and Latino students' interactions with faculty and other institutional agents; and evaluating how community cultural wealth (CCW) as an empowerment framework and the various forms of capital (aspirational, familial, social, navigational, resistant, and linguistic) explain how Black and Latino engineering students can persist to graduation throughout their engineering studies.

As previously mentioned in Chapter One, the researcher posed the following research questions:

- What personal qualities and other factors do Black and Latino engineering students identify as important for their persistence and success in engineering studies?
- How do Black and Latino engineering students interact with engineering and non-engineering faculty, and how do they perceive the role of these interactions in their academic and social development?
- How do Black and Latino engineering students interact with institutional agents (e.g., administrators, advisors, mentors/coaches, and other engineering professionals), and how do they perceive the role of these interactions in their academic and social development?
- How do Black and Latino engineering students describe the influence of sociodemographic factors (e.g., race, ethnicity, and culture) on their interactions with faculty and institutional agents?
- What forms of capital in the community cultural wealth (CCW) framework are apparent in the discussion of personal factors, sociodemographic factors, and

interactions with faculty and other institutional agents that facilitate successful navigation in engineering studies among Black and Latino students?

To provide a broad overview of the role of engineering faculty interactions with Black and Latino students and understand personal factors that contribute to the overall success of these students, a qualitative research method was employed. Qualitative research is concerned with how meaning is negotiated (Bogdan & Biklen, 2007). Additionally, qualitative research explores the meaning that individuals or groups attribute to a social or human issue (Creswell, 2005). A qualitative case study design was chosen because of the need to critically explore an in-depth comprehension of how successful Black and Latino engineering students interpret their personal (both academic and social) experiences as they interact with engineering faculty. According to Merriam (1998), a case study utilizes various data collection methods such as interviews, observations, and documentation reviews that can help one acquire a holistic view of a specific phenomenon. In this study, an online demographic questionnaire and interview data were collected to understand what resources are made available to Black and Latino engineering students as they successfully navigate through their engineering disciplines. To provide a rich description of the institutional setting and context as part of this chapter, several institutional documents and websites were reviewed (Appendix A).

Institutional Setting

This case study was conducted in a large public urban research university – Southeastern Urban University (SUU) - located in the Southeastern part of the United States. Currently, there are more than 26,000 students at this institution, the majority of whom are undergraduate students (about 21,000 based on Fall 2013). SUU offers 80

bachelor's degree programs and their undergraduate population consists of approximately 32% students of color including Black, Latino, Native American, Asian, and Multi-Racial students. According to the university's diversity plan (2012-2013), the number of students of color has increased steadily since 2005, with Blacks and Latinos representing 17% and 7% of students, respectively. Additionally, faculty of color comprised 17% (5% are Black and 3% are Latino) of the total at the institution. Although Black and Latino students remain underrepresented in engineering even at this institution, this particular institution was selected for the study because of its ethnically diverse urban location, student body make-up, and continuing efforts to improve persistence and retention for ethnic-racial student groups (e.g., Black and Latino students). These factors are also ideal for the proposed study.

College of Engineering (COE)

At SUU, the College of Engineering (COE) is one of seven colleges on the campus. There are several disciplines in the COE including civil and environmental engineering, electrical engineering, engineering (undesignated), computer engineering, mechanical engineering, systems engineering, and five engineering technology programs (civil, construction management, electrical, fire safety, and mechanical). The institution is unique in the regard that it is one of a handful of institutions in the United States to offer four-year engineering technology programs. Currently, there are 114 engineering professors and 28 engineering technology professors; of which, six are Black and Latino engineering professors and one is a Latino engineering technology professor. Black and Latino engineering and engineering technology faculty members make up less than 5% of the COE.

For the 2013-2014 academic year, there were roughly 2,700 students enrolled in the COE, of which, students of color (i.e., Black, Latino, Native American, and Multi-Racial) made up roughly 15% of the COE's student population. Female students made up 9% of the COE at the institution participating in the study. The COE provides students with opportunities to participate in over 20 engineering-related organizations including organizations that promote racial and gender diversity such as National Society of Black Engineers (NSBE), Society of Hispanic Engineers (SHPE), and Society of Women Engineers (SWE). Additionally, various educational programs such as leadership academy (leadership training program) and peer-to-peer mentoring are offered to students. All of the various programs and social organizations provide diverse students an opportunity to engage in engineering-related extracurricular activities outside of classroom engagement.

Participant Description

As previously stated, Black and Latino students experience lower persistence, retention, and degree completion in higher education institutions (Kim & Anderson, 2006; Lee, 2011) and are often underrepresented in engineering disciplines in comparison to their White and Asian counterparts (Freehill et al., 2008). Therefore, high-achieving or successful Black and Latino students in the College of Engineering (COE) at this particular higher education institution were selected as the sample for this study to identify ways to improve factors such as low retention and graduation and less representation of students of color in engineering (both locally and nationally). The specific selection criteria for the participants included:

- high-achieving or successful students self-identifying as Black or Latino;

- third-, fourth-, and fifth-year engineering students with good academic standing (C-average or better) and involvement with leadership opportunities (e.g., research and student activities) at the particular institution;
- male and female participants being between the ages of 18-24; and
- students pursuing a discipline through the College of Engineering at the specific institution.

Specific to the COE at SUU, there were approximately 212 Black and Latino engineering students (142 in engineering and 70 in engineering technology) that were in their third through fifth year in Spring 2014. There were 182 male students and 30 female students. Additionally, roughly 75 Black and Latino engineering students (of all classifications) were registered as members for engineering-related student organizations (e.g., SHPE, NSBE). Although there were 212 potentially eligible students for the study, there were students who did not qualify due to the various defined factors of success such as being involved on campus in non-engineering and/or engineering-related activities and having a C-average or higher and being in good academic standing). However, in qualitative research, sample sizes tend to be small and are usually determined by the research objective, research question(s) and, subsequently, the research design (Onwuegbuzie & Collins, 2007; Onwuegbuzie & Leech, 2007). Therefore, an exploratory case study research design was utilized, for which Creswell (2002) suggests that a sample size of three to five participants would be sufficient.

Eight engineering students of color (five Black and three Latino) participated in this study; they are introduced in Table 2. There were equal number of students in terms

of gender (four females and four males), student classification (four juniors and four seniors), and transfer status (four out of eight students transferred to SUU). Additionally, four of the students were first in their families to attend college and half of the participants also had family members with engineering degrees (e.g., parent, sibling, or aunt/uncle). The average overall GPA for participants was 2.9 and 3.1 for the major GPA. By having eight participants, I was able to obtain rich information, ensure data saturation, and gain insight on the case of successful (e.g., at least C-average and involvement in student organizations or research activities) Black and Latino engineering students.

Table 2: Characteristics of Black and Latino engineering student participants

Pseudonym (race/ethnicity, gender)	Class (transfer)	College of Engineering Major / GPA	First Generation (Yes/No)	Family Member With Engineering Degree	Type of Leadership and Involvement
Agrepina (Latina female)	Senior	Civil / 3.0	Yes	None	Research and Student Organizations
Alexis (Black female)	Senior	Civil (Technology) / 3.0	No	None	Research, Internships, and Student Organizations
Carmen (Black female)	Junior (transfer)	Electrical / 3.0	Yes	None	Research and Internships
Jason (Black male)	Senior (transfer)	Civil (Technology) / 3.1	No	None	Research and Internships
John Doe (Black male)	Senior	Mechanical / 3.0	No	Sister, Aunt, and Uncles	Research and Student Organizations
Kid A (Latino male)	Senior	Computer / 3.2	Yes	None	Student Organizations
Ricky (Latino male)	Junior (transfer)	Electrical / 3.5	Yes	Uncle	Student Organizations
Sonya (Black female)	Junior (transfer)	Systems / 2.7	No	Father	Research, Internships, and Student Organizations

Participants were selected using purposive sampling since the research study focuses on specific Communities of Color and college/university classifications (i.e., Black and Latino third-, fourth-, and fifth-year students in engineering) at the chosen institution. Purposive sampling allowed the researcher to select information-rich cases that offer insight into the phenomena being studied (Patten, 2002). Participants were recruited through the College of Engineering (COE); and campus entities (e.g., National Society of Black Engineers (NSBE), Society of Hispanic Engineers (SHPE), peer mentoring program, multicultural affairs) that provide services to both Black and Latino engineering students. Each participant who completed both phases of the interviewing process (brief online questionnaire and the individual interview) received a \$10 gift card per each phase, provided through funding from the NSF project grant.

In a study by Perez II (2012), Latino male students were recruited using a nomination process. This study utilized a similar process and participants were recruited by sending e-mails to (1) faculty, administrators, and staff; and (2) undergraduate student organizations (e.g., NSBE, SHPE, peer mentoring program, and multicultural affairs) that serve Black and Latino engineering students, in which those parties nominated students to participate in the study. Once those parties provided nominations, the students who were nominated were sent an email asking for their participation in the study. An invitation to participate in the study was also sent by the Associate Dean of the College of Engineering to third-, fourth-, and fifth-year Black and Latino students (including students who transferred in with junior and senior status) so that students could volunteer independently to participate in the study (see Appendix B). A majority of the participants volunteered to participate in the study without a nomination from faculty members or

institutional agents. Additionally, four out of eight participants were involved in engineering-related organizations such as NSBE or SHPE.

Data Collection

A pilot study was conducted in Spring 2013 using Yosso's (2005) social capital theory to understand engineering students' interactions with peer mentors and institutional program agents; and understand the role that social factors such as race and gender played in those interactions. The pilot study related to the dissertation research topic in that it allowed me to see how engineering students of color interact in a peer mentor/coach to mentee relationship outside of the classroom, and observe what social connections and opportunities occurred as a result of those interactions and being involved on campus. Three students of color (Asian American male, Filipino female, and African American male) were interviewed. Through their different perspectives, I was able to identify factors that have an impact on their academic endeavors while pursuing engineering.

The pilot study was helpful in developing interview protocols to elicit the conversations (especially those pertaining to challenges in engineering and racial experiences) desired. Additionally, the study allowed me (the researcher) to better define the research questions and data collection procedures for the dissertation research. I found that the engineering students of color who participated in the pilot study were very hesitant to talk about race as it relates to their interactions with mentor peers and their experiences with race while in an engineering program. Therefore, I developed a brief online demographic questionnaire, and detailed interview protocol, for the dissertation study to aid me in probing for critical responses related to students' academic and social

experiences related to sociodemographic factors (e.g., race, ethnicity, and culture) and CCW.

After approval from the Institutional Review Board, primary data for this project were collected at SUU during the Spring and Summer semesters of the 2013-2014 academic year through a brief online demographic questionnaire (completed through Survey Share website) and audio-recorded individual interviews. Students completed the online demographic questionnaire before participating in an individual interview, which allowed the researcher to obtain demographic information and specific incidents and experiences to discuss during the interviews. After reviewing the brief online demographic questionnaires, the researcher conducted semi-structured interviews with each individual participant. Additionally, institutional documents and websites were gathered throughout the data collection process and were reviewed and utilized to offer a rich description of the context and setting of SUU.

Brief Online Demographic Questionnaire

Participants who self-identified as being high-achieving or successful Black or Latino junior and senior students (in third-, fourth-, or fifth-year) in the College of Engineering and were nominated or expressed interest in the study were sent an e-mail to thank them for agreeing to participate. Additionally, participants were provided a link in that email to proceed to the brief online questionnaire through Survey Share (see Appendix C). On the Survey Share website, students were provided directions as well as consent information before filling out the questionnaire. The criteria were displayed via Survey Share so that students who did not qualify for the study (i.e., not self identifying as Black or Latino as well as junior or senior) would be restricted from participating any

further in the questionnaire. This particular step ensured that non-eligible students would not complete the study or experience fatigue from answering questions for a questionnaire in which they were ineligible. This particular phase of the study was completed online through Survey Share so that all sensitive information could be stored in a password-protected space.

The brief online questionnaire included demographic (e.g., parents' educational status, socioeconomic status) and academic (major, grade average in classes, GPA) information as well as questions to understand their social involvement on campus. The questionnaire took the majority (six) of participants fewer than 15 minutes to complete while a few students completed it in multiple sessions. However, all were completed within one week. Further instructions were given to interview participants after completing the online questionnaire. The responses from questions in the brief online questionnaire as well as an interview protocol were utilized to guide the individual interviews.

Individual Interviews

After completing the questionnaire, each student voluntarily participated in individual interviews that were conducted based on the interview protocol (see Appendix D) and responses from the questionnaire. According to Tashakkori and Teddlie (1998), interviews are a powerful method of data collection. This method allowed participants to share valuable information pertaining to their educational experiences while studying engineering, which is critical to the examination of CCW since it views ways that Communities/Students of Color are empowered through various forms of capital in their experiences with engineering faculty members and other institutional agents. Participants

were asked questions to provide accounts of their experiences inside and outside of the classroom and their interactions with both faculty members (e.g., non-engineering and engineering) and other institutional agents. Students were also asked to discuss how social factors (e.g., race, ethnicity, and culture) and CCW had influenced their interactions with both non-engineering and engineering faculty at SUU. Interview questions related to personal qualities and other factors that inform the various forms of capital in CCW as defined by Yosso (2005) were also be explored.

Individual interview times ranged from 40 to 80 minutes (with an average interviewing time of 56 minutes) and took place at a location on SUU's campus, which was convenient for the participants. Participants completed consent forms prior to participation in the interview (see Appendix E). All interviews were audio-recorded and transcribed verbatim. To ensure trustworthiness and credibility of the data, all participants went through a member checking process in which they were asked additional questions pertaining to the demographic questionnaire or interview data and were given a summary of themes and findings and provided an opportunity to review their transcripts and offer feedback. Each transcription was filed electronically on a password-protected laptop computer and participants of the study were assigned pseudonyms to maintain their confidentiality.

Thematic Analysis of Responses

Data analysis focused on identifying common themes and key points related to students' interactions with engineering professors and experiences; and social factors such as race, ethnicity, and culture while pursuing engineering. Using thematic analysis, emergent themes from were created and became categories of analysis (Fereday & Muir-

Cochrane, 2008). Six steps in thematic analysis were utilized during this study, which included: reading the transcripts multiple times to understand participants' responses, coding the most important words or phrases related to students' experiences in their engineering studies, developing themes based on codes identified, reviewing themes that had been developed, and redefining both major and minor themes to present findings. This process allowed the researcher to consistently develop themes and sub-themes that summarize the experiences of interview participants as it relates to various factors such as social factors that may influence academic success, engineering faculty and agents' interactions, and participants' use of various forms of capital that allow them to interact with faculty and continue to be successful in engineering.

Review of Institutional Documents

According to the Freehill and colleagues (2008), ways that higher education institutions can engage underrepresented students of color in engineering to persist and graduate include creating special programming (e.g., mentoring programs, living-learning communities, academic assistance programs) to support and retain students of color as they go through the college process, and eliminating systemic barriers and utilizing the admissions and retention of students of color as a primary metric of institutional success. Swail et al. (2003) also points out that institutional effectiveness and commitment are key factors that must be considered when evaluating students entering higher education. Document analysis, in particular, reviewing documents of the institution being studied, was utilized because it provided an opportunity for the researcher to document institutional perceptions of Communities of Color as well as efforts being made to retain and support students of color both generally and in engineering.

Documentation reviewed included examining public primary and secondary documents (Creswell, 2003) (see Appendix A). Some examples of primary documents include the COE or student organization websites and institutional documents/data. Secondary documents would be diversity initiatives or plans for the specific college or institution and articles related to the Black and Latino student populations at the selected institution (Vue, 2013). There were specific student organizations and websites that were reviewed. Specifically, those organizations and websites were reviewed based on the criteria of providing: services to Black and Latino engineering students (e.g., reviewing COE website; engineering-related organizations that promote diversity); information that describes the nature of faculty and students of color's involvement at the institution (e.g., statistics on faculty and students of color); and information that explains the role of the institution and institutional factors that impact Black and Latino students (e.g., diversity initiatives and strategic plans of SUU and the COE). Other key and relevant information was identified through dialogue with interview participants and meetings related to specific engineering-related organizations that serve Black and Latino students (e.g., NSBE, SHPE).

Researcher's Role and Trustworthiness

Based on my own personal experiences as a first-generation, Black woman who graduated with a STEM discipline during my undergraduate career, this study resonates with me in terms of the benefits and challenges with persisting in STEM disciplines. Although my experiences at my undergraduate institution were overall positive, I specifically remember enduring the rigorous coursework especially tough science courses and needing mentorship to help me maneuver through STEM disciplines (Foxx & Tickle,

2014). I experienced disconnect from faculty even though I was actively involved on campus and assisted faculty in specific departments. While enduring the process of navigating a STEM discipline, I found the process to be challenging and overwhelming, both academically and socially (Foxx & Tickles, 2014). Hence, conducting this study allowed me to comprehend other students of colors' perceptions of interactions with faculty while in a STEM program and add to the research in developing ways to ensure the academic and social success of STEM students. I understand that my experiences are capable of shaping this research study and realize that it will be challenging to remove myself from the study. Therefore, it is vital to take into consideration how my experiences shape this research study as well as provide multiple forms of evidence to support the data collected during this study.

Acknowledging personal connections and identifying biases in the data collection process in qualitative research can be important in providing valuable sources of insight and theory, and allowing the researcher to observe how the data is organized and presented (Maxwell, 2005; Merriam, 2009). In order to ensure that the participants' experiences are separated from my own experiences, I utilized memoing. Memoing is the recording of reflective notes or ideas (balanced between descriptive and reflective notes) about what the researcher is learning from the content being collected (Miles & Huberman, 1984). Reflexivity through memoing, which is the researcher's aim to understand their values and experiences in a research study, addresses threats to credibility and trustworthiness in a qualitative study (Maxwell, 2005).

