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CULTURAL CAPITAL IN URBAN COMMUNITIES AS A PATHWAY TO ENGINEERING
AT A PREDOMINANTLY WHITE INSTITUTION: NARRATIVES OF AFRICAN
AMERICAN WOMEN IN ENGINEERING

BY

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DISSERTATION

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ABSTRACT

The goal of this research study is to gain an understanding of the unique first year experiences of five minority women in pursuit of engineering degrees at a Predominantly White Institution (PWI). The three-essay dissertation examines two research questions specifically, 1) As African American girls in urban communities overcome challenging circumstances to succeed in math and science in high school, what experiences do they report as motivating them to pursue engineering at a selective predominantly white institution (PWI)? and 2) What is the role of family, school and community networks in gaining college access and their choice of major?

The three-essay dissertation addresses these questions by examining the academic trajectory and illuminating the first person narrative experiences of the African American women, all of whom attend the same PWI. The papers will individually and collectively provide insight into the experiences of the five students, exploring issues of college access and choice of major. The first essay examines the pre-college and summer bridge experiences of the five students in preparation for their first year of study and the social and cultural influences from their urban community. A second essay focuses on the high school to college transition of the five students, and the challenges they face as they traverse two very different worlds, leaving predominantly minority communities to attend a PWI. The women identify challenges they experienced during this transition as they traverse multiple contexts. The focus of the third and final essay is a case study of the one student, who remained in engineering after the first year. The case study methodology provides the researcher an opportunity to triangulate several data

sources in order to gain a detailed understanding of the student's experiences of persistence in contrast to the four other women, who left the field of engineering. The researcher examines their social and cultural networks and the complexities of race and gender in a field where minorities and women have been historically under-represented. The findings suggest that the young women were guided onto an engineering college pathway, by the social and cultural resources found in their own urban communities.

The findings are expected to guide future more expansive research and invoke discussion among practitioners in student and academic affairs about institutional interventions to support college diversity, student engagement and the retention of African American women in engineering.

Index terms: Race, gender, & engineering; college access; women of color & engineering education; urban social capital; critical race feminism.

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Dedication

As the first person to graduate from college in both of my parents' families, I dedicate this
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INTRODUCTION

The emerging knowledge-based economy requires a diversified workforce with highly technical educational skills, specifically in the fields of science, technology, engineering and mathematics (STEM), in order for the United States to remain competitive in the global economy (American Society of STEM Education, 2011; Obama, 2009). The economic and technological growth of the United States in response to the rapidly changing global economy requires significant numbers of graduates in STEM fields of study (National Science Foundation, 2013). US projections indicate that a significant increase in the number of engineers is needed in its workforce by 2020 (Bureau of Labor Statistics, 2006-2016; ASEE, 2011). However, the American Society for Engineering Education (American Society of Engineering Education, 2011) indicates that US engineering enrollment and graduation rates have not kept pace with the increasing demand for domestic engineering talent. Women currently comprise more than 50% of the US population (US Census Bureau, 2010); and the strength and productivity of the US workforce and our country's global competitiveness will increasingly depend on the educational progress of women.

While minority women represent the largest increase among bachelor's degree recipients (National Center for Educational Statistics (NCES, 2013), they remain underrepresented in the fields of science, technology, engineering or mathematics (STEM). Unfortunately, while a significant number of well qualified minority and female students leave high school intending to major in a STEM field, many do not transition to college and others graduate in another field (Castleman & Page, 2014a; Huang, Taldese, Walton & Peng, 2000; Seymour & Hewitt, 1997).

Among minority women who enroll in STEM fields in college, very few persist past their first year (Hurtado, 2013; Bowen, Chingos, & McPherson, 2009; Espinosa, 2011;

Malcom, Hall & Brown, 1976; National Science Foundation, 2011, 2013; Ong, Wright, Espinosa, & Orfield, 2011) and African American women remain one of the least represented among engineering degree holders (ASEE, 2011).

While institutions have become increasingly diverse (Kellner, 1997), strategies to engage more women and minorities in the STEM fields have not been successful (National Academy of Sciences, 2007, 2010; Kuh, G., Kinzie, J., Schuh, E. & Whitt, E. J., 2005). The lost talent among minority women could fill a vital domestic talent gap in the highly technical fields needed to meet the demands of a rapidly growing technology-based economy and to remain competitive on the global market (Bureau of Labor Statistics, 2007). In order to satisfy the growing needs of a highly technical skilled and a diversified workforce, institutions will need to do more to recruit and retain women and minorities in the STEM fields.