During my memoing experience or moments of reflection, I would observe students' body languages (e.g., facial expressions, sudden body movements or gestures;

fluctuations in vocal tones), and the emotional reactions provided by participants as they answered individual interview questions to understand their perceptions from the perspective as both a researcher and former student who graduated with a STEM degree. Often times, my reflections of the experience of the study would take form through narratives, poetry, and questions. One example of this practice would be writing questions and narrative to follow up on what it is like being a woman of color in STEM. Many of the female participants mentioned this factor and it allowed me to reflect on my personal experiences being a woman of color in a STEM discipline and also allowed me to ask more questions to the participants to understand both the personal and academic challenges with this particular factor in and out of the classroom. I would also observe the experience of being a person of color at a predominantly White institution and the challenges that may be associated with that factor. The process of memoing also allowed me to follow up with participants with questions and gain more collective insight on overall perceptions of specific factors such as race or cultural factors or interactions with engineering faculty.

In qualitative research, triangulation or having multiple ways to confirm the data ensures the trustworthiness and integrity of the study. In this study, member checking, memoing, and collecting data through an online demographic questionnaire, individual interviews, and review of documentation were utilized. Member checking was conducted by allowing the participants to verify information provided through the online demographic questionnaire and giving participants the opportunity to provide written or verbal feedback on thematic coding and data from their transcripts. Additionally, some participants were contacted to provide additional information to their initial responses

given during their in-person interviews. Documentation was also reviewed from websites and documents such as the College of Engineering, Multicultural Affairs, SUU's diversity plan, and other institutional documents related to multicultural organizations, faculty members of color, and specific organizations that offer diversity in the College of Engineering. Additionally, the online demographic questionnaire provided descriptive statistics related to demographic information and students' involvements with organizations and activities both on- and off-campus.

Limitations

There are a few limitations that are associated with this study. One limitation is that the sample is not representative of all underrepresented groups in engineering (i.e., Native Americans and women of all races/ethnicities) and will only include Black and Latino engineering students and address questions related to diversity issues for those two ethnic-racial groups. Another limitation is that the sample included only high-achieving or successful Black and Latino engineering students; therefore, forms of community cultural wealth were not examined in unsuccessful students. Additionally, the research study is being conducted at one single institution. Therefore, the information learned will not be representative of all underrepresented groups in engineering for multiple types of higher education institutions. Although there were equal representations of gender in the study and the experiences of two racial-ethnic groups were observed, there was minimal Latina participation. However, qualitative methods are less concerned with sample size for generalizability purposes and are more concerned about transferability.

Transferability is defined as the extent to which findings are useful or meaningful to

theory, practice, and future research (Lincoln & Guba, 1985) and allows readers of the study to make assumptions based on their various perspectives.

Summary

This qualitative case study seeks to explore students' perceptions of their interactions with engineering faculty and institutional agents and understand the role that social factors (i.e., race, ethnicity, and culture) and empowerment through cultural wealth plays in those interactions. In this chapter, the researcher described plans used to address the research questions through various data collection methods. Multiple data sources were utilized to ensure triangulation and member checking was used during the data collection and analysis procedures to reduce the researcher's bias. The study employs a primarily qualitative research design that includes an online questionnaire, individual interviews, and document analysis using institutional documents that illustrate how the university and the College of Engineering perceive Black and Latino students.

CHAPTER 4: FINDINGS

This qualitative study aimed to explore the educational experiences of eight successful Black and Latino engineering students using a community cultural wealth (CCW) framework to guide the study. The purposes of this study were to understand what personal qualities or other factors are important to Black and Latino students while they successfully pursue their engineering studies, and the nature of the role of interactions with engineering faculty and non-engineering faculty, as well as other institutional agents (such as advisors, mentors/coaches, and other professionals), play in their academic and social development. Additionally, this study sought to identify how sociodemographic factors, such as race, ethnicity, and culture influenced Black and Latino engineering students' interactions with faculty and other agents, and determine how the forms of capital (i.e., aspirational, familial, social, navigational, resistant, and linguistic) in CCW explain how these students persist in engineering.

In this chapter, the findings are presented and drawn from contextual data from institutional documents, along with information from interviews and questionnaires provided by eight high-achieving or successful Black and Latino engineering students at Southern Urban University (SUU). This chapter begins with brief descriptive profiles of the eight Black and Latino engineering participants, and continues with the elaboration of four data-based themes that highlight students' success in engineering, interactions with faculty and other institutional agents, sociodemographic factors (e.g., race, ethnicity, and

culture), and forms of CCW-based capital evident in their responses.

Participant Profiles

The participants in this study are described and presented below in alphabetical order by the pseudonyms they chose for themselves.

Participant 1: Agrepina

Agrepina, a Latina civil engineering senior, likes to be involved in organizations, one of which was an organization on campus that focuses on her Latino culture and involvement in engineering. She describes herself as well-organized. She loves mathematics and chose engineering as a career path because of the design process.

Participant 2: Alexis

Alexis, a Black civil engineering technology senior, describes herself as a creative, outgoing, and detailed-oriented person. She has participated in internships related to her major and participates in a student organization that provides peer mentorship to students who are in their first year of college.

Participant 3: Carmen

Carmen is a Black electrical engineering junior who chose engineering because she was awarded a scholarship to pursue a STEM discipline. She describes herself as a determined and hardworking student who wants to make something out of her degree. She has had the opportunity to work on several internship and research projects related to her major and is actively involved on campus with disability services.

Participant 4: Jason

Jason, a Black civil engineering technology senior, describes himself as a hardworking and open-minded individual. He chose engineering because he has always

liked mathematics and was recommended by his mathematics teacher in high school to consider engineering as a future career. He is currently participating in a research/internship opportunity.

Participant 5: John Doe

John Doe is a “resourceful” Black mechanical engineering senior who is actively involved in student organizations on campus that focus on Black males and students of color in engineering disciplines. He chose to major in engineering because he has engineers in his family and also because of the flexibility including financial stability and unlimited possibilities that comes with being a mechanical engineer.

Participant 6: Kid A

Kid A, a Latino computer engineering senior, is a self-described methodical and analytical person who enjoys the process of things. He chose engineering because his dad was an engineer and he was pretty good at working on computers. He is actively involved on campus with a student organization specific to Latino students in engineering.

Participant 7: Ricky

Ricky is a Latino electrical engineering junior who describes himself as a family-based, people person who can sometimes be shy. He was motivated to pursue engineering by his uncle who is an engineer in another country and is currently participating in a student organization on campus that is engineering-focused and an honor society for transfer students.

Participant 8: Sonya

Sonya, a Black systems engineering junior, describes herself as an organized and very social person who genuinely loves to help other people. She was motivated to

pursue engineering by her love for mathematics and by her dad who is an engineer. She is involved with a peer mentoring program designed to assist first-year college students and is also involved in a student organization for Black students in engineering.

The questionnaire and interview data provide insight on how these eight underrepresented students have remained successful in their engineering programs and have utilized interactions with faculty and other institutional agents and sociodemographic factors to navigate through college. The four major themes of the findings include: (1) Personal Qualities and Factors that Facilitate Success, (2) The Nature and Role of Interactions With Faculty and Institutional Agents, (3) Sociodemographic Factors in Engineering, and (4) Impact of Community Cultural Wealth. Each of the major themes included both major and minor sub-themes (shown in Appendix F).

Personal Qualities and Factors that Facilitate Success

Although the eight participants traditionally defined success with measures such as completing college, having high academic performance, and making good grades; they also mentioned other perceived qualities of success such as working hard to inspire others, having strong leadership and great self-presentation, doing what they love in terms of a career, and collaborating with others to be successful. In this theme of ‘Personal Factors and Qualities that Facilitate Success’, there were two major sub-themes including ‘Typical Definitions of Success’ and ‘Seeing Success as More Than Just Studying Engineering’. From the major sub-theme ‘Typical Definitions of Success’, two minor sub-themes developed were ‘Having Good Learner/Student Behaviors’ and ‘Persisting with Good Grades to Graduation’. From the major sub-theme ‘Seeing Success as More

Than Just Studying Engineering’, the minor sub-themes ‘Hard Work and Determination to Achieve an Accomplishment’, ‘Leadership and Career Development Through Involvement with Others’, and ‘Support from Family and Friends’ were established. These minor sub-themes reveal the personal qualities and success factors that Black and Latino engineering students at SUU utilized daily to persist in engineering.

Typical Definitions of Success

All participants of the study agreed that success included factors such as getting good grades, paying attention and learning in the classroom, and graduating from their engineering programs. As an example, Carmen said, “I love school. I’m always wanting to better myself in some type of way”, which indicated that her experience was about learning and understanding engineering so that she could be the best engineer. The interviews with Black and Latino engineering students offered key reflections of perceived qualities and factors that represent academic success in their engineering programs. Some key words that all participants mentioned in defining success from a student’s perspective included learning, listening, making good grades, and graduating. Thus, two sub-themes are presented: (1) Having Good Learner/Student Behaviors, and (2) Persisting with Good Grades to Graduation.

Having Good Learner/Student Behaviors. During the interview process, most of the participants expressed that they enjoy modeling good student behaviors (e.g., listening and learning) and described the importance of learning and listening in maintaining academic success. For example, Agrepina explained that she “loves the hands-on learning” process in engineering and Kid A also said, “I like to learn. I feel like my biggest drive is just to learn engineering and anything that comes to a degree that I’m

taking.” He later described how learning in his classes has influenced his direction in terms of career by saying, “This case, I’m going for computer engineering...there’s virtually endless possibilities as to what you can do with that. From hardware design to software design, as I’m thinking something between, something completely unrelated, maybe something more towards electrical side”. When John Doe was asked to describe personal qualities that aided in his success, he said, “I’m a good listener...I’m ready to learn whatever I need to learn”. When describing success, Ricky, an electrical engineering student, said, “...success for me...you actually understand everything you’re doing. I mean my life story is go through classes and just do the necessary to pass.” Ricky then described the learning process of going through his semester-long project with his classmates:

We had to put together different knowledge for different classes we took before...we took that for that class...we had to do that for the other class and then you see all that you did before is actually important work and it’s actually worth it and then all the time you put in at it...we had to go out of comfort zone and try, research...it was a whole semester long project of coming with ideas and prototypes and errors. At the end, we actually succeed.

Ricky recalled learning and using various techniques from classes he had previously taken that were instrumental to his success on this particular project. The hands-on experiences from the classroom proved to be vital to the learning experience for both Ricky and for Kid A, who recalled courses that sparked ideas for future directions in projects and careers.

Additionally, Carmen, who is also an electrical engineering student, highlighted how challenges in the classroom with academic performance are utilized to promote learning.

I don't consider, say, not making a C in a class, or even maybe failing a class, like failure. It might still be success because you might have learned something that you can fix now.

Carmen, who explained that she loves school and is always looking for ways to improve, thought success came from learning from your failures in the classroom. Carmen believed that challenges to courses were utilized to increase success in future classes because of the chances given to improve in the classroom.

I'm always the type if I don't understand something, I'm going to ask because I don't want to wait and three classes down the line...they're like, "Oh, but you should know this", and I've never understood it from freshman year.

This comment spoke to the importance of Carmen progressing in her learning and seeking to learn things along the way that may be useful later.

Several participants highlighted how the experiential learning in the classroom added to their success in the engineering program. Modeling good learning and student behaviors allowed the students to understand techniques and skill sets associated with becoming a great engineer. Additionally, persisting and making good grades provided the confidence needed to move forward in the academic discipline. Therefore, students' accounts of persistence and maintaining good grades are explored in the next sub-theme under the theme 'Typical Definitions of Success'.

Persisting with Good Grades to Graduation. Maintaining good grades is essential to persistence and graduation for all students pursuing degrees in higher education. Equally, all eight participants believed in the importance of having good grades and high grade point averages (GPAs). As reported in the questionnaire, overall GPAs for the high-achieving/successful Black and Latino engineering participants ranged from 2.5 to 3.5 and seven had a major GPA of 3.0 or higher. For all eight participants, graduating and accomplishing this major goal of becoming an engineer was a priority. Jason, a senior in civil engineering technology, mentioned that students have to “successfully complete [their] goals” and the other seven participants individually agreed that being consistent in their grades and pushing forward to graduation were the keys to their academic success. When asked to describe success in terms of being a student, participants said:

I’ve kind of completed college...I guess that would be one success right there. (Agregpina)

As a student? Basically graduating, as far as this program...if you can make it to your senior year and graduate with this program, you done a good job. (Alexis)

Well, this is my fourth year and I'm still in the program, so that's successful to me. (John Doe)

As of right now, my number one goal is just to graduate. I feel like it is so critical that I get to pass through all my classes because in the end what I’m going for is a degree. (Kid A)

With engineering as long as you stay in it...honestly as long as you graduate, like that's successful. (Sonya)

Additionally, Ricky described how good grades in the classroom not only affected graduation but also a potential career. He explained, “I’ll get pretty good grades...I mean, grades are really important for the future, especially for jobs” illustrating how good grades promoted academic excellence and led to great career opportunities. Carmen also rationalized the concept of maintaining good grades and explained that success should not be all about the grades, but the high standards that students must develop while taking classes to ensure that they’ve done their best academically.

If you say you're going for a C...you could have a bad day during testing...you get that D; but, say if you were going for a B, I just feel like just naturally you would study a little bit more...then, say something falls short, and you get that C. Well, at least you passed. I think that’s what success is, just setting the bar a little bit higher than normal.

Carmen emphasized that having a positive mindset when approaching coursework to get good grades can be important when challenges are presented. In all coursework, Carmen felt that “setting the bar a little bit higher than normal” accounted for shortcomings in grades and that “just being consistent in your academic studies and in your college career period” ensured academic success.

Seeing Success as More Than Just Studying Engineering

Although Black and Latino engineering student participants provided information on typical academic success factors (as noted in the literature review), they also suggested that success was more than just factors such as good grades or graduation from an engineering program. For instance, Agrepina stated, “I don’t think anybody can really define that [success] correctly” while Alexis offered a definition for success, which was:

“You can love what you do...I feel like being successful is being happy all around and being wealthy all around your life”. Key words such as leadership, involvement with organizations, teamwork and relating to others, hard work, and presentation were perceived by the participants as being personal factors that aided in facilitating their success. Thus, three minor sub-themes were established, which were: (1) Hard Work and Determination to Achieve Accomplishments; (2) Leadership and Career Development Through Involvement with Others; and (3) Support from Family and Friends. These sub-themes described success in relation to personal qualities and other factors of the eight participants as well as success factors based on students’ experiences in engineering.

Hard Work and Determination to Achieve Accomplishments. In being successful Black and Latino engineering students, the majority of the participants highlighted hard work and determination as key factors to being successful in engineering, but also mentioned other milestones in their lives. In defining success, Alexis stated that her pursuit of a civil engineering technology degree was just “one more milestone that I've accomplished, just another one to mark off my list”. Kid A shared the same sentiment by describing success with the word “accomplished”. Similarly, other participants highlighted hard work and determination as part of their personal qualities and factors of success:

What it means to be successful is basically to put your all in everything, and just to try your best, and stay consistent with trying your best...working hard and understanding what's in front of you. I feel like that's the gateway to success...I'm very determined. (Carmen)

I guess working hard, stuff like that...just working hard, not procrastinating. (Jason)

I...work really hard...try my best in everything. (Ricky)

I would say...determination to push forward. (Agregpina)

As previously stated, several participants expressed their eagerness to learn and often worked hard on hands-on learning projects whether individually or in groups. Hard work and determination were also deemed necessary to participants in order to be successful and often required the participants to really push themselves and go above and beyond.

Leadership and Career Development Through Involvement with Others. Personal leadership and career development are important aspects of success for all eight participants. On the online demographic questionnaire, all students indicated that they were either involved in student organizations (e.g., engineering-related and non-engineering-related) on campus or research/internship opportunities (most being off-campus opportunities). Based on the interviews, six out of eight participants referred to working with others in relation to being successful. Participants also highlighted that starting and preparing for careers through networking and memberships in certain organizations helped with specific aspects of development (e.g., self-presentation, job interview skills, and speaking skills) were a vital part of success.

Specifically, some of the participants connected success to their leadership and career development and stated:

I could get a really good job then that would be a success. (Kid A)

I have been part of organizations and taken leadership roles. I have studied abroad...so yeah, I would base it [success] off my accomplishments.

(Agregpina)

I got that co-op experience...real world experience and I felt pretty successful because it basically showed me what I could be doing. (Sonya)

In addition to the leadership experiences and opportunities to develop professionally, three participants (Agregpina, John Doe, and Sonya) also mentioned the need for other personal areas of development (e.g., networking and communication, teamwork, mentorship, and support from both formal organizations and internship employers and professors) to be successful:

I've met a lot of great people through that organization. They've helped me a lot to develop as a professional rather than just a student. Job interviewing, applying for jobs, how you must dress and present yourself, how to do a little pitch to present yourself towards other companies.

(Agregpina)

I'm not doing anything in my free time, why not go volunteer at the school...go to the information session...talk to this recruiter...that's something that's really helped me...because I wouldn't describe myself as a genius or a very academically good student. I'm just a good talker who knows how to dress well. From...working in corporate America, the people who I know who are really successful are able to relate to people...hold conversations...listen and learn and be able to implement ideas. (John Doe)

You have to be able to just be proactive...as far as networks...I don't know if you have heard of [national student organization]. It's like an alliance for minorities...those organizations have been helpful. (Sonya)

Jason and Ricky highlighted how teamwork with group projects as well as good communication with professors guarantee success, both socially and academically. Jason suggested that success is “working with groups, studying with groups” and Ricky stated that success is about “picking the right team members because that’s the definition of a team, everybody works together”. Ricky also mentioned that another key to success is not only working in a team with peers, but also becoming socially successful by working with professors and establishing mentors through relationships with those professors. He specifically said, “Always try to have good communication with the teachers, that when you do ask them questions, they are your mentors”. Communication with others can be perceived as personal factors of success for some students and even access to networks and groups aid in the development of students as career professionals and leaders.

Support from Family and Friends. When asked how family members were supportive in their successful pursuit of an engineering degree, seven out of eight participants explained that family members were supportive. Most of the participants used terms like support/supportive, help/helpful, and influence when describing family members’ roles in their success as a student. Although three of the participants had family members who were engineers (John Doe, Ricky, and Sonya); they indicated that family members showed more support towards the general college process, not necessarily them majoring in engineering. Specifically, students stated:

They've always been encouraging. I know my sister...she was a really good [engineering] student so I guess I'm more lenient to tell my sister I got a really bad grade than tell my parents...I always keep them updated... I've never had a problem with encouragement from my parents. (John Doe)

Yes, well, first, family wise, I have all the support, even more than I can have. They always been really good to me...always support me in anything I say, everything I want to do. I mean that's been a key factor in my success...because as a engineering student, I don't have that much time to work or do other activities and they help. (Ricky)

My dad [engineer] definitely because he pays for my school...and just my other family members, they ask me how things are going. Just asking me how things are going is helpful and yeah just...[having a] support system from my family members. (Sonya)

For the other five participants without engineers in their family, more support may have been shown towards the college process because family members may not have fully understood what engineering was or entailed as a major.

...My family...they didn't really pressure me to go to college...they didn't know exactly what the process was, but they're extremely supportive.

(Agregina)

My father, he's very techy...he knows a little bit. He encourages me and my grandmother, his mother, was a history teacher, and she doesn't know

the engineering side, but she knows the school aspect. They influence me.

(Carmen)

I think I'm very blessed for having a very supportive family...very united family. My dad is my number one fan...my mom...she actually didn't get to go to college so she doesn't know what it's like. Even though she's supportive sometimes, she doesn't really understand what I'm going through. (Kid A)

When I had both my parents saying I could do it...that's what really helped me...I just know I had support. (Jason)

While most participants mentioned supportive families, a few participants indicated that certain family members were either not supportive, but not necessarily discouraging. For example, Alexis mentioned that "they [family] don't really push me, but they don't really discourage me either" and then rationalized this comment and said, "It's just, they know I got me and they know that I'm taking care of me. I've always been independent. So, it's nothing to really worry about". Additionally, Carmen explained that when it came to support and encouragement from her family on her mother's side, it was minimal and said "they think I'm going to be a hardhat [with] glasses, and working on some machine that women shouldn't work on. They don't understand. So, if anything, they don't really encourage me". These two women's family members were not discouraging, but it appears that they didn't really understand engineering or the process as indicated by the other participants who did have supportive families.

When it came to support from non-engineering peers, four of the participants agreed that their friends didn't really understand engineering unless they were in the

discipline and that at times they had to reinforce studying needs versus hanging out, but their peers were usually supportive:

None of my friends are in engineering so they don't understand what I go through or why I can't go out...they are somewhat supportive. (Ricky)

I guess...they push me to a certain extent...when it's partying time, it's partying time...when I need to study or get ready for a test, they're like okay. (Alexis)

My peers influence me sometimes indirectly. (Sonya)

My friends are supportive, but they can be a distraction...they don't have, as hard classes as me so they want to party all the time, and I just can't. (Jason)

Overall, peers outside of engineering were somewhat supportive, but did not understand engineering or the participants' work ethic. Research shows that STEM students tend to have more rigorous grading systems and challenging coursework than other disciplines (Rask, 2010; Sharkness et al., 2010). This may partially account for why Black and Latino engineering students work hard and perceive distinctions in their academic major and work ethic when interacting with non-engineering peers.

In relation to interactions with engineering peers, participants indicated that working together and supporting one another were important with all the difficult coursework and projects. Kid A mentioned several times that his peers would "hang out after class" and other students made references to being introduced to engineering-related student organizations by peers as well as studying with peers.

I need to be here [at SUU]...I can't study at home...I have my buddies [peers] here to study with... (Kid A)

This girl [peer] walks in, giving out flyers for SHPE and she was like, “Come to our meetings. There’s a lot of fun...I decided to go one of the meetings and I met her...she was very connected...I thought it was a really good organization because we do a lot of things in there and they’re all engineers...we all just hang out. (Kid A)

Other participants characterized interactions with engineering peers as having buddies, people to hang out with, and connections and exposure to resources.

Well, I learned from NSBE because my mentor [peer] was the president. She said, “Hey, you're in NSBE now”. I said “cool”...one person who graduated...she was a part of SHPE and I knew she was cool so I would always go to meetings or all the events they had. (John Doe)

Well, in one class, we [Jason and a peer] just sat next to each other and ever since then we just clicked and it’s just the two of us [studying together all the time]. (Jason)

They [professors] tell you about certain [student organizations] but then sometimes you hear it from students. And they're [peers] like, "Oh, did you hear about [minority student organization]”? (Sonya)

The participants were able to better relate to their engineering peers than non-engineering peers because they understood the process and were connected to resources that were helpful in learning more about engineering and opportunities.

The Nature and Role of Interactions with Faculty and Institutional Agents

This theme, ‘The Nature and Role of Interactions with Faculty and Institutional Agents’, described the nature of Black and Latino engineering students’ interactions with

various stakeholders including engineering faculty, non-engineering faculty, and institutional agents such as advisors, mentors/coaches, and other professionals (e.g., engineers, internship and job employers). There were two major sub-themes, which included ‘Understanding Contact with Engineering Faculty’ and ‘A Different Kind of Experience with Non-Engineering Faculty’. From the major sub-theme ‘Understanding Contact with Engineering Faculty’, the minor sub-themes were: (1) Indifferent Perceptions of Engineering Faculty and (2) Typical Interactions Outside of Class. This major sub-theme examined students’ perceptions of interactions with professors and identified how participants typically interact with professors. The major sub-theme ‘A Different Kind of Experience with Non-Engineering Faculty’ depicted the various interactions that participants have with non-engineering faculty members and describes how students understand those interactions as it relates to maneuvering while in an engineering program. Lastly, the major sub-theme ‘Role of Institution and Interactions with Institutional Agents’ will be explored to see how institutional agents interact with students and how Black and Latino engineering students perceive those interactions as being both positive and negative influences.

Understanding Contact with Engineering Faculty

On the online demographic questionnaire, six out of eight participants indicated that they were either very satisfied or satisfied with the quality of teaching in engineering-related courses. Additionally, participants indicated during the face-to-face, individual interviews that professors do a fairly adequate job in teaching coursework and providing relevant expert advice pertaining to the field of engineering. However, a majority of participants perceived interactions with engineering faculty as indifferent, and

they interacted less frequently with these professors as they progressed in their academic programs. The minor sub-themes that derived from this major sub-theme ‘Understanding Contact with Engineering Faculty’ are ‘Indifferent Perceptions of Engineering Faculty’ and ‘Typical Interactions Outside of Class’. These sub-themes described the specific experiences of the Black and Latino engineering participants as they interacted with engineering professors.

Indifferent Perceptions of Engineering Faculty. A majority of the participants perceived overall interactions with engineering faculty as indifferent (neither positive nor negative). Although positive interactions with engineering professors were highlighted, participants also talked about their negative interactions with some faculty members and perceptions of indifference. Some words that characterized their comments include “lack of care”, “indifferent”, “not approachable”, and “anti-social”. The following comments reflect the participants’ perceptions of how engineering professors appear to be somewhat unavailable or less open:

Engineers in general are anti-social so some professors can definitely seem like that...don't really see much communication between professors and students unless you're doing a research project with them or asking them questions about your course. I don't think any of my professors are unreachable in a sense either. It's more of if you want to approach them, you can. (Agregpina)

...You see them in their offices and that's all they're doing is like researching. I think another reason...I didn't see the benefit of going to their office [is] if I knew the professor already had a reputation of not

helping you out or explaining things directly, why would you go over there and waste your time? It didn't make sense to continue trying.

(Agregpina)

[Interactions are] indifferent. Everyone is just doing what they're doing...a lot of teachers do research at school...I hear that from my peers. They're like, "Oh, yeah, teachers do research here, they don't care"...I'm like, "Oh, okay." (Carmen)

A lot of times they're [professors] busy, and they can't always help. (Jason)

I consider my interactions with engineering faculty as indifferent...even though I've had a lot of help from my mentors and teachers, I perceive a lack of care towards my overall education...it almost seems as if the measure for academic progress were the grades students obtain rather than the amount of knowledge and skills acquired through engineering courses.

(Kid A)

I never really had a tight relationship with a professor or a faculty...it's...just straight school, very business...you know how you call [a] teleprompter and they're like happy and professional, but you really don't know them. You know they don't care...I try to keep it at that. (John Doe)

I would describe my interactions with engineering faculty [as] indifferent...our department...it's still fairly new, faculty is still new, and the department is small, it's neither positive or negative since everyone is still figuring things out as they go. But, when I do seek help or information, it is always available. (Sonya)

Some participants shared specific instances of challenges in interactions with engineering faculty. Kid A mentioned two professors who appear unapproachable and described interacting with them in the classroom:

He's [professor] very particular because when you take classes with him, he'll be the guy that if you ask a question and it's just a stupid question, he'll say "that's a stupid question, why are you asking things like that?", not in a mean way. He'll call you dumb, but it's almost in a sarcastic way. He will make fun of students. He wouldn't really care if you learn it or not. He just does this class.

Kid A then described another experience with a faculty member and connected the negative interactions with the professor's rank as tenured.

The professor that I took...he came to be very strict...he will say, "Does anybody have a question?" But, if you didn't ask your question, that was your fault because he will not go over it again. If you don't ask a question at the right moment, it's not like he's going to go out his way to actually teach it to you...you may think that's a little cruel, but it happens. Some faculty members are...there to help you, but you almost got to know what is it that you're asking...especially the associates [higher ranked professors]. They don't like to waste their time with useless questions.

Two other participants, Ricky and Alexis, also described particular instances that alluded to professors being perceived as unapproachable or even unreachable to help with potential opportunities for students.

She [professor] was really nice all the time...it was like...she wasn't open...did not talk to her. (Ricky)

I didn't even know I could use him [professor] as a reference until after I got a job and he's like, "Did you use me as a reference?" I'm like, "No. I didn't know I could." He's just like, "Well, you should have". (Alexis)

While the majority of students shared indifferent perceptions of engineering faculty, there was some discussion of positive experiences, illustrated in descriptions of some engineering professors as helping/helpful, open, providing advice, and passionate. Three participants (Alexis, Jason, and Ricky) perceived their overall interactions with engineering faculty as a positive experience.

One interaction I had with the one professor I call "Papa Bear", he's very motivating. He just wants you to succeed, honestly. (Alexis)

Yeah, well one of my teachers recommended me to talk to other students...that definitely helped with certain classes...sometimes they [professors] hold extra study sessions and that definitely helps...when I first started going here, I was struggling...and he [professor] saw me working hard...and he helped me out and allowed me to turn in homework late, and he helped me, I say succeed. (Jason)

My one teacher for engineering class, he was really passionate about it. We would always talk outside, after class, just ask him a lot of questions. He was really nice all the time. He was really open with his office hours...one [professor]...he always would tell stories, little stories about him and his

career. I like really hearing about their lives and how they try, what they did, and what they're doing. (Ricky)

While Agrepina, Kid A, Sonya, and John Doe described overall interactions as indifferent, they shared examples of positive experiences:

I started to talk to one professor and he gave me a summer research project...that's one of the resources that I was given...I'd say availability [of professors] is pretty good. I've worked with another [professor] with [student organization]. So, I've done outside projects with him. (Agrepina)

Most of the faculty is very open for anything whether that be academic advice or...career advice. Some of the faculty would give you suggestions to things even if you don't really ask them...that's pretty cool. They actually care about what you're doing; you're not just one more number in their list. (Kid A)

So, everyone is a little bit more open and casual...I feel like it's more personal here. (Sonya)

I've been part of leadership academy ... there's [professor/mentor name], he knew my sister so that's probably why he took me under his wing...because he really had a strong history with my sister...he kind of took an interest in me. He'd say, "Hey, how are you doing?" whenever I go to his office or "you should join this" or "you did a great job on this stuff", so he's always...kept in touch with me. (John Doe)

Kid A also mentioned positive experiences with a few other professors and said,

The other professor...he actually takes the time for you to learn. He actually goes the step of walking some students through the process of actually helping them. He cares about them...I have another professor too...he wants people to learn...to understand. He's always suggesting...if you have questions come to my office, shoot me an e-mail, but just make sure you know this stuff.

Overall, participants captured both positive and negative experiences with engineering faculty. While students perceived that some professors were helpful and open, some faculty members were also described as unapproachable or restricted. The balance of both negative and positive perceptions of interactions shared possibly explains how they came to the conclusion that overall interactions with those professors were indifferent.

Typical Interactions Outside of Class. Students typically met with engineering professors after class or during office hours. Students preferred face-to-face interactions due to the nature of the work, but sometimes used email to contact faculty members. The frequency and duration of visits during office hours were typically between one to four times a month, but two participants, Alexis and Sonya, mentioned seeing professors often especially the ones they had frequent classes or great relationships with in their engineering programs. All of the participants lived off-campus, and all but one of the participants worked non-academic jobs. Kid A and John Doe worked less than 10 hours a week while other participants (Alexis, Sonya, Jason, Ricky, and Carmen) worked between 11-40 hours during the 2013-2014 academic year.

Some participants suggested that it seemed harder to get to campus and tend to school matters, such as meeting with faculty, because they worked in addition to going to school or lived far from campus and had transportation challenges. Participants described typical interactions with professors as going to office hours or staying after class to get help with coursework, sending an email for engineering-related information, and meeting with faculty members because “it’s professional”. Typical interactions included:

I didn’t really talk to my professors...whenever I do want to contact a professor, it’s usually because I have a homework problem...that’s not something you want to e-mail...it’s hard to explain. (Agregpina)

I’m not really an office hour kind of person. I see them just about every day of the week...and probably I spend most of my time here in class. (Alexis)

Well, towards probably my first year, I talked to the faculty members, probably on a weekly basis. But now, not as much...I pretty much know what to do now. (Jason)

...I keep all of my interactions with faculty kind of professional...I just kind of go in there and get the business done. Like, if I need help on a homework question I’ll say hey, I’ve been working on this...show my face, let them know my name, and show them that I’m...working hard in the class... (John Doe)

[Interactions are] mostly in person, [or] email...because engineering...is really hard to explain it through emails or through text so it’s always easier to just talk to them. In a month, [I interact] maybe four times. (Ricky)

I try to go class as much as I can, but go visit them to the office maybe like once or twice a month, not too often...I get my questions together if I need to ask them. It's usually more towards the end of the semester... (Kid A)

I have to drive on both sides of campus. I don't like that at all. Parking is horrible, it's a lot factors that I feel like is why...I can't spend as much time with my teachers... my grades are more important and I'm trying to...have a life, too. (Carmen)

...I probably see the faculty about once or twice a month just to ask them questions about transfer credits or how something was going to affect me, or how I can make sure I graduate on time. (Sonya)

Alexis, who indicated having close relationships with two professors in the engineering department said, "Mainly, interactions happen in class, rather than outside of class, unless it's with two of the professors". She described one faculty member who she calls "Papa Bear" as a father figure and explained that she is "playful" with both "Papa Bear" and the other professor she referred to as laid back. She provided an account of an experience with the laid back professor and said, "I always go to her and be like, so, what's this? Is this going to be on the test?" She also mentioned "Papa Bear" in addition to the laid back professor and stated, "I just walk up to them and talk to them whenever I have a question. If I have a question on my mind, I'll ask." Although Alexis had a closer relationship with a few of her professors than most of the other participants, typical interactions were usually professional and focused on academic coursework or engineering-related projects.

A Different Kind of Experience with Non-Engineering Faculty

When participants were asked to describe their interactions with non-engineering faculty, four participants (Jason, Alexis, Ricky, and Agrepina) noted that they had very minimal contact with non-engineering faculty due to various reasons such as having more engineering courses and always being in the engineering building for classes, projects, or study groups. All of these participants lived off-campus and worked or participated in research or internship activities either on- or off-campus. Additionally, two of these four participants were transfer students (Jason and Ricky). Responses from those participants when asked about contact with non-engineering faculty included statements such as “I’ve never really spoke to professors or been outside of the engineering department” or “I’ve taken my general or other courses at another institution”. Although Agrepina had very minimal experiences with non-engineering faculty, she described contact with her math professor:

I do talk to one of my math professors. We just talk about our experiences abroad since he’s from China. He’s getting his PhD here actually. He usually talks about his experiences back home and I tell him about my abroad stories, that’s usually how our relationship has been.

The other four participants (Carmen, John Doe, Kid A, and Sonya) mentioned experiences with non-engineering faculty members as being positive experiences using words such as “positive”, “helpful”, “caring” and “encouraging” to describe overall interactions and specific examples.

Other faculty members outside of engineering...my interactions have been very positive. Sometimes I will say a little more positive than the ones from the College of Engineering. It’s different, but it’s in a good way. (Kid A)

...My first non-engineering interaction with a professor...a [project] that turned from just building a project into a behavioral study...we got involved with [a major company]...she was very encouraging. She kind of saw the possibilities. (John Doe)

Like one day...it was like two hours before an exam and I didn't have the right calculator for my test and I went to my professor...he was like, "I have a calculator, but I'm not giving it to you because you should have it by now". So, I went to the math department...and they were like, "okay, just bring it back after your test." So, I was like, "Oh, that was helpful"...that was outside of engineering and that was definitely a positive experience. (Sonya)

Now, the math department, I feel like they're wonderful. My Calculus II teacher, she was great. She actually tried to get me to join the actuarial club and was giving me information to become an actuary. I can say that the math department, the teachers that I've had, most of them are pretty hands-on...pretty caring...want their students to do good. (Carmen)

Additionally, Carmen not only highlighted her positive experiences with the mathematics department; she also described an experience with a physics professor:

...The teacher that I had, it was her first time teaching calculus-based physics for engineering...and she used to teach algebra-based, which is totally different... because I took the algebra-based one at my other school, and that was a breeze, and then I came here, and was doing calculus-based, and totally different, even my grade, totally different.