In educational research, there is only limited information about the postsecondary experiences of Black women in the sciences and the contributions of urban communities to their college access. On the other hand, a large body of research focuses on deficit models of educational attrition suggesting minorities and women lack the resources to be successful in higher education, especially in math and science (Ogbu, 1992; Cooley, Cornell & Lee, 1991). Many researchers have concluded that disadvantaged circumstances in urban communities contribute to the academic failure of minority students in their pursuit of college (Kozol, 2012; Palmer et al, 2010). In the past few decades minority women, many of whom come from urban communities, have increasingly become the largest group of baccalaureate degree recipients

(College Board, 2010, 2015). This trend is expected to continue as the growth of the minority population in the US is expected to become the majority by the year 2020 (Hobbs & Stoops, 2002).

The purpose of this research study is to increase understanding of the experiences of African American women in their first year of engineering at a Predominantly White Institution (PWI). By gaining insight into their experiences, institutions will be able to create policies and programs to retain African American women beyond their first year. This three-essay dissertation examines two research questions specifically: 1) As African American girls in urban communities overcome challenging circumstances to succeed in math and science in high school, what experiences do they report as motivating them to pursue engineering at a selective predominantly white institution (PWI)? and 2) What is the role of family, school and community networks in gaining college access and choosing a major ?

The three-essay dissertation addresses these questions by illuminating the first-person narrative experiences of the African American women in their first year of study at the same PWI. The papers will individually and collectively provide insight into the experiences of the five students, exploring issues of access, inclusion, and equity. The first essay examines the pre-college and summer bridge experiences of the five students in preparation for their first year of study and the social and cultural influences on them. A second essay focuses on the high school to college transition of the five students and the challenges as they traverse through two very different worlds, leaving predominantly minority communities to attend a PWI. The women identify social and cultural challenges they experienced during this transition. The focus of the third and final essay is a case study of the one student who remained in engineering after the first year. The case study methodology provides the researcher an opportunity to triangulate several

data sources in order to gain a detailed understanding of the student's experiences during and after her first year of study, comparing and contrasting the experiences of the four other women who left the field. The researcher examines the timing and role of the social and cultural networks this student utilized for her academic success.

The papers address the subtleties and complexities of race and gender in a field where minorities and women have been historically under-represented. Singularly and collectively, the three papers illuminate the experiences of five African American women who pursued engineering at this PWI in their own words. The findings suggest that these women relied heavily on the resources in their separate predominantly minority urban communities to gain access to college and to prepare for and identify engineering as a field of study.

These three essays contribute to the academic literature by illuminating the experiences of African American women along their pathways to engineering and the meaningful contributions of their urban communities. The findings will guide future, more expansive research and invoke discussion among practitioners in student and academic affairs about institutional interventions to support college diversity, student engagement, and the recruitment and retention of African American women in engineering.

CHAPTER 1: Cultural Capital in Urban Communities as a Pathway to Engineering Access to a Predominantly White Institution: Narratives of African American Women in Engineering

ABSTRACT

For the past two decades, minority women have seen the largest increase among college degree recipients, yet African American women remain disproportionately underrepresented in engineering. This study examines the first-year experiences of five African American women pursuing engineering at a Predominantly White Institution (PWI) to gain a better understanding of the everyday lived experiences of African American women given their multiple identities of race, gender, and social class. Through their first-person narratives, the women reveal the strength of the social and cultural networks in their urban communities that have contributed to their academic pathway in engineering and college access at this PWI. This paper is the first in a series of three that illuminate and prioritize the narrative experiences of five African American women as they pursue engineering degrees at the same Predominantly White Institution. The papers individually and collectively reflect their experiences.