Carmen and three other participants (Jason, John Doe, and Sonya) also mentioned challenges with physics and other non-engineering courses. Specifically, Carmen explained:

I do not like our physics department at all... because I just feel like it's hard, but I don't feel like they give you the necessary tools, and I've reached out, I've went to the tutors, the academic success center. I've went to the [study] sessions, I've went to the resource center everything you can possibly think of, I've done for physics.

Four participants indicated that they struggled with physics courses; however, Carmen was the only one who mentioned negative interactions with physics professors. Although half of the participants had minimal interactions with non-engineering professors, they did not share any negative perceptions. The other half of those participants found non-engineering faculty members to generally be helpful and described those interactions as positive.

Role of Institution and Interactions with Institutional Agents

Institutional climate and factors play a major role in how students interact on campuses with institutional agents such as advisors, mentors, administrators, and other professionals. Institutional documents and websites were explored to provide a rich description of the institution. Also, information related to programs and services for faculty and students of color were presented. At SUU, there are over 350 organizations that are accessible to students, of which over 100 of those organizations address the multicultural needs of students of color.

Additionally, SUU's campus offers services for both their Latino and Black students through Latino Student Services and the Black Student Union, two organizations whose primary missions are to build and empower those Communities of Color. In addition to services and programming being provided to all Black and Latino students, SUU also offers an array of programs and services that cater to students in both engineering and other STEM disciplines. This section presents the minor sub-themes 'Different Levels of Interactions in Advising' and 'Mentorship from Other Professionals/Administrators'. These sub-themes provide an understanding of Black and Latino engineering students' interactions with institutional agents and how the institution supports those interactions.

Different Levels of Interactions in Advising. There are various levels of advising that take place at institutions. There is general advising that usually takes place at the beginning of an undergraduate students' college career to satisfy general course requirements. Then, there is mandatory advising within a student's academic discipline that tracks the academic progress of a student in their declared major. Students can also have advisors through student organizations that they may become members of and interact with to provide academic and career guidance. All participants mentioned their interactions with advisors on different levels. Participants mentioned helpful interactions with engineering advisors as it related to coursework while other participants discussed quality interactions with general and program advisors. Only a few participants mentioned negative interactions with an advisor (e.g., major or other major advisors). Therefore, this theme explores the various levels of interaction in advising as experienced

by the participants and how their interactions with advisors have positively or negatively affected their educational experiences.

Advising within the College of Engineering at SUU is mandatory for all students. Although the advising guidelines are similar for all engineering departments in the college, the advising process varies depending on the department. Specifically, in the engineering technology department, students are required to participate in group advising each semester while students have the option of participating in group or individual advising in engineering disciplines (e.g., electrical, computer, systems, and mechanical) with the completion of other steps in the process. Some departments (e.g., electrical and computer engineering) also indicate that they offer faculty mentorship for long-term planning and career development and supplemental advising for at-risk students. This sub-theme describes Black and Latino students' interactions with engineering advisors as they navigate through the various engineering disciplines.

Participants specifically talked about their interactions with major advisors. When four participants (John Doe, Kid A, Ricky, and Jason) mentioned perceived interactions with major advisors, they mentioned words such as helpful and encouraging:

...I give her my [identification number], tell her what I would like to know, she either helps me or puts me into contact with someone. (John Doe)

The electrical and computer engineering (ECE) advisors have usually been very helpful with suggesting, directing, and encouraging me to pick a path in my career. They also give me some tips on how to go about taking some courses over others...overall I wouldn't have any complaints...if I have

any questions about classes they usually seem to find an appropriate answer to direct me. (Kid A)

Oh, my [major] advisors...they definitely have helped me a lot...I was registering for classes and there were two classes that were time conflicts and I needed them to graduate...she [major advisor] made it happen to where the classes were at different times...if she didn't do that, I would probably have not graduated 'til next year...I think our advisors are pretty good here. (Jason)

They [advisors] always encourage us...to look into organizations and try to do outside activities. They always do that. I always get the emails or stuff. I mean, that's great really. (Ricky)

Alexis and Jason described the nature of their interactions with engineering advisors, which usually included going to discuss the next classes to take for the next semester. Alexis said:

As far as my advisors go, I'm more of the type of person, I'm a tell you what I'm going to take [classes]. If I really want something, I really don't care about your opinion... so they signed off on everything and I usually just go through it...even if I am struggling [in classes].

Jason mentioned going to visit his advisor at least once a month, saying "...well, usually when I go in there, it's about classes for next year in the future."

Engineering advisors are instrumental in determining course load and providing direction while students pursue engineering.

Although participants mentioned engineering advisors being helpful, Carmen developed negative perceptions of her advisor based on her experiences. Specifically, she stated,

My advisor...she wouldn't be the reason why I stay in engineering...[she's] kind of discouraging because...she's like, "If you don't want to do this, just let me know". She then went on to explain, "I should be thinking more of why I would want to do this [pursue engineering] versus why I wouldn't because if I don't have many reasons on why I would want to do it, [I] would just automatically figure out what I need to do.

In this response, Carmen explained that her advisor should be persuading her of why she should remain in engineering versus discouraging her to leave when challenges arise. This speaks to Carmen's resiliency in believing that she can be successful in engineering and if not, she knows how to figure out and navigate towards the potential new direction (in terms of academic disciplines).

Overall, the participants saw engineering advisors as beneficial to their academic process, but one student had negative perceptions of her advisor based on a perceived lack of encouragement to stay in engineering. Some participants described relationships with other types of advisors, including general/non-major advisors and program advisors. Those interactions are described in the subsequent sub-themes.

At SUU, general and program advising is essential to assure the retention and timely graduation of college students. Typically, students meet with general advisors to

ensure that they are meeting their academic goals and to develop a plan when challenges arise or when they are thinking about switching majors or majoring in two disciplines. Also, program advisors (under a contractual agreement) work with student organizations to provide insight to groups of students on matters such as organizational goals for the academic year, leadership, and concerns related organizational needs. Program advisors can also be useful for providing guidance to individual students and recommending resources or academic help. Although most participants did not recall or experience interactions with general advisors (four participants were transfer students), Agrepina recalled her experiences with a general advisor and his encouragement to stay in engineering:

Yeah, I met my general advisor. I still talk to them every once in a while.

We just have random conversations, but he did tell me about some programs...I remember my freshman year...I was planning to go into architecture. He's like, "Well, I don't want you to leave but I guess I'll tell you...what exactly the program would be about." He explained it all to me.

While Agrepina reflected on encouraging interactions with a general advisor, other participants reflected on their interactions with program advisors, who were described as positive, flexible, helpful, and resourceful.

They've been positive. I know with the [student organization at SUU], we had like a separate advisor...when I told her I was going to study engineering, she was happy for me. She was all excited, "Yeah, we need more Black people, Black women in engineering". (Alexis)

In [student organization at SUU], that's kind of STEM-related...she [advisor] was positive and she even told me about ways that I could get more money for school. So, they definitely recommend resources for you.

(Sonya)

Sometimes I schedule meetings with our advisor...would just go talk to her, but overall my interactions with her just being very good. She's a very sweet lady...very helpful, very resourceful. She always finds way to help us. She was an engineer herself. Overall, I feel like my interactions have been very successful with her. She's very open-minded...very helpful. (Kid A)

Kid A also described an experience with his program advisor where they had to take care of some business concerning the organization and how he remembered it being a really positive experience.

I actually went up to her and said, "We need to go to the bank." She said, "Yeah, sure whenever." At that point, she even offered to drive. She said, "Whatever time is best for you". She's very flexible in her schedule. We went and she was very helpful. She did everything...I didn't really see like anything coming from her head that would look like "I don't have time for this" or "maybe you got to find someone".

Ricky mentioned contacting an advisor in the math department to get more information:

I really wanted to talk with a math advisor about...a double math major...I didn't see anything online if it was possible and I sent them a couple of emails and tried to talk them, I haven't still heard back from them...but, besides that, I haven't had any other negative comments.

On the online demographic questionnaire, seven participants agreed that there was some level of satisfaction (very satisfied, satisfied, or somewhat satisfied) with academic counseling for their major, involvement with student organizations, and both formal and informal mentoring from faculty and advisors. Overall, advisors at every level (e.g., general, major, or program) appeared to have been vital to the participants' academic progress as mentioned during participants' individual interviews. Seven out of eight participants mentioned that their interactions with the various types of advisors were generally positive and beneficial; however, Carmen perceived her experiences as negative and discouraging while Ricky mentioned instances where he felt that non-engineering advisors could be more helpful.

Mentorship from Other Professionals/Administrators. Based on the online demographic questionnaire and individual interviews, all participants are either involved with student organizations or internships/research opportunities that are on- and off-campus. Additionally, three participants (Ricky, John Doe, and Sonya) had family members who had engineering degrees and three other participants (Carmen, Jason, and Kid A) knew engineers prior to enrolling at SUU. In total, six participants had access to engineering professionals outside of the institution. During the individual interview process, several participants highlighted the nature of their interactions with other professionals (e.g., engineers, internship employers, researchers) and generally characterized them as mentorship encounters and opportunities to develop as a student and a professional. Participants' highlighted that these professionals were encouraging, resourceful, and provided mentorship; and they provided the following comments:

The main mentor for the Collegiate 100, which is 100 Black Men [of city]...he wanted me to go the Collegiate 100, but I was going through school stuff...so, like this year...I was inducted...I'm part of the Collegiate 100. It's kind of a mentoring environment. (John Doe)

Outside of school, you know like old supervisors or old bosses, they check up on me all the time and definitely encourage me to keep going with engineering. So yeah, I have had positive experiences. (Sonya)

[Mentor's name], he's just somebody that came out of nowhere. I just was looking for an on-campus job, and I applied, and it was something actually in the architecture building, and he didn't know anything about it. It was something about a manager. I was just looking for a job, it was nothing career-related. (Carmen)

Although Ricky had not experienced many encounters with engineering professionals outside of his uncle or the institution, he highlighted the importance of engineering professionals and said, "I'm going to start talking to a lot of engineering professionals. You have to talk to them to network or just see if we can do anything. I see that as a great opportunity". Overall, participants found interactions with professionals, whether on- or off-campus, to be meaningful and opportunities to be mentored in areas such as career and personal development.

Sociodemographic Factors in Engineering

While all of the participants recognized that they were underrepresented in their engineering programs, most did not perceive that they were subjected to racial challenges such as prejudice, stereotypes, and racism with faculty members. However, some

participants felt that racial/ethnic and cultural stereotypes played a significant role in their interactions with their engineering peers. Additionally, several participants recognized that their engineering programs were very diverse and that there was a need to learn and be understood by people of other cultures while pursuing their engineering disciplines.

This major sub-theme presents three minor sub-themes, which are: (1) Racial and Cultural Aspects in Faculty-Student Interactions, (2) Working Hard to Prove Them Wrong, and (3) Perceived Needs to Understand and Relate in Racial and Cultural Aspects. Racial and Cultural Aspects in Faculty-Student Interactions

During the interviews, some of the participants expressed that race played a role in their interactions with faculty members while most participants suggested that race does not matter and that it is up to students to interact with faculty members. Agrepina and Alexis perceived that racism, stereotypes, and racial and cultural differences did not matter in their interactions with faculty:

I really don't think race has anything to do with it. I think it's the student, if you want to interact with the teacher then you want to interact with the teacher. If not, the teacher won't take the first step. I think it's usually the student who has to. (Agrepina)

I don't really see any difference in being a black female in the program or in engineering, period...with professors...there's an African professor, I interact more with him. The lady professor that I was talking about earlier, she's more down to earth. I interact more with down to earth professors, but Papa Bear, he's just like he sounds. He's like daddy of the major type

deal...I guess everybody's different. It just varies per professor honestly.

(Alexis)

An emphasis on students putting forth the effort and being proactive in their relationships was important to participants of this study. Feeling that sometimes racial/ethnic stereotypes played a role in his interactions with faculty, John Doe agreed with Agrepina and Alexis that it was important to take initiative to interact with faculty. He stated:

I'm not afraid to ask questions so maybe initially when they [professors] see me [race and stereotypes play a role]...I speak with them and that's when they learn more about me and they're more willing to open up to me.

Although some participants indicated they did not see how race, ethnicity, and cultural factors affected their interactions with faculty, other participants suggested that the role of sociodemographic characteristics (e.g., race, ethnicity, and culture) play a major role based on looks in the hallway by a professor, noticing fewer Black students working as research assistants, and cultural language barriers that provided a disconnect between the professor and student. Specifically, those participants said:

I just know it's a different look to me in a hallway. When some old White guy walks down, and I walk down, [it's like] "What's she doing here?" You know? That's just me. I mean, just maybe they've never seen, or haven't seen in a long time, like, "Is she supposed to be here?" but not in a negative way, just in general. I've noticed that, because I'm very observant. (Carmen)

I think there's a difference...there's not many Black engineers at this school...not as many Black people in the major so I know a lot of people

get opportunities working with the teachers. Like, what do you call it? Like their assistants? I don't know what it's called, research assistants. I don't think there's Black people in that...I've never had a bad experience with a teacher that I just thought didn't like me. Most teachers like me so I didn't have any. (Jason)

Yeah, I feel like sometimes I just cannot connect with some teachers because of the same thing [strong accent and communication issues]... like just American teachers, there's not the same connection as if I have a Hispanic teacher or just a different nationality teacher because they know, I mean just the teaching style and learning style is really different from the United States. They know where you come from and what you go through and some American teachers, they might not...sometimes that might push me back a little bit, but not as much. (Ricky)

While sociodemographic factors such as race, ethnicity, and culture were highlighted as playing a role in the educational experiences of some of the participants of the study, other students took personal responsibility for their social awareness and exposure. Some participants felt that being proactive in relationships with faculty members and finding ways to relate and connect with professors to make them aware of who they were would eliminate any social concerns while other participants questioned gestures made in the hallway and lack of research opportunities that they linked to social aspects.

Working Hard to Prove Them Wrong

Although some of the participants did not perceive that there were racial and

cultural factors to consider in their interactions with faculty members, they did highlight that sociodemographic factors (race, ethnicity, and culture) played a role in how they interacted with their engineering peers. Seven out of eight participants mentioned being the only Black or Latino engineering student in their program or only seeing a few students who look like them in the classroom. Additionally, three participants (Alexis, John Doe, and Carmen) referred to being in a program with peers who are “church-going rednecks”, “nerds and rednecks”, and “White guys”. Male participants made the following statements about being the only “one” (Black or Latino student in their engineering program) and how that prompted them to work harder to be more competitive and prove that they had the skills and knowledge to be an engineer:

Usually, I’m either the only Black person or there might be one or two. But, that doesn’t change my mindset. I still have to go to class, study, [and] work as hard. (Jason)

Well, everyone probably knows your name or know you as a Black kid in class. So, I kind of use that to my advantage...whenever I'm doing something, I try to be better than everyone else. I don't see it as a weakness... I'm just better...I still am the only Black kid, but I wouldn't say alienated. I just have a different attitude. (John Doe)

I guess it’s not many Latinos in classes...I mean, they know I’m different, so whatever...I have a strong accent or when I speak too fast it’s not as well, you can’t understand as well...so people say, “Okay, what you just say, I don’t understand,” or they’ll be like, my writing skills, they’re not as perfect as other people and then so they kind of set me apart a little bit because of

that and [I] will strive to prove them wrong, of course. I feel like I'm as capable as they are. It just ... might take a little more effort. (Ricky)

The male participants talked about having a different mindset and attitude and how that was vital to them in pushing beyond being underrepresented in their programs and the classroom. Specifically, they talked about this common experience pushing them to be better and work harder towards being academically successful.

Gender Plays a Major Role in Interactions with Peers. While there were no specific questions about gender in the interview protocol, participants' responses indicated that gender played an important role in students' interactions with engineering peers. Specifically, all four women and one of the men of the study highlighted gender as an issue in their field. John Doe highlighted the issues that women face based on having women engineers in his family and being involved with student organizations that support women. He specifically provided examples of gender bias as described by his female peers in the classroom and said:

...I heard some horror stories from women in the civil department or the mechanical engineering department like how they're on teams with guys and they're just not respected...they show their work and [guys] say, oh I'm going to go check your work that kind of stuff...this is mad disrespectful and it's blatant to them so that's something I definitely learned especially from going to the [women's engineering] conference and seeing how it's a lot different ... it's not just being a Black minority, it's worse for women.

John Doe's comment highlighted how women would often experience negative encounters with their male counterparts in engineering.

Additionally, the women of the study mentioned comments, highlighting both gender and their race and ethnicity. They mentioned being the only Black girl or female or the only Hispanic woman in their classes and program and the need to prove that they belonged.

I mean...there are only two or three black women in my classes and all my classes...so you basically have a standard that you need to uphold for yourself because you are a minority and you need to let them know that you can do it and you can compete with everybody else in the room...so I just see it as me trying to grow as an individual in my career and not just, "Oh, I'm the black student in the room" or "I'm the only Black female in the room." (Alexis)

Yeah, they have little moments where they talk about females or whatever, but it doesn't really bother me like it would bother other females. It's mainly a guy major, not just an all White major...I don't really see a difference. Everybody knows who I am and when I speak, I am heard. (Alexis)

I was the only chick, the only Hispanic in my group. No, I didn't feel alienated at any point of time. I mean, everybody is respectable. They have a lot of your inputs to go put in. Now is my input respected, I don't know about that. I can't read people's minds. (Agrepina)

Race definitely plays a role, you have to work a little bit harder... I feel like I always have my guard up...if a White guy make[s] a 20 [and] I make a 20, I'm dumb, in everybody's mind. I just feel like Black people have more to

prove, or minorities in general. That's just a personal opinion of mind...we're not given a lot of chances...I haven't seen another Black girl in electrical engineering...seen one in computer engineering, and a couple in the other branches, but I haven't seen a Black girl in electrical...if I do bad, it's three times worse than if a [White peer] does bad, even if we get the same grade... I have to stay mindful. (Carmen)

I mean there are not a lot of Black students that do engineering...not a lot of females in general and definitely not a lot of Black females...and most times, I'm usually the only Black female...sometimes you just feel comfortable seeing people that look like you...and when you don't see people that look like you...that's going back to the proactive thing, you have to want the knowledge. (Sonya)

Based on the interviews conducted with the participants, it was perceived that the Black and Latino engineering student participants possessed an academic resilience and behavioral attitudes that suggested that they had to work hard, prove they belong in their engineering programs, and were as intellectually knowledgeable as their peers. Students suggested that it was pressure to prove that they could do the work and excel both in higher education and in their careers.

Perceived Needs to Understand and Relate in Racial and Cultural Aspects

Several participants agreed that the College of Engineering at SUU was very multicultural and racially/ethnically diverse; however, roughly 15% were students of color (e.g., Black, Latino, Native American, and Multiple Races). In particular, Carmen and Kid A highlighted the diversity of the engineering program:

Everyone's pretty open with race, because I noticed with [SUU], a lot of people aren't from the United States, so it's more than just Black, White, and Latino; it's African, and Japanese, and it's just a lot of different...like a melting pot. (Carmen)

It's very multicultural. You never really know what kind of people you're going to find in there because you can expect virtually any race, Latino, Asians, Whites, Blacks, mixtures of in-between. I'm very accustomed to like seeing a lot of multicultural things. I feel more that it's like a minority. (Kid A)

Ricky also highlights his friendships with peers and says, “[They’re] really nice and really open to friendship or to interchange ideas...it’s really a big diverse group.”

Although participants highlighted diversity as a positive attribute to the college of engineering, several students also expressed the perception that there is a need for more cultural and racial understanding when interacting with their peers. For example, three participants (Agregina, Sonya, and Kid A) described instances where they are not culturally understood. Agregina establishes that she does not “really show my Hispanic side” because “they [peers and faculty] wouldn’t understand it” when she interacts with them. She mentioned reserving the cultural aspects of her life for friends and family. Sonya recalls instances where her natural hair, which is associated with being a part of the culture for Black women, is a topic of discussion among her peers:

...The way I wear my hair sometimes may not be what, you know, what most White students are used to seeing...people make comments about your hair...I just explain to them, you know, what being natural is and...my hair changes a

lot...it's just my hair, you know, but some things are just [a] lack of understanding and they [peers] don't understand.

However, Sonya suggests, "It's not that it's a stereotype or, you know, somebody's judging you...it's a lack of understanding", providing the argument that students may not understand or relate to the cultural aspects and that there is a need to explain and relate culturally to others.

Kid A also individually agreed that sometimes "there's a difference in mindsets". Kid A described himself as coming from "a third world country" and he explains that the mindset there is very different from America and that those cultural values allowed him to understand that "people have to look up for other things, people have to care for other things, different ambitions, different lifestyles, different ways of thinking". This suggested that there is a need to relate to others and their cultures and lifestyles because people tend to lead and operate by the things they value and find necessary in meeting their goals. John Doe, in talking about playing into stereotypes as a Black man, highlights that it is important to define who you are for others and get them to relate so that stereotypes can be eliminated.

I know there's a lot of stereotypes about Black men in general and I definitely play on some of them...I never had anyone come up to me and confront me because...I'm in there giving off vibes of intimidation...if you don't give them something to describe you as, they'll make up their own description. They may know some other Black kid who was their last Black friend...who smoked weed...who dropped out of engineering and then they say...this must be a trend...he's probably going to drop out...doing bad in

school...as opposed to...knowing I'm working...doing co-ops. People look up to me and say, "Oh how do you do that?"

Participants established that there is a need to understand who they are, not just as a student, but also as persons in Communities of Color with various cultural considerations.

Impact of Community Cultural Wealth

Community cultural wealth (CCW) is defined by Yosso (2005) as an array of knowledge, skills, abilities, and contacts possessed and utilized by Communities of Color to challenge both macro- (institutional) and micro- (individual) forms of oppression that they may have experienced. As a model used to understand how cultural wealth can influence a student's higher education process and utilized to eliminate a deficit perspective, several forms of capital make up the CCW framework. These forms of capital are: aspirational, familial, social, navigational, resistant, and linguistic capital (Yosso, 2005). Five forms of CCW are most evident in participant responses, which are: aspirational, social, resistant, navigational, and familial capital. Four minor sub-themes addressed some of the forms of capital that were represented most through the responses in the interviews and the online demographic questionnaire.

Struggle Ensures Success

In examining success factors of participants while being in an engineering program and interacting with engineering faculty, discussions of pushing through challenges and barriers such as hard courses, difficult homework, challenges with projects, and communicating with professors, participants relied on aspirational capital. Aspirational capital, which is the ability of an individual to maintain their future hopes

and dreams while faced with barriers and challenges, was apparent in how students perceived that they had to prove that they belong by being intellectually competitive with their peers and pushing themselves to meet with faculty that sometimes appear “cold” and “unapproachable” to get assistance with challenging homework problems and project assignments. Several participants offered comments that showed their dedication to their engineering discipline and success. For example, participants stated comments such as “you basically have a standard that you need to uphold for yourself because you are a minority and you need to let them know that you can do it” (Alexis) and “making it past those classes...feeling accomplished” (John Doe).

While most participants admitted that the work in engineering is not easy and all but one participant mentioned they had thought about switching to another major because of the rigorous coursework or sense of fulfillment in another major, it was evident that being able to design things that people used and leaving a legacy empowered them to keep going because a rewarding career was awaiting them. Alexis specifically mentioned the legacy aspect of success in becoming an engineer by saying, “It's engineering. We construct the world. We have a duty to protect you...the bridge you just drove over this morning...an engineer made that, created that bridge. You don't even realize that you're trusting them [engineers] with your life.” Some of the interview comments that stood out when participants evaluated their perceptions of success in engineering and their future hopes and dreams were:

So, for me, just success is honestly just getting a degree. And, just having an engineering degree, you know it's a big deal because a lot of people don't have that. (Sonya)

Well, this is my fourth year and I'm still in the program, so that's successful to me. (John Doe)

So, I feel like just being consistent in your academic studies and in your college career period, and working hard, and understanding what's in front of you. I feel like that's the gateway to success, its no reason why you couldn't be successful. (Carmen)

Family Means Everything

Familial capital is a form of capital that supports the cultural and family knowledge of an individual and acknowledges one's community history and commitment to community cultural intuition (Yosso, 2005). There were several participants who mentioned the importance of support from their family and how they consistently kept their families involved in their college process. This was of the utmost importance for especially first-generation college students because there was a pressure there to be the first in the family to "make it". First-generation college participants and their families shared the common goal of succeeding; if the student made it, the family made it and were successful as well. Familial capital provides a sense of importance to both family and community and benefits Black and Latino engineering students by allowing them to share their cultural knowledge and sense of family in their school environments and through participation in engineering-related opportunities.

Based on the online demographic questionnaire, at least four out of eight participants were involved in culture- and race-related student organizations. This was a form of familial capital because students created a sense of cultural community at SUU through culture-related organizations on campus. Additionally, participants heavily

relied on the knowledge and resources of their family (e.g., family engineers, financial support, emotional support, connections to mentors) to help them navigate through their engineering programs. Participants mentioned receiving both financial and general advice from their families concerning the college process. Participants expressed some of the following comments that highlight examples of familial capital:

Oh and sometimes having like family members who have either been to college or have worked in certain professions is helpful. You know, just giving you advice on different things that you encounter. (Sonya)

But I mean the support, that's what really gets me over the hump. I mean, they help me if I'm ever, if I ever need any money. They try as long as it's for a good cause. I mean, like with books... if I ever need extra books, they've always got my back. (Jason)

They're [family] pressuring me to really do what I do best, which is look for opportunities because I guess ... I've called and told them... 'm not doing well in school. I got to do this, this or that, or they'll kick me out of the program and they've always been encouraging when I'm doing well and when I'm doing bad and I make sure I keep them informed as to how I'm doing. They always give me advice saying, don't stress out so I never had a problem with encouragement from my parents. (John Doe)

My dad is my number one fan. He's the one that wants to see me graduate the most. Sometimes it's more than me. He's like "I can't wait until you graduate and start working". (Kid A)

Capitalizing Socially and Navigationally with Faculty and Institutional Agents

Based on the online demographic questionnaire, all participants were part of student organizations on campus or participated in research/internship opportunities. Through those opportunities, all of the participants mentioned moments of learning and opportunities for mentorship from either faculty or institutional agents such as advisors, mentors, and engineering professionals. According to the CCW framework, social capital aims to explore networks and community resources that students use to maneuver through a higher education institution (Yosso, 2005). Some examples include mentoring, participating in research or STEM-related programs, and engaging with peers, faculty, and institutional agents while gaining knowledge and connecting to new resources. Participants mentioned how being a part of certain organizations and having mentors or supportive faculty or advisors have aided them in their college process. They stated:

...That's the kind of the skill I normally just adapted and that's why probably why I got picked up for a co-op program because I seem like that kind of person. I'm ready to learn whatever I need to learn. (John Doe)

Always try to have a good communication with the teachers...when you do ask them questions, they are your mentors. (Ricky)

Alliance for minorities...basically like a national program and they help retain and matriculate minority stem students. So, being a part of those programs, they give you scholarships and people who have actually graduated, and people who can, you know, give you advice on what classes to take. You know, definitely being a part of those organizations has been helpful. (Sonya)

I was talking to him [professor] on different stuff I seen Mercedes Benz do with control theories. There's different videos I see because I watch Science Channel like cartoons sometimes and we just had a good chat. He said I'd really like to have you work in my lab, I told him I'm working with [major company] this summer and he said well how about next summer, I said yeah. Then, he kind of went somewhere...the kind of ideas and questions I ask him, that's the kind of stuff people get PhDs for, I'm like...that was really my first time just being encouraged to continue to go further in my education. (John Doe)

That's the project I'm doing now, but he [mentor] helped me with that, because he knew people and referred me. [mentor's name] said he said a lot of good things about me, because we had a long talk, and that's how I got on the project. He helped me out. (Carmen)

Sometimes I schedule meetings with our advisor...I would just go talk to her, she's always very helpful, very resourceful. (Kid A)

They [advisors] always encourage us...to look into organization...like just now, starting next semester, I join the [engineering-related student organization]. (Ricky)

Additionally, navigational capital, the ability to maneuver in unwelcoming environments, was apparent in interactions with engineering faculty members. Students' interactions with engineering faculty were perceived as indifferent and participants highlighted them as not approachable at times. However, participants relied on the capital from non-engineering faculty members and the fact that there

were instances when engineering faculty members provided valuable knowledge to help sustain them in their educational experiences. Some examples of navigational capital included being involved with research opportunities and activities through institutional agents and other engineering professionals and using resources from other departments and non-engineering faculty members to be successful in engineering.

Stereotypes Don't Bother Me

Although participants did not experience many racial/ethnic and cultural challenges with faculty, the discussions from interviewing participants suggested that most of them had encountered challenges with peers pertaining to sociodemographic factors. However, the Black and Latino participants suggested that they were not affected by their peers and possessed a high resiliency to overcome obstacles and various oppositions as they navigated through the higher education institution. Therefore, participants of the study provided accounts of resistance capital, which is knowledge and skills fostered through oppositional behavior that challenge inequality issues (Yosso, 2005). Students provided accounts of persisting in an occasional hostile climate with peers yet spoke of developed skills and environments that aided them in addressing their various challenges. Some solutions utilized to address the challenges in interacting with peers included joining gender- and race- or culture-related organizations that served as a support system, connecting with other peers with similar issues who were either in an engineering program or had been in an engineering program, and displaying major confidence in their abilities and owning their leadership when in study groups or other

settings with peers. Some examples from the interviews that demonstrated resistant capital included:

I mean, I never felt I was alienated because people have asked me homework problems. They've had troubles with their homework and they've come up to me for suggestions. So, I don't consider myself as that far below them if they're coming to me for questions. (Agrepina)

At some points, I came out as getting the highest grades in the class and the teachers let it be known. For me, it's just like competition. I'm very competitive, so it's like a competition...I don't really think it matters, like the color of your skin or anything. It just varies on your mindset. I came from a hood background...I'm trying to better myself. I'm not trying to go back there. I'm trying to show the people there that you can be something. You can do better for yourself. (Alexis)

It's actually pretty cool because you get to learn from other cultures. So, when it comes to cultural aspects...it's not bad. I'm part of a Latino organization. We also accept people from other countries. (Kid A)

I will say one of my biggest conflicts is maybe the second language. I'm not as good as native people, somebody from here, to do presentations or write reports...You just have to be proactive and really just want it for yourself regardless of who look like you because at the end of the day it's not a lot of people that do. So, you got to really want it for yourself and not think about the other stuff. (Ricky)

Summary

Four main themes were expressed through the analysis of the online demographic questionnaire, the interview data retrieved from all eight participants, and the contextual data related to institutional perceptions of faculty and students of color (e.g., Black and Latino) at SUU. One finding revealed that there were various factors and personal qualities that aided in the overall success of Black and Latino engineering students including hard work, a desire to learn, working well with others, being involved with organizations, and having strong support from family and sometimes peers. Student participants described success from both the student and personal aspect indicating that success was about fulfilling academic goals (e.g., communicating and learning from faculty members, making good grades). However, success also extended beyond engineering and included participants graduating doing what they loved, being happy and wealthy, leaving a legacy through their engineering work, and developing both professional and personal leadership through networks.

Another finding revealed that students felt that interactions with engineering faculty were indifferent (neither positive nor negative) yet had very positive interactions with non-engineering professors and institutional agents such as advisors, engineering and non-engineering professionals, and mentors/coaches. Additionally, Black and Latino engineering students did not perceive race, ethnicity, and culture as playing a major role in their interactions with faculty members, but definitely perceived challenges related to stereotypes, racism, and gender differences in their interactions with peers. Additionally, student participants expressed a need to understand cultural differences in their engineering programs given the very racially and ethnically diverse culture in the College

of Engineering at SUU. In terms of community cultural wealth, some forms of capital were more visible than others. Specifically, aspirational, resistant, social, navigational, and familial capitals were evident when it came to examining factors of success, interactions with faculty and institutional agents, and sociodemographic factors and the role that they played in interactions with engineering professors. The next chapter, Chapter Five, will provide a discussion of the findings and highlight implications for practice and future research.

CHAPTER 5: DISCUSSION

There is a growing body of research that continues to highlight unfavorable outcomes of Black and Latino engineering students in higher education rather than provide examples of success for these underrepresented groups. It is imperative to establish racial-ethnic diversity in engineering to increase the creative knowledge and innovation of products and services to remain globally competitive with other countries (Chubin, May, & Babco, 2005). Therefore, this study was conducted to understand the personal qualities and other factors, the role of interactions with engineering faculty and other institutional agents, and the role of community cultural wealth (CCW) in how successful Black and Latino engineering students navigate through their studies at a research university located in an urban area. Specifically, the research questions for this study were:

1. What personal qualities and other factors do Black and Latino engineering students identify as important for their persistence and success in engineering studies?
2. How do Black and Latino engineering students interact with engineering and non-engineering faculty, and how do they perceive the role of these interactions in their academic and social development?
3. How do Black and Latino engineering students interact with institutional agents (e.g., administrators, advisors, mentors/coaches, and other

engineering professionals), and how do they perceive the role of these interactions in their academic and social development?

4. How do Black and Latino engineering students describe the influence of sociodemographic factors (e.g., race, ethnicity, and culture) on their interactions with faculty and institutional agents?, and
5. What forms of capital in the community cultural wealth (CCW) framework are apparent in the discussion of personal factors, sociodemographic factors, and interactions with faculty and other institutional agents that facilitate successful navigation in engineering studies among Black and Latino students?

The findings are drawn from an online demographic questionnaire and interviews with eight successful Black and Latino engineering students at Southern Urban University (SUU), along with contextual information gleaned from an analysis of institutional documents and websites. Major themes were developed through the analysis of the online demographic questionnaire and the interview data, which were: (1) Personal Qualities and Factors that Facilitate Success, (2) The Nature and Role of Interactions with Faculty and Institutional Agents, (3) Sociodemographic Factors in Engineering, and (4) Community Cultural Wealth.

While two conceptual frameworks – critical race theory (CRT) and community cultural wealth (CCW) – guided this study, the primary lens for interpreting the results was CCW. According to Yosso (2005), CCW is an array of knowledge, skills, abilities, and contacts possessed and utilized by Communities of Color to challenge both macro- (institutional) and micro- (individual) forms of oppression that they may have

experienced. This model provides an understanding of how cultural wealth can influence a student of color's higher education process and be used to eliminate deficit perspectives that can be associated with underrepresented groups (e.g., Black and Latino engineering students). Several forms of capital make up the CCW framework: aspirational, familial, social, navigational, resistant, and linguistic (Yosso, 2005). Having Communities of Color in mind, Yosso's (2005) CCW framework explains these forms of capital as the following:

- Aspirational capital - ability to maintain their future hopes and dreams while navigating present life challenges
- Familial capital - cultural and family knowledge as well as their commitment to a sense of cultural community and its history
- Social capital - utilization of networks and community resources to maneuver through institutions (e.g., colleges and universities)
- Navigational capital - ability to maneuver through social institutions, such as higher education institutions, that may not be welcoming for Communities/Students of Color
- Resistant capital - ability to foster knowledge and skills through opposing behaviors that challenge inequality issues
- Linguistic capital - intellectual and social skills attained through communication experiences in more than one language and/or style.