Index Terms: college access; race and gender; urban education; cultural capital; women and engineering

INTRODUCTION

There is only limited information about the postsecondary experiences of Black females in the sciences and the contributions of urban communities to pre-college preparation and educational trajectories (Yosso, Parker, Solórzano, & Lynn, 2004; Jayakumar, Vue & Allen, 2013; Wilson, & Allen, 1987b) that support, nurture and provide resources for the academic achievements of students in math and science and prepare these students for college. Black family interactions and resources in urban communities have long been misunderstood and characterized as counterproductive to academic achievement (Moynihan, 1965; Clark, 1983). Little is known about the strength and value of cultural resources (Yosso, 2006; Jayakumar, Vue & Allen, 2013) in urban communities of color and their role in academic preparation and college access (Waxman, Gray, & Padron, 2004; Goldman, 2012; Barbarin, McCandies, Coleman, & Atkinson, 2004; Carlone & Johnson, 2007; Griffith, 2010). Minority students living and attending school in urban communities are often perceived as being ill-prepared and lacking the resources that support postsecondary educational access (Chau, Thampi & Wight, 2010; Davis, 2018; Trent & St. John, 2008). Yet despite obstacles, many minority students from urban communities persevere and gain admission to selective institutions in science and engineering.

This chapter explores the pre-college preparation of respondents and the ‘community mothering’ that nurtured their academic trajectory and college access. The young African American women in this study credit the resources in their predominantly minority urban communities as being vital to developing their pre-college academic skills and creating opportunities for college access. More specifically, these young women suggest that their academic acumen is attributable to the networks and resources found in their own predominantly

minority communities, which runs counter to predominant perceptions of the effects of these communities.

The five study participants reveal through their experiences the strength of the resources in their urban communities that contributed to their academic achievement in the sciences and college access in engineering. The findings suggest that the social and cultural networks in the students' predominantly Black urban communities gained through family, school and church were important to their pre-college preparation and college access.

This study contributes to the field of educational research by prioritizing the experiences of African American women who reveal that social and cultural capital in their own urban communities were vital for their academic achievement and college access in engineering. The study provides a greater understanding of the experiences of these African American women in the field of engineering where women and minorities remain disproportionately underrepresented by examining the first-year experiences of the respondents and the resources they utilized in their communities to gain college access in engineering at a selective, predominantly white institution (PWI). The women in the study share their experiences and perceptions about their first year of college in engineering. Through in-depth interviews, observation and document reviews, the researcher uses a critical race feminism analytical framework to interpret their experiences. The intersectional framework privileges the narrative experiences of the women of color in their everyday lived experiences of oppression and/or discrimination due to their multiple identities of race, gender, and social class. By doing so, the researcher sought to gain a more detailed understanding of the students' academic preparation and resources leading to their college pathway. This study contributes to the field of educational research by not only increasing the understanding of the educational experiences of African American women, but also by

illuminating the resources within urban communities that contribute to college pathways and the pursuit of engineering as a field of study.

REVIEW OF LITERATURE

The Need for Diversified STEM Talent

The increasingly technical and scientific knowledge-based global economy requires a diversified US workforce with highly technical and scientific skills to adequately meet the needs of industry and remain competitive in the global era (National Academy of Sciences, National Academy of STEM, & Institute of Medicine, 2007, 2010). According to a recent National Academy of Science Report, our skilled and technical workforce needs are currently being met by those who complete at least a Bachelors degree in a science or engineering field of study (National Academy of Sciences, 2010). However, the American Society for Engineering Education (ASEE, 2011) indicates that US engineering enrollment and graduation rates have not kept pace with the increasing demand for domestic engineering talent. For example, among all bachelor's degrees attained in the United States in 2012, only 4% were awarded in engineering fields compared to 19% in Asia overall and 31% in China (NCES, 2015); this is in spite the US projections of a significant increase in the number of engineers needed by 2020 (Bureau of Labor Statistics, 2007).

African American women accounted for more than 63% of all African Americans who attended a four-year institution in 2012 (U.S. Department of Education, NCES, 2013). In a 2011 survey by the Higher Education Research Institute (HERI) at the University of California Los Angeles, data suggests that only 3.2% of African American women among all college freshmen nationwide intended to major in engineering, and few of those students completed engineering degrees (Hurtado, 2013).

Many high achieving minority students are from urban communities and meet the prerequisites for engineering (NCES, 2013). Educational literature on college going behavior underestimates the important contributions of urban communities of color and their role in strengthening and sustaining the college pipeline for math and science preparation for college (Wang, 2013). The growing trend of math- and science-prepared women and the increasing numbers of minority women graduating from college suggest they could fill the unmet need for STEM degree recipients. However, institutions must first gain useful information about strategies to attract and retain minority women in engineering fields. Understanding the first-year experiences of African American women who pursue engineering may provide useful information to create more opportunities for access and retention in STEM fields among minority women.