The CCW framework provides an alternative to deficit theories and critically examines the roles that sociodemographic factors (e.g., race, ethnicity, and culture) play in students' attainment of an engineering degree through interactions among students, faculty, and

institutional agents. Five forms of capital (aspirational, resistant, social, navigational, and familial capitals) were apparent in this study related to looking at personal qualities and other factors of success, interactions with faculty and institutional agents, and sociodemographic factors through Black and Latino engineering students' interactions with faculty and institutional agents. These forms of capital in CCW will be further explored through the discussion of key findings.

Discussion of Key Findings

In Chapter 4, the findings related to personal qualities and other factors of success, interactions with faculty (both engineering and non-engineer professors), interactions with institutional agents (advisors, mentors/coaches, administrators, and engineering professors), and sociodemographic factors (race, ethnicity, and culture) were explored. These findings will be discussed in this chapter to understand their linking connection to the CCW framework. Specifically, the discussion of findings presented the following themes: (1) Understanding Personal Qualities and Factors of Success through CCW; (2) Understanding Faculty-Student Interactions through CCW; (3) Understanding Interactions with Institutional Agents through CCW; and (4) Understanding Sociodemographic Factors through CCW. Additionally, implications for future research and practices in higher education are examined followed by a conclusion of the study.

Understanding Personal Qualities and Factors of Success Through CCW

Participants were asked to share personal qualities and success factors that aided in their persistence and success while in an engineering program. A key finding was that Black and Latino engineering students perceived that hard work, a desire to learn, working well with others, being involved with organizations, and having strong family

and peer ties were vital in aiding these students in navigating a higher education institution. Some students mentioned typical definitions and measures of success such as making good grades, interacting and learning from faculty, and networking with institutional agents; this aligns with current research studies on student success in STEM, or specifically engineering (e.g., Bernold et al., 2007; French et al., 2005; Johnson, 2007; Ohland, 2011; Ohland et al., 2008; Sharkness et al., 2010). Participants' abilities to excel academically led to higher persistence and retention rates in engineering, especially for Black and Latino students because they were empowered by their achievement in a field that is often rigorous. While success was defined academically, it was also of importance for participants to establish measures of success in relation to personal endeavors. By participants suggesting that success meant accomplishing life goals, doing what they love in terms of a career, creating a legacy, and finding happiness and fulfillment in their lives, a greater sense of commitment was established that outweighed the complexities of being in the field of engineering. The challenging and rewarding design process associated with engineering that is carried out on a daily basis in communities (e.g., building bridges or other infrastructures) connected participants to a deeper meaning of success, which is vital to their persistence in higher education.

In addition to personal and academic qualities of success, other factors related to success were apparent such as family and peer support. According to Palmer, Davis, & Hilton (2009) family support is vital to the success of students because of the emotional and financial investments given by family members. Additionally, research shows that Black and Latino students place high emphasis on maintaining strong family ties (with both immediate and extended members) (Marin & Marin, 1991; Marín & Triandis, 1985;

Perez II, 2012; Suarez-Orozco & Suarez-Orozco, 1995). Similarly, research highlights that family is pivotal to the success of Black and Latino students in STEM disciplines such as engineering (Fleming et al., 2013; Martin, Simmons, & Yu, 2014; Williamson, 2010). Participants linked their individual success to success that often times involved their families and the investments of family members towards their college educations. Although family members may not have understood engineering as a career, family members were often supportive of the college process and the student's completion of a degree. Findings of this study confirmed that family and peer support are important factors of success, which has also been indicated in previous research, especially for STEM students of color.

In examining CCW's connection to participants' perceptions of personal qualities and other factors of personal and academic success, it is apparent that aspirational and familial capital were heavily utilized. Several times participants mentioned ways in which they maintained their future hopes and aspirations despite present challenges; Yosso (2005) refers to this as aspirational capital. The mere fact that Black and Latino engineering participants successfully remain in a discipline in which they are often times underrepresented speaks to this idea of aspirational capital. Specifically, participants' reflections on future achievements, such as being the first in their families to graduate from college or being the first engineer in their families, outweighed rigorous coursework and perceived challenges related to engineering-related projects and some of their interactions with engineering faculty. Participants' motivations (e.g., financial and career stability, leaving a legacy and impact on world) for pursuing engineering were greater than their challenges in the classroom; which ensured high self-efficacy and academic

performance. According to research literature, students who have higher perceptions of academic self-efficacy tend to have a higher academic performance (Concannon & Barrow, 2010; Sharkness et al., 2010). In this study, all participants had a strong belief in their academic abilities to complete coursework and other tasks associated with their engineering programs, which was apparent through their high academic performances (e.g., making good grades and having excellent major GPAs).

Although a welcoming and inclusive campus climate for students of color is an important part of student success (Brown, Morning, & Watkins, 2005; Trenor et al., 2008), participants explained that the engineering environment can be challenging. However, it is often the support of their families that helped them maintain their successes. The consistency of family support and involvement in the participants' college endeavors along with feedback and ideas from participants' families proved to be important in this study. Some of the participants who were first-generation college students mentioned the process of obtaining an engineering degree as a collective goal since family members also wanted them to be successful, have a rewarding engineering career, and gain financial security. The pressure to succeed and be a role model or positive example to other family members was also important for some participants. However, students clearly demonstrated their commitment to family and a sense of community through their involvement in specific organizations and with individuals that also create a sense of family at their higher education institution.

Yosso's (2005) familial capital highlights the participants' perceptions of family knowledge and their commitment to a sense of cultural community. In this study, familial capital was apparent through students' relationships with family members in

exchanging ideas and stories that provided perspective of their family's history or culture. Some participants specifically talked about having family engineers that shared stories and experiences to help students navigate in their engineering programs. Familial capital was also apparent in the supportive networks and groups established by the participants on campus. Participants highlighted being connected to various student organizations, programs, and groups of peers as vital to developing their leadership and ensuring success. Being successful was not just a personal goal of the students, but also a goal of the families to push students to excel beyond the families' educational or professional levels. Aspirational capital possessed by students played a role in how their familial capital developed. Specifically, the example of the pressure for participants to succeed in college as a way to encourage other family members to pursue their goals and be successful highlighted how maintaining hopes and dreams despite challenges in engineering education was connected to the importance of a sense of community and family. The forms of capital in CCW are not mutually exclusive nor static; it was apparent in this study since the aspirational and familial capital were linked to each other in examining personal qualities and factors of success. Participants' aspirations were driven at times by history of family achievement (or lack thereof) as well as support and a collective goal between the participants and their families.

Understanding Faculty-Student Interactions Through CCW

In this study, faculty-student interactions are defined as contact (e.g., face-to-face meetings, email communication, and phone calls) between faculty members and underrepresented students of color in engineering. Faculty-student interactions are an important success factor for underrepresented students of color in engineering because

positive quality relationships (Carini et al., 2006) and frequent support and interactions (Cole, 2008; Cole & Espinoza, 2008) with faculty are positively linked to students' high academic performance. Cole and colleagues (2008) suggested that perceived support from faculty contributed to better grades for Black and Latino students. However, most of the participants in this study had good grades yet perceived that interactions with engineering faculty were indifferent (neither positive nor negative).

Perceived indifferent interactions with engineering faculty were due to the fact that while faculty were knowledgeable about engineering and some professors were usually helpful, available, and friendly when they interacted with those professors (suggesting that there was a perceived quality of relationships); there were also interactions where students perceived an overall lack of desire to develop students beyond the classroom. Faculty typically did not volunteer additional support or offer help without students initiating the interaction. There was a perceived lack of care stemming from negative feedback or professor's attitudes in and out of the classroom, and engineering professors were sometimes busy with other areas such as research, which led to less frequent interactions with engineering faculty members. Students expressed going to office hours when they really needed help with coursework or not going as often as they did in the beginning because of various factors including other obligations (e.g., internship and research opportunities, and part-time employment), unapproachable faculty (e.g., busy with research, and attitudes and behaviors towards students), and living off-campus. The challenges with participants' interactions with faculty were complex and several factors must be considered such as institutional policies and structures, students' activities and level of engagement with faculty, and the multiple

responsibilities of faculty members.

Some participants mentioned receiving negative feedback from engineering professors. Although Cole (2008) found that negative feedback and study assistance from faculty members led to lower grades and challenges with self-efficacy and confidence, participants in this study did not indicate poor academic performance or lower self-confidence as a result of negative comments from faculty. Instead, participants maintained high academic performance and pushed beyond issues with faculty to get assistance with coursework. Participants were resilient and relied on knowledge and resources through the use of infrequent quality interactions with engineering professors from time to time, inside and outside of the classroom, and the need to “show their face” or show professors that they were interested in learning from them.

Social capital is described by Yosso (2005) as ways that students of color utilize networks and resources to help maneuver through a higher education institution. In this study, students would go to office hours and get help from the experts in the field, and would use those interactions to establish their professionalism and investment in their academic success. Additionally, participants relied on navigational capital, the ability to maneuver in unwelcoming environments. Although students’ interactions with engineering faculty were perceived as indifferent and participants highlighted them as not approachable at times, several participants provided accounts of positive learning experiences and transfer of knowledge from non-engineering faculty members and relied on the capital from these non-engineering faculty members to also help sustain them in their higher education experiences. Examples of navigational capital included being

involved with research opportunities and activities through non-engineering faculty and using resources from other departments to be successful in engineering. Social and navigational capital were developed with non-engineering faculty members.

Understanding Interactions With Institutional Agents Through CCW

All participants of this study were involved in student organizations on campus or had research/internship opportunities. Through various involvements in student organizations and research opportunities, learning moments and mentoring opportunities occurred as the result of interactions with institutional agents such as advisors, mentors, and engineering professionals. By participants highlighting their access to more knowledge and resources through institutional agents, there was a major investment of social capital. According to the community cultural wealth framework, social capital aims to explore networks and community resources that students use to maneuver through a higher education institution (Yosso, 2005). The wealth of knowledge and resources transferred from interactions with institutional agents (e.g., as advisors, engineering and non-engineering professionals, and mentors/coaches) were overall perceived as positive experiences to participants. Research has found that participation in STEM programming, student organizations, and undergraduate research had a high impact on academic performance and self-concept (Chang et al., 2010; Navarra-Madsen et al., 2010).

Adversely, Hurtado and colleagues (2009) also found that students of color may be racially and socially stigmatized in racially-based structured research programs. Also, advisors and active campus involvement outside of STEM may have negative effects on the persistence of STEM students of color by creating awareness and value of disciplines

outside of STEM (Bonous-Hammarth, 2000; Cole & Espinoza, 2008; Grandy, 1998). However, the four participants who were involved in racially-composed student organizations did not perceive that they were racially or socially stigmatized by institutional agents or faculty. Additionally, only one participant highlighted negative encounters with an advisor; however, that encounter did not sway the student from pursuing an engineering degree. This particular experience of a negative encounter with an advisor actually increased the students' resilience to be successful despite the negative opinions of others.

Navigational capital was also utilized in conjunction with social capital in students' interactions with institutional agents. Students relied heavily on mentorship and resources outside of engineering to aid in their professional research experiences. Participants mentioned getting certain co-op and internship opportunities because of who they knew, some of whom were not engineering faculty. One participant acknowledged the lack of research assistants of color in his engineering department yet several participants emphasized participating in research opportunities. These opportunities were presented through institutional agents and interactions in student organizations. Navigational capital allowed participants to navigate through engineering programs and consistently develop their engineering-related skills through access to engineering professionals and faculty (both non-engineering and engineering) while attending a predominantly White institution where they are underrepresented in their specific discipline. Yosso (2005) explains navigational and social capital as being valuable in reassuring students that they are not emotionally alone in pursuing higher education and allowing them to maintain high levels of academic achievement. By participants having access to

the resources and opportunities, they were able to better adapt and remain successful in engineering while at SUU.

Understanding Sociodemographic Factors Through CCW

The theme ‘Sociodemographic Factors in Engineering’, as described in Chapter Four, was important for providing an explanation of how the roles of race, ethnicity, and culture played in participants’ interactions with faculty and institutional agents. However, the findings did not only address the role of sociodemographic factors (race, ethnicity, and culture) in interactions with faculty and institutional agents, but also gave insight to the role of gender in students’ interactions with their engineering peers. This section presents two minor sub-themes: ‘Race, Ethnicity, and Culture’ and ‘Gender Among Peers’.

Race, Ethnicity, and Culture. Many studies focused on STEM do not disaggregate by race and gender, or include a small sample of students who are underrepresented in research studies. This may be reflective of the underrepresentation that exists in engineering when it comes to women and students of color (i.e., Black, Latino, and Native American students) (Newman, 2011). Therefore, it was essential to consider the role of social and cultural factors in determining academic success for students of color in engineering and eliminating potential challenges (e.g., hostile institutional climates, limited interactions with faculty and peers, and lowered motivation) that occurred as a result of an imbalance of ethnic-racial diversity in engineering programs (Anderson & Kim, 2009; McGee & Martin, 2011).

In this study, Black and Latino engineering students also did not overall perceive race, ethnicity, and culture as playing a major role in their interactions with faculty

members. Although students stated that sociodemographic factors did not play a significant role in how they interacted with faculty members, their body language (e.g., less eye contact, fidgeting, facial expressions) and some of their comments gave the researcher cause for reflection. Overall, most of the participants were uncomfortable in talking about sociodemographic factors, particularly race and tended to shy away addressing that issue yet provided distinct racial differences in comparison to other engineering peers or peers who interacted with engineering professors. These racial differences, such as a lack of Black students serving as research assistants for professors, being accepted in the program because of affirmative action purposes, or having to prove that they belong in their engineering programs were discussed. These differences were mostly highlighted by Black participants. Although racial challenges were not highlighted in regards to interactions with professors and institutional agents, some students did mention racial differences that could be attributed to a very minimal number of Black and Latino students in their disciplines (which might create some distinctions in interactions with engineering faculty members and peers).

Participants alluded to the fact that there are only a few professors of color (e.g., Black and Latino) in their departments; this is one of the major challenges faced nationally in both engineering education and the engineering workforce. According to Yoder (2011), Black engineering faculty members have made up a total of 2.5% over the past five years while Latino faculty have consisted of almost 4% in 2011. This is drastically less than the populations of those races in the United States, thus making them underrepresented in engineering education. At SUU, there are less than 5% of Black and Latino professors in both the engineering and engineering technology departments in the

College of Engineering. Research suggests that having same-race faculty in engineering for students of color is important (Leggon, 2010; Lundberg & Schreiner, 2004; Newman, 2011; Slaughter, 2009). However, some (but not all) of the participants mentioned having mentorship moments with some of the same-race professors (both engineering and non-engineering) and institutional agents and being able to utilize them for a range of tasks including help with coursework, recommendations for internships, or to have casual conversations about careers and life (e.g., Alexis' conversations with Papa Bear). The participants saw benefits from mentoring with others (e.g., professors, institutional agents) regardless of race, but some students highlighted the lack of Black and Latino faculty members.

Participants mentioned that they experienced stereotypes and racial and gender challenges in their interactions with peers. Similar to a study by McGee and Martin (2011), it was found that participants' academic achievement and engagement were not negatively affected by racial challenges with their peers. Instead, students used their experiences with stereotypes and racism to increase their self-confidence and gain the resiliency needed to prove others wrong. According to Moore, Madison-Colmore, & Smith (2003), the "prove-them-wrong syndrome" explains the experiences, attitudes, and personalities of Black males who were pursuing engineering degrees and explains that this syndrome was developed from a psychological phenomenon that prevails when society casts an image of Black intellectual inferiority (Howard & Hammond, 1985; McGee & Martin, 2011). Research by Fries-Britt (1995; 1998) and Fries-Britt and Griffin (2007) suggests that academically successful students, particularly Black students, engage in proving their academic capabilities and worth at higher education institutions.

Although participants experienced negative stereotypes and racial challenges in connections to engineering peers and in regards to their intellectual capabilities, they remained guarded and resilient and found other cultural spaces to express themselves. Racially-composed student organizations focused on engineering or same-race study and hanging out in groups with engineering peers were found to be common spaces for those students.

Students possessed both resistant and navigational capital to dismiss stereotypes and racial challenges presented by their peers. Students proved themselves and worked harder, in terms of coursework and studying, despite oppositional behavior. Additionally, students formed study groups and some were involved in racially and culturally-composed student organizations in which they created collaboration with same-race peers. Although negative stereotypes can create disengagement between students and educationally-related activities (Fries-Britt & Griffin, 2007; Perez II, 2012; Steele, 1997; Steele & Aronson, 1995; 1998), participants of the study still maintained high GPAs and a strong work ethic that included involvement both on- and off-campus.

Role of Gender Among Peers. Although race played a major role in participants' interactions with peers, gender also played an important role in students' interactions with peers. Specifically, all of the women of the study highlighted gender as an issue in a male-dominated field. One male in the study also highlighted the issues that women face, being that women in his family were engineers and the fact that he had attended women's engineering student organization events on campus and witnessed gender bias in the classroom. Overall, five out of eight participants had witnessed or experienced issues with gender. While women in engineering experience challenges that may include

gender bias, women of color experience what researchers call “the double bind” of being both a woman and a person of color (Ong, Wright, Espinosa, & Orfield, 2011). There were several instances where women participants made references to being a “Black woman in engineering” or a “Latina” or “female” in the field and questioned whether their inputs or opinions were respected and valued in the learning process, especially when collaborating on team projects with peers. The acknowledgment and perception of engineering being a guy major by a few of the women participants highlighted current issues in engineering especially for women of color where they are constantly proving their capabilities because of both gender and racial stereotypes. One male participant (John Doe) who was sensitized to issues surrounding women in engineering provided accounts of attending meetings of a student organization that served women in engineering fields and how women would describe particular negative experiences with their male counterparts inside and outside of the classroom. He didn’t understand why women were not respected in the field, especially since he had close female family members who were engineers. Although the findings highlighted that there were definitely gender issues that were faced by the female participants of the study; there may be an intersection of combined gender and race issues that offer a unique set of challenges for women of color in engineering disciplines.

Implications

With an increase of racial and ethnic diversity that is occurring in the United States, it is important to understand the issue of underrepresentation of Black and Latino students in engineering. Many studies highlight why Black and Latino students remain unsuccessful in engineering; however, there is a need to examine how these students are

empowered as these students interact with faculty members, institutional agents, and their peers; and successfully persist at a higher education institution. Thus, this section provides implications for future research and practice for higher education administrators and particularly colleges of engineering nationwide.

Implications for Future Research

Several studies have examined the experiences of underrepresented STEM and engineering students. However, there is a need to understand interactions with faculty members, institutional agents, and peers among Black and Latino engineering students as well as students from other underrepresented groups. Therefore, the following suggestions are recommended:

Intentional Focus on URM Students' Faculty-Student Interactions. There are few studies that solely examine faculty-student interactions in engineering. Additionally, there are few studies that explore interactions of underrepresented students of color (e.g., Black, Latino, Native American) with faculty members (especially Black, Latino, and Native American professors) in engineering or how they successfully navigate while experiencing challenges with those interactions. While there were several articles reviewed for this qualitative study, only 15 articles included aspects of faculty-student interactions related to underrepresented groups such as Black and Latino engineering or STEM students. Additionally, less than 5% of Black and Latino professors are in the COE at SUU. Although this current study explores faculty-student interactions for high-achieving or successful Black and Latino engineering students, additional similar studies should be conducted using both qualitative and quantitative methods to provide further exploratory and explanatory work on the topic (Tashakkori & Teddlie, 1998).

Future research should incorporate longitudinal data that explore cultural empowerment theories such as CCW or social-relational models at multiple institutions (e.g., MSIs, HSIs, HBCUs, PWIs) to understand how environment affects interactions and perceptions of culture and race. Longitudinal studies would facilitate understanding of processes over time and whether experiences are institution- or program-specific or more common at multiple institutions among URM engineering students. Care should be taken to include participants from certain ethnic/racial groups in engineering such as Blacks, Latino/as, Native Americans, and should include both students and faculty members as participants. Although this study focused specifically on high-achieving, successful URM engineering students, additional studies should examine URM students who were not successful navigating an engineering program.

Studies should also focus on the significance of both the quantity and quality of interactions with faculty members and evaluate both the perceptions of engineering or STEM and non-engineering/non-STEM and compare how they understand the importance of interactions with underrepresented racial-ethnic groups in engineering or STEM disciplines. Evaluating the comparisons between STEM and non-STEM faculty and URM students will allow future research to understand the influence of major in navigating at a higher education institution. These types of studies would add to current understanding by indicating ways in which interactions between underrepresented engineering students of color and faculty play out across different types of institutions. Additionally, these types of studies would explore perceptions of faculty members (especially faculty of color) in understanding how additional Black and Latino faculty can be recruited and interact with same-race students.

Examining Intersectionality of Race and Gender. A major problem in higher education is the extremely low participation of both women and minorities in engineering; raises issues in the profession such as social justice, gender equity, and diversification (Lord et al., 2009; Watson & Froyd, 2007). In particular, women of color deal with various complex issues surrounding both race and gender; therefore, it is vital to analyze race in conjunction with gender rather than ignoring both of these sociocultural constructs (Lord et al., 2009). Although there are some studies (e.g., Lord et al., 2009; Martin, Simmons, & Yu, 2013) that examine the intersectionality of race and gender as it relates to Black and Latina women in engineering, more studies are needed that examine and compare URM women engineering students experiences in both engineering education and their engineering careers to compare interactions with male peers in both environments and note changes over a period of time.

The theory of intersectionality (Collins, 1990; 1993) suggests that gender should be working together with race rather than both operating independently to address overlapping factors of different social outcomes and inequalities. Using intersectionality theory, interconnectedness of gender and race and each distinct sociodemographic factor can be explored. Since engineering is primarily dominated by males, it is important to increase the numbers of women of color in the field to provide a more globalized and creative society (Lord et al., 2009; Watson & Froyd, 2007). Future research using intersectionality theory would help draw connections as to ways that both gender and racial differences in engineering education and the workplace affect various ethnic-racial women that are underrepresented in engineering.

Implications for Practice

In addition to recommendations for future research, there are also implications for practice as suggested by the participants and the researcher based on the documentation and interviewing data found at SUU. Specific recommendations for SUU are as follows:

Faculty-Student Mentoring Opportunities. In order for underrepresented students of color in engineering to be successful in Colleges of Engineering, it is important for colleges to create a culture that promotes meaningful relationships between faculty and students and allows for various methods of academic success. According to Christe (2013), formal mentoring programs promote close connections between faculty members and students and can provide students with motivation, encouragement in terms of academic success, and encourage more STEM connections. Therefore, one suggestion of practice would be to create a faculty-student mentoring program in the College of Engineering for URM students in their third and fourth years (e.g., juniors and seniors). Through this programming, students would be provided opportunities to work on various research projects with professors, seek career advice, and gain knowledge and access to the necessary resources to be successful while in college.

According to Vesilind (2001), every professor may not be good at mentoring initially; thus, faculty members must be trained to be mentors and rewards/incentives should be put in place to encourage faculty members to participate. Mentoring has several benefits for students, which include increased social capital, more frequent contact with faculty members, increase self-confidence, and higher academic performance.

Additionally, faculty mentors benefit from mentoring as well. Some of their benefits include a boost in self-confidence by helping students, better relationships with students,

effective leadership in the classroom, and more recognition by the department.

Additionally, colleges could create an incentives program for faculty members who are involved with extracurricular activities related to the department. These incentives could include volunteer recognition, awards, promotions, and even greater acknowledgment by the university.

Collaborative Efforts to Promote Diversity and Unite Agents in the COE. In this study, Black and Latino engineering participants expressed challenges with faculty and peers within their departments. Therefore, it is important to emphasize the importance of collaboration among students, faculty, and program administrators. One way to unite all agents (students, faculty, and administrators) in Colleges of Engineering (COE) is to create spaces for programming and events that allow for interaction among all entities, student learning, and networking. Cornell University has several STEM initiatives that they have adopted to increase diversity in their engineering programs (Cornell University, 2014). Two strategies utilized to connect both students and faculty as well as community stakeholders include “First Friday Dinners” and “Lunch and Learn”.

The “First Friday Dinners” are evening professional development opportunities where engineering and corporate professionals, faculty, administrators, and engineering students (both undergraduate and graduate) assemble during the first Friday of every month. During these dinners, presentations are given on various topics such as internship, employment, and research opportunities or strategies for academic or professional success. Students and student organizations participate in these dinners as well and can help with activities to engage students that attend. Additionally, Cornell University provides “Lunch and Learn” events on a monthly basis. In this informal environment,

engineering alumni are featured or local employers in the profession. This idea allows for interaction with the community, exposure to local employers for students, and interaction between engineering professors and students.

Since these suggestions require a greater time commitment for faculty/staff, students, and administrators, an alternative may be to create an online space (e.g., discussion forum or blog space) that allows all engineering professors to interact more with students in terms of presenting and offering more interactions (e.g., research opportunities, community service). While SUU offers events at the beginning of the year to acquaint students to resources offered through the College of Engineering and sends numerous emails to students, participants mentioned that they usually overlook emails because of the overwhelming number of emails received from multiple entities on campus. This suggestion provides a solution to eliminating the perception that engineering faculty members seem unapproachable and also provides more research opportunities for students who may not have as much exposure as other students.

Increase Recruitment and Retention Efforts. With the high numbers of underrepresented women and persons of color (e.g., Black, Latino, and Native American) in engineering, it is vital to develop a strategy for recruiting and retaining these students in higher education. There are several STEM initiatives that have been established by the National Science Foundation and President Obama (e.g., Educate to Innovate, US 2020 for one million STEM mentors) that seek to promote more participation in STEM education and careers especially for women and persons of color (URM groups). Although there are many initiatives to grow the number of underrepresented students of color in STEM including engineering, there are several aspects to consider when

increasing the participation of URM students in STEM disciplines. Those aspects include how to: (1) enhance URM students' knowledge and skill sets; (2) support URM students with different aspects such as finances, academics, career, and personal endeavors; (3) help them create and maintain networks of support; (4) provide connections that facilitate successful transitions (both academically and socially) and help with advancing to the next milestone facilitating the creation of networks and sustaining them; and (5) provide bridge experiences focused on facilitating successful transitions from one educational milestone (Dyer-Barr, 2013; Maton & Hrabowski, 2004; Maton, Hrabowski, & Schmitt, 2000). It is important that colleges of engineering (including SUU) connect with local K-12 environments to begin the process of making URM students aware of STEM programs at an early stage of their lives.

Southern Urban University (SUU) currently has a program in which engineering students volunteer and create projects with K-12 entities. Additionally, SUU recently started an early college STEM high school on campus to support STEM efforts. These efforts at SUU should be utilized to increase admission into the engineering departments and administrators in COE at SUU should work with the STEM high school on campus to ensure collaborative efforts and programming. This serves as a great opportunity for engineering undergraduate and graduate students to get involved and become mentors and role models to aspiring engineers. It also provides an incentive for engineering professors and administrators to get students more involved with research opportunities to share those experiences with high school students.

An increase in engineering faculty of color (especially Black and Latino professors) is also needed. Currently, SUU has a very low percentage (less than 5%) of

Black and Latino engineering and engineering technology professors. Some suggestions for increasing ethnic-racial diversity among faculty would be utilizing programmatic ideas such as the “Lunch and Learn”, “First Friday Dinners”, and faculty-student mentoring programming to attract potential faculty members. These events would show the effort that the COE is making to provide more open access to the local community, diverse engineers, students, and alumni of the COE.

Conclusion

Several research studies highlight why Black and Latino students remain underrepresented in engineering programs. However, many studies do not focus on why these students remain successful in STEM programs. This particular study highlights the perceptions of eight successful and high-achieving Black and Latino engineering students as they successfully navigate at SUU and interact with faculty members and institutional agents. Additionally, this study seeks to understand how Black and Latino engineering students use their knowledge, skills, and abilities acquired through CCW to continue to be successful and remain persistent in their engineering programs.

This study highlights four themes, which include: (1) Success has Different Levels of Attainment, (2) Nature and Frequency of Interactions Changed Based On Stakeholder, (3) Need to Understand Sociodemographic Factors in Engineering, and (4) High Significance of CCW. This chapter provides an explanation of these various themes through the lens of CCW and draws conclusions on ways that the study can be utilized when conducting future research and practices for higher education institutions, specifically engineering programs. Overall, the findings of the study highlight that more research should be conducted to specifically understand the needs of Black and Latino

engineering students as they interact with the faculty members, institutional agents, and peers on campus. The findings should also encourage higher education practitioners to create more programs that encourage faculty-student interaction, promote mentorship, and provide opportunities for research.

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APPENDIX A: REVIEWED INSTITUTIONAL DOCUMENTS

Reviewed College of Engineering Web Pages and Data from COE Administration:

- Page on academic programs offered by college
- Faculty/Staff webpages (teaching resources, faculty development, faculty organizations and committees, administrative resources for COE)
- Strategic plan for college of engineering 2010-2015
- Resources and support for current students (leadership academy, peer mentoring program, freshman learning community)
- Engineering student organization web pages (promoting diversity): NSBE, SHPE, SWE
- Communicated with Associate Dean to obtain data on numbers of undergraduate students and faculty of color

Institutional Web Pages and Documents and Data from Interview Participants:

- Multicultural Affairs web page (Black and Latino organizations/services and other racially-composed organizations)
- Multicultural Academic Services (mentoring programs and STEM-related programs)
- Last updated diversity plan 2012-2013
- SUU Website (institutional size, type, overall student climate)
- University supports targeted to students of color: federally-funded programs (e.g., LSAMP Stokes Minority Alliance)
- Registered student organizations on Org Sync
- Registered members for particular student organizations
- College of Liberal Arts and Sciences (CLAS) diversity newsletter

APPENDIX B: RECRUITMENT EMAILS

Dear Faculty, Administrators, and Staff,

My name is Krystal Foxx and I am a doctoral candidate in the Department of Educational Leadership program at [institution name blinded].

I am conducting my dissertation study on successful Black and Latino engineering students as part of a larger federally funded project. The study will explore students' academic and social experiences; personal qualities that aid in their success; interactions with engineering faculty, non-engineering faculty, advisors, and mentors/coaches; and racial and cultural factors that contribute to their role as an engineering student.

Participants in this study will be asked to complete a brief online questionnaire, followed by a 60 to 90 minutes confidential individual interview with me. Students may be contacted for up to two times for follow-up information to address questions or information pertaining to their main interview. Students will receive a \$10 cash/gift card for their successful completion of each phase of the study, one for the online questionnaire (10-15 minutes to complete) and one for the 60-90 minute individual interview.

To participate in this research project, students must:

1. Self-identify as Black, Latino, or Multiple Races (in which one race is Black or Latino)
2. Be at least 18 -24 years old
3. Be enrolled full-time as a student in an engineering discipline (can be a full-time transfer student)
4. Have junior or senior class-standing (i.e., earned 60 or more academic credit hours)
5. Demonstrate satisfactory academic performance (e.g., not on academic probation, C-average or higher in coursework) and
6. Engaged in on-campus engineering-related and/or other activities outside of coursework (e.g., student organizations such as NSBE or SHPE, peer mentoring program, or other organizations).

I would highly encourage you to nominate students for this study. Strong participation will generate information to improve the representation of Black and Latino students in engineering education through better recruitment and retention efforts. If you have additional questions, please contact me (email, phone number) or my dissertation advisor, Dr. Sandra Dika (email, phone number).

Sincerely,

Krystal Foxx
Doctoral Candidate, Educational Leadership
University at North Carolina at Charlotte

Distinguished Officers of [Insert Student Club/Organization],

My name is Krystal Foxx and I am a doctoral candidate in the Department of Educational Leadership program at UNC Charlotte.

I am conducting my dissertation study on successful Black and Latino engineering students as part of a larger federally funded project. The study will explore students' academic and social experiences; personal qualities that aid in their success; interactions with engineering faculty, non-engineering faculty, advisors, and mentors/coaches; and racial and cultural factors that contribute to their role as an engineering student.

Participants in this study will be asked to complete a brief online questionnaire, followed by a 60 to 90 minutes confidential individual interview with me. Students may be contacted for up to two times for follow-up information to address questions or information pertaining to their main interview. Students will receive a \$10 cash/gift card for their successful completion of each phase of the study, one for the online questionnaire (10-15 minutes to complete) and one for the 60-90 minute individual interview.

To participate in this research project, students must:

1. Self-identify as Black, Latino, or Multiple Races (in which one race is Black or Latino)
2. Be at least 18-24 years old
3. Be enrolled full-time as a student in an engineering discipline (can be a full-time transfer student)
4. Have junior or senior class-standing (i.e., earned 60 or more academic credit hours)
5. Demonstrate satisfactory academic performance (e.g., not on academic probation, C-average or higher in coursework) and
6. Engaged in on-campus engineering-related and/or other activities outside of coursework (e.g., student organizations such as NSBE or SHPE, peer mentoring program, or other organizations).

I would highly encourage you to nominate students for this study. Strong participation will generate information to improve the representation of Black and Latino students in engineering education through better recruitment and retention efforts. If you have additional questions, please contact me (email, phone number).

Sincerely,

Krystal Foxx
Doctoral Candidate, Educational Leadership
University at North Carolina at Charlotte

[Student Name],

Congratulations! “You have been nominated by an engineering faculty member or officer of a student organization” [Note: Insert nominator] or “You have been selected” [Note: Insert if for self-nomination] to participate in a research study that focuses on how Black and Latino students navigate successfully through an engineering program.

This study will explore your academic and social experiences; personal qualities that aid in your success; interactions with engineering faculty, non-engineering faculty, advisors, and mentors/coaches; and racial and cultural factors that contribute to your role as an engineering student.

To participate in this research study, you must:

1. Self-identify as Black, Latino, or Multiple Races (in which one race is Black or Latino)
2. Be at least 18-24 years old
3. Be enrolled full-time as a student in an engineering discipline (can be a full-time transfer student)
4. Have junior or senior class-standing (i.e., earned 60 or more academic credit hours)
5. Demonstrate satisfactory academic performance (e.g., not on academic probation, C-average or higher in coursework) and
6. Engaged in on-campus engineering-related and/or other activities outside of coursework (e.g., student organizations such as NSBE or SHPE, peer mentoring program, or other organizations).

The study has two parts - a brief online questionnaire (10-15 minutes) and confidential individual interview with me (60-90 minutes) – and you would receive a \$10 cash/gift card for your completion of each part. However, if you are ineligible for the study and complete the online questionnaire, you will not receive the \$10 cash/gift card. Additionally, you may be contacted up to two times for follow-up information pertaining to your completion of the 60-90 minute interview.

Your participation will generate information to improve the representation of Black and Latino students in engineering education through better recruitment and retention efforts. If you have additional questions, please contact me (email, phone number).

Please proceed to SurveyShare link [insert link here].

Sincerely,

Krystal Foxx
Doctoral Candidate, Educational Leadership
University at North Carolina at Charlotte

APPENDIX C: ONLINE DEMOGRAPHIC QUESTIONNAIRE

Hello! You are invited to participate in this online questionnaire that allows you to reflect on your perceptions and experiences related to studying an engineering program at SUU. This survey is part of a university-approved study and will take you approximately 10-15 minutes to complete. To participate in this research study, you must meet ALL of the following criteria:

- You self-identify as Black, Latino, or Multiple Races (in which one race is Black or Latino)
- You are at least 18 years old
- You are enrolled full-time as a student in an engineering discipline (can be full-time transfer student)
- You have junior or senior class-standing (i.e., earned 60 or more academic credit hours)
- You are not on academic probation and have a C-average or higher in coursework
- You are involved in either engineering or non-engineering activities outside of the classroom (e.g., student organizations such as NSBE or SHPE; peer mentoring).

If you do not meet ALL of these criteria, please exit this survey now. Your identity will not be recorded and you will not be compensated. If you meet ALL of the criteria, please read the following information:

- Your input is greatly appreciated and will provide insight on how engineering students of color successfully navigate through an institution based on social factors (e.g., race/ethnicity, culture, and gender) and academic experiences. For completing and submitting this online questionnaire, you will be given a \$10 cash/gift card at the time of your face-to-face individual interview.
- Please note that your participation is voluntary and confidential. By completing this online questionnaire, you are giving your informed consent and agree to participate in this research project. If you decide not to participate, it will not affect your academic status or reputation. Krystal Foxx, the doctoral student researcher and principal investigator, will manage all interview data. Any personal identifiers will be removed from your responses and replaced with pseudonyms and anonymous information. Results of the questionnaire will be presented generally for the participant group and will include basic demographic data (e.g., race, ethnicity, gender).

If you have any questions about this survey, please contact Krystal Foxx (email, phone) or the supervising faculty member, Dr. Sandra Dika (email, phone). If you have any questions or concerns about the research component of this survey, please contact the UNCC Office of Research Compliance. Please enter your SUU email address and click the 'Continue to Survey' button below. Thank you.

1) To participate in this research study, you are agreeing that you meet ALL of the following criteria:

1. You self-identify as Black, Latino, or Multiple Races (in which one race is Black or Latino)
2. You are at least 18 years old
3. You are enrolled full-time as a student in an engineering discipline (can be full-time transfer student)
4. You have junior or senior class-standing (i.e., earned 60 or more academic credit hours)
5. You are not on academic probation and have a C-average or higher in your coursework
6. You are involved in activities that are either engineering or non-engineering related outside of the classroom (e.g., student organizations; peer mentoring).

If you answered "yes" to all of the following, please enter your email address below to complete the survey. If you answered "no" to some or all, please exit this survey. Your identity will not be recorded and you will not be compensated for this study. (Check Yes or No)

Section 1 - Demographic Information

2) Please indicate your race/ethnicity.

- Black or African American
- Latino or Hispanic
- Multiple races (in which one is Black or Latino)
- Race other than Black or Latino

3) What is your university designation based on credit hours?

- Freshman
- Sophomore
- Junior
- Senior

4) Do you speak a language other than English?

- No
- Yes, please specify other languages spoken:

5) What is the highest level of education that your parent(s) or guardian(s) have attained?

- Less than high school
- High school graduate/GED
- Associate's degree

Some college but no bachelor's degree
Bachelor's degree
Some graduate school but no graduate degree
Master's/Doctoral/Professional Degree (Ph.D, Ed.D, MBA, JD etc.)

6) Do you have brothers or sisters who have a bachelor's degree?

Yes
No
Only child
Don't know

7) Do you have a parent, guardian, sibling, or other family member who has a degree in engineering? Check all that apply.

Father/male guardian
Sibling
No family member has engineering degree
Other (please specify):

8) Prior to enrolling at SUU, did you know at least one person who was working/had worked as an engineer?

Yes
No
Don't know

9) Prior to college, I graduated from a:

Public high school
Private high school
Home school
Other (please specify):

10) Please estimate the number of college Advanced Placement (AP) and/or International Baccalaureate (IB) courses you completed during high school:

0
1-3
4-7
8-10
11+

11) In HIGH SCHOOL, how satisfied (very satisfied to not satisfied, not applicable option) were you with the:

- Quality of teaching in mathematics courses
- Quality of teaching in science courses
- Academic counseling on college-related information
- Resources related to college preparation
- Formal or informal mentoring from a mathematics and/or science teacher

12) Where did you get most of your information about engineering and/or other potential majors prior to attending college? Check one answer.

- Parents
- Siblings
- Other family members
- Peers
- Teachers
- Counselors
- Internet
- Other (please specify):

13) What is your current major in College of Engineering? If you have a second major or minor, please list them as well.

14) Approximate overall GPA? (on a 4.0 scale)

15) Approximate GPA in your major? (on a 4.0 scale)

16) As of today, in what year of studies are you at SUU?

- First
- Second
- Third
- Fourth
- Fifth
- Sixth
- Greater than sixth

17) Are you a transfer student?

- No
- Yes, I transferred from

18) Where do you currently live?

- On-campus
- Off-campus, but within 2 miles of campus
- Between 2 to 5 miles away from campus
- More than 5 miles away from campus

- 19) How are you financing your college tuition? Check all that apply.
- Financial aid (e.g., federal grants, loans, and work-study)
 - Employment (not a work-study position)
 - Private scholarships (e.g., scholarships from foundation/major corporation)
 - Other (please specify):
- 20) What amount of your college expenses is paid by financial aid (e.g., Pell Grant, federal work-study)?
- None
 - Less than half
 - About half
 - More than half

Section 2 - Academic Involvement and Career Goals

- 21) In COLLEGE, how satisfied (very satisfied to not satisfied, not applicable option) are you with the:
- Quality of teaching in engineering-related courses?
 - Academic counseling for major?
 - Involvement in student organizations on campus?
 - Formal or informal mentoring from a faculty member, advisor, etc.?
 - Research or internship opportunities available?
- 22) Are you currently participating in any program/organization(s) both on and off campus that are designated by race, gender, age, creed, disability, or national origin (e.g., SWE, NSBE, SHPE, NAACP, Latin American Coalition)?
- No
 - Yes, please specify program/organization(s):
- 23) When you complete your undergraduate degree, are you planning to enroll in a graduate program?
- Yes
 - No
- 24) If you answered YES to number 23, please name the graduate program and college institution(s) you have applied to or are considering applying to (example: Master's program at college for biomedical engineering):

25) Please check all undergraduate years that you conducted or participated in research or internship opportunities during your engineering studies at SUU. Do not check responses that exceed your current classification (i.e., if you are a junior, you would not check that you completed research your senior year)

Freshman year
Sophomore year
Junior year
Senior year
Not applicable

26) Please indicate the location of your previous or current research or internship opportunities. Check all that apply.

On-campus
Off-campus

27) Were you recommended for any of these research or internship opportunities by a faculty member or other institutional representative (e.g., advisor, administrator, mentor)?

No
Yes, please specify who (e.g., faculty, advisor, mentor):

28) In what types of non-academic activities do you participate (e.g., sports, volunteer activities, student organizations)?

29) During the past academic year, what is the average number of hours per week you worked for pay in non-academic jobs (e.g., retail, babysitting)?

None - have not worked
1-10 hours
11-20 hours
21-30 hours
31-40 hours
More than 40 hours

30) What career(s) are you aspiring towards?

31) Is there anything else you would like to add about your experiences during your engineering studies?

32) The next step in the study involves a confidential interview, which will last between 60 to 90 minutes at a time convenient to you. Please mark all times that you are typically available during the week:[provided list of dates]

Thank you for participating in this questionnaire. Your responses have been recorded. If you have completed the entire questionnaire and match the selection criteria for the study, you will be compensated with a \$10 cash/gift card at the confidential individual interview. You will be contacted shortly via email to set up an interview time and location. If you received this message after beginning the first section of the questionnaire, it means that you did not meet one or more of the selection criteria and was directed to exit survey.

APPENDIX D: INTERVIEW PROTOCOL

Hello, thank you for taking the time to talk with me about your experiences at this institution. I am conducting a study that seeks to understand how Black and Latino engineering students remain successful based on personal qualities and factors as well as their interactions with faculty members and other institutional agents such as non-engineering faculty, administrators, academic advisors, and mentors/coaches. Over the next hour or so, I will ask you several questions pertaining to your academic background and experiences, future goals and expectations, race/ethnicity- and culture-related experiences, and social engagement while at the institution. Do you have any questions regarding this process before we get started?

Questions

1. Please tell me your name, academic major, and a few words you would use to describe yourself as a student. (Ice Breaker)

Note: Check online questionnaire to see if they are a transfer student. If so, get them to tell about their experiences prior to coming to the institution.

2. Based on your online questionnaire, I learned that you that got most of your information about college or engineering from _____, which is great. What made you choose to major in engineering and who/what (person or program) influenced you the most to pursue it? (Aspirational and Social)
3. What does it mean to you to be successful? (All Forms of Capital)

Probes/examples:

In developing this research study, I found that the literature addresses possible outcomes (both positive and negative) that Black or Latino students could experience while pursuing an engineering discipline. You continue to successfully navigate through your major.

- Grades
- Reputation with faculty or others (advisors, non-engineering professors, mentors etc.)
- Meeting and completing goals
- Being a leader inside or outside classroom while in an engineering program

4. What personal qualities have aided you thus far to be successful?

Probes/examples:

- Be a part of specific organizations
- Meet new friends/network with those who can help you
- Learn more about yourself
- Develop your skills and knowledge in discipline

5. Was there ever a time where you thought about leaving engineering or changing to another major? Please explain. (Resistant)
6. Tell me what it's like to be a Black or Latino student in an engineering program. (Sociodemographic Factors)

Probes/examples:

- No racial differences?
 - Are there challenges? Difficulties?
 - Do you think that your experience is typical to Black and Latino students who may not be in an engineering program?
7. In what ways have your family and friends influenced your success in engineering? (Familial, Resistant, and Aspirational)

Probes/examples:

- Provided encouragement during academic dilemmas
 - Discouraged you for various reasons (don't know much about major, think its too difficult/challenging etc.)
 - Don't really ask about your college experiences
8. Tell me about your experiences interacting with various engineering faculty members. (All Forms of Capital)

Probes/examples:

- Are they positive or negative? (encourage you or present challenges)
 - Duration (i.e. how long and often do you meet with them)
 - Give examples of a typical interaction with them (nature of conversation/dialogue)
 - Inside the classroom?
 - Outside the classroom (recommend resources or other forms of support)?
 - Do you work on projects with the professor?
9. Tell me about your experiences interacting with various non-engineering faculty members, advisors, and mentors/coaches. (All Forms of Capital)

Probes/examples:

- Are they positive or negative?
- Duration (i.e. how long and often do you meet with them)
- Give examples of a typical interaction with them
- Do they encourage you to stay in engineering or present challenges?
- Nature of conversation/dialogue
- Recommend resources/other forms of support

10. In your online questionnaire, you noted your involvement in organizations or work/research opportunities including (note: state some examples from participant's survey). Were any of these experiences the result of your interactions with engineering faculty members? How about non-engineering faculty, advisors, mentors/coaches)? Please explain. Note: if applicable (Social and Navigational)
11. How have your oral and written communication skills contributed positively or negatively to your interactions with engineering faculty? How about non-engineering faculty, advisors, mentors/coaches while in an engineering program? (Linguistic and Sociodemographic Factors)

Probes/examples:

- Do you speak multiple languages and find them useful when participating in internships/study abroad opportunities?
 - Have you heard of the terms “code switching” or “acting white” while interacting with faculty? What does it mean to you? (will provide a definition)
12. Have you ever witnessed or experienced any racial or cultural bias/racism, discrimination, or prejudice while in the engineering program or with interactions with others (e.g., peers, faculty members, advisors)? Please explain. (Resistant, Aspirational, and Sociodemographic Factors)

Probes:

- Stereotypes that may exist because you are a Black or Latino student at institution or in engineering
 - Do you ever feel alienated in the classroom because of your race/ethnicity?
 - How did incident (if any) make you feel?
 - What did you do about it?
 - Do you think that your race plays a role in your interactions with faculty (e.g., faculty member does not interact with you because of your race or even certain personal qualities/characteristics)
13. What advice would you offer to faculty members and administrators, advisors, mentors/coaches in supporting all engineering students or specifically Black and Latino students?

Probes/examples:

- New program/services
 - Ways to interact better with students (is there something missing from interactions?)
 - Other support?
14. Based on our conversation, is there anything else you would like to add or a question that you would like to go back to and elaborate on?

APPENDIX E: CONSENT FORM

Informed Consent for

A Cultural Wealth Perspective on Success in Engineering for Black and Latino Students: Perceptions of Interactions with Engineering Faculty and Other Institutional Agents

Project Title and Purpose

A Cultural Wealth Perspective on Success in Engineering for Black and Latino Students: Perceptions of Interactions with Engineering Faculty and Other Institutional Agents

The purposes of this research are to describe the perceptions and experiences of successful Black and Latino engineering students at one public research institution related to: (1) the personal qualities or factors they identify as important for persisting and succeeding in engineering studies; (2) the nature of their interactions with engineering faculty and other institutional agents such as non-engineering faculty, administrators, academic advisors, and mentors/coaches, and the role that those interactions play in their academic and social development; (3) the social differences such as race/ethnicity, culture, and gender that they suggest influence their interactions with faculty and other agents; and (4) their community cultural wealth (CCW) that establishes how various forms of capital such as aspirational, familial, social, navigational, resistant, and linguistic capital help Black and Latino engineering students navigate in the higher education institution.

Investigator(s)

This study is being conducted by Krystal Foxx, a doctoral candidate in the Department of Educational Leadership (College of Education), under the supervision of Dr. Sandra Dika, Assistant Professor in the Department of Educational Leadership.

Eligibility

You may participate in this project if you are a full-time junior or senior (have 60 credit hours or more) student majoring in an engineering discipline, self-identify as Black, Latino, or Multiple Races with one race being Black or Latino, are 18 -24 years old, and are considered a successful engineering student, which includes:

- Demonstrate satisfactory academic performance (e.g., not on academic probation, C-average or higher in coursework) and
- Engaged in on-campus engineering-related and/or other activities outside of coursework (e.g., student organizations such as NSBE or SHPE, peer mentoring program, or other organizations)

Overall Description of Participation

You will have completed an online brief questionnaire that took 10-15 minutes to complete. Following the online questionnaire, you will be asked to complete one individual interview. The individual interview will take 60-90 minutes and will be based on an interview protocol listing several key questions about your academic and social experiences while being in an engineering program. You may also be contacted one or two times for more information as a follow-up to your interview responses; however, each follow up conversation should not last longer than 30 minutes. The student investigator, Krystal Foxx, will schedule and conduct the interviews on campus for your convenience. Your interview will be audio-recorded for verbatim transcription later.

Length of Participation

The study has two parts, the brief online questionnaire and the confidential interview. The brief online questionnaire should have taken approximately 10-15 minutes to complete and the individual interview will take 60-90 minutes. If needed, you may be contacted one or two additional times after your interview for follow-up information concerning your interview responses. The length of time should not exceed 30 minutes each time you are contacted for follow up information. The total estimated time for participation in this study is between 2 to 2.75 hours.

Risks and Benefits of Participation

There are no major known risks for your participation in this study. However, the project may involve risks that are not currently known. There may be some uncomfortable feelings throughout the interview because of some questions asking about your personal and professional experiences. The interviewer will try to make the questions as open and tactful as possible to reduce or eliminate these feelings. Other than the possibility of minimal discomfort related to interview questions, there are no other psychological, academic, economic, or legal risks associated with participating in this study.

This study may potentially benefit society by generating information to improve recruitment and retention efforts of underrepresented engineering students, thereby contributing to increasing the diversity of engineering professionals in the United States. Benefits to the individual may include being able to understand factors that contribute to your success while in engineering.

Volunteer Statement

You are a volunteer. The decision to participate in this study is completely up to you. If you decide to participate in the study, you may stop at any time. Your academic status or reputation while being in an engineering program will not be affected if you decide not to participate in the study or choose to stop participation once you have started.

Confidentiality Statement

Any information about your participation, including your identity, is completely confidential. The following steps will be taken to ensure this confidentiality. The investigators, Krystal Foxx and Sandra Dika (dissertation advisor), will manage all student interview data. Krystal Foxx will remove all identifiable information from each interview transcript during the transcription process and use pseudonyms (fictitious names) instead. The faculty and staff members in College of Engineering will have access only to the final report presenting aggregated data without any identifiable information attached. The expected number of interviewees recruited is ten.

Statement of Fair Treatment and Respect

SUU wants to make sure that you are treated in a fair and respectful manner. Contact the University's Research Compliance Office if you have questions about how you are treated as a study participant. If you have any questions about the actual project or study, please contact Krystal Foxx (email, phone) or Dr. Sandra Dika (email, phone).

Approval Date

This form was approved for use on 3/24/2014 for one year.

Participant Consent

I have read the information in this consent form. I have had the chance to ask questions about this study, and those questions have been answered to my satisfaction. I am at least 18 years of age, and I agree to participate in this research project. I understand that I will receive a copy of this form after it has been signed by me and the principal investigator of this research study.

Participant Name (PRINT) DATE

Participant Signature

Investigator Signature DATE

APPENDIX F: LIST OF THEMES AND SUB-THEMES

Major Themes	Major Sub-Themes	Minor Sub-Themes
(1) Personal Factors and Qualities that Facilitate Success	A. Typical Definitions of Success	a. Having Good Learner/Student Behaviors
		b. Persisting with Good Grades to Graduation
	B. Seeing Success as More Than Just Studying Engineering	a. Hard work and Determination to Achieve Accomplishments
		b. Leadership and Career Development Through Involvement with Others
		c. Support from Family and Friends
(2) The Nature and Role of Interactions with Faculty and Institutional Agents	A. Understand Contact with Engineering Faculty	a. Indifferent Perceptions of Engineering Faculty
		b. Typical Interactions Outside of Class
	B. A Different Kind of Experience with Non-Engineering Faculty	
	C. Role of Institution and Interactions with Institutional Agents	a. Different Levels of Interactions in Advising
		b. Mentorship from Other Professionals/Administrators
(3) Sociodemographic Factors in Engineering	A. Racial and Cultural Aspects in Faculty-Student Interactions	
	B. Working Hard to Prove Them Wrong	
	C. Perceived Needs to Understand and Relate in Racial and Cultural Aspects	
(4) Impact of CCW	A. Struggle Ensures Success	
	B. Family Means Everything	
	C. Capitalizing Socially and Navigationally with Faculty and Institutional Agents	
	D. Stereotypes Don't Bother Me	