Minority Women as a Source of STEM Talent

“One of the things that I really strongly believe in is that we need to have more girls interested in math, science, and engineering. We’ve got half the population that is way underrepresented in those fields and that means that we’ve got a whole bunch of talent...not being encouraged the way they need to.” -- President Barack Obama, April 2009.

For some time, policy makers and practitioners, researchers, industry professionals, and then-president Obama's administration have sounded the alarm that US institutions need to increase the number of STEM degree recipients to remain globally competitive and meet the growing technological needs of domestic industry (Bowen & Bok, 2000; National Academy of Sciences, 2010). Who will meet this growing unmet need remains unclear, but in his address to the Academy of Sciences, President Obama acknowledged that among our female domestic population there exists a great deal of untapped talent (Obama, 2009). Several research studies

have confirmed the growing need to increase training and college access in science, technology, engineering and mathematics (STEM) in order to meet the technological growth of the US and of industry (Bureau of National Affairs, 1964; Bowen & Bok, 2000; National Science Foundation, 2011, 2013). To achieve this lofty goal, many suggest that educational institutions must increase opportunities for STEM college access among an increasingly diverse student population.

Minority women represent a huge untapped source of engineering talent that could satisfy the growing domestic demand for engineers and contribute to the diversification of engineering. Over the past two decades, minority women have had the greatest increase among bachelor's degree recipients (National Center for Educational Statistics, 2013), yet remain disproportionately underrepresented in science and engineering fields (National Science Foundation, 2011, 2013). In the US, minorities represent the fastest growing segment of the population (U.S Census, 2010), and the shifting racial demographics suggest that by 2020 ethnic minorities will become the majority population (Hobbs & Stoops, 2002). Despite more than two decades of increasing numbers of female and minority college graduates, both groups remain disproportionately underrepresented in STEM fields of study (National Science Foundation, 2011, 2013; College Board, 2015). This is particularly problematic given the changing US demographics, with more than 50% of women in the workforce (US Department of Labor, Bureau of Labor Statistics, 2007), more minority women holding college degrees than any other group, and industry's increasing need for a technically-skilled workforce (Carnevale & Strohl, 2013; Executive Office of the President, 2014; Hobbs & Stoops, 2002). The strength and productivity of the US workforce and our country's global competitiveness will increasingly depend on the educational progress of minority women (National Science Foundation, 2013;

Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline, 2011).

Prospective STEM Students and ‘Summer Melt’

One reason for the significant demand gap for STEM graduates is that a significant talent pool remains largely untapped because institutions do not attract and retain significant numbers of women and minorities into science and engineering (Espinosa, 2011; Johnson, 1980; Malcom, Hall, & Brown, 1976). Many minority students capable of contributing to the STEM talent pool are lost during the summer preceding college enrollment, a period known as ‘Summer Melt’ (Castleman, Arnold, & Wartman, 2012). During this time, almost 20% of low income and minority students who have been admitted to and planned to attend college after high school do not attend (Castleman, Page, & Schooley, 2014). The summer melt highlights the critical time of transition between high school and college (St. John, Hu, & Fischer, 2011; Trent, 1970), when more than 200,000 students who possess the prerequisite college science skills do not go on to pursue a college degree in STEM. More than 36% of college bound students who are lost during the summer melt have met the science requirements for a four-year college admission based on their ACT scores (Castleman, Page, & Schooley, 2014). This ‘lost talent’ can be found primarily among low income, minority, and female students.

STEM Pipeline and Completion Rates Among Women and Minorities

Another explanation for the lack of women and/or minorities in the engineering pipeline is the lack of mentorship or close ties to a faculty member (Huang, Taldese, Walton & Peng, 2000; Seymour & Hewitt, 1997). In the US, many minorities and girls leave the math and science pipeline early and this exodus continues during middle school (Oakes, 1990). This is a critical period for students planning to pursue science and engineering, since middle school math and science choices will determine high school course selection and ultimately impact college academic preparation. While a significant number of well qualified minority and female students leave high school intending to major in a STEM field,

many do not transition to college at all and others graduate in different fields (Huang, Taldese, Walton & Peng, 2000; Seymour & Hewitt, 1997).

A diminishing pipeline, low enrollment rates, and abysmal retention rates of minorities and women in the sciences at US colleges provide more reasons to engage this population in order to understand the conditions that support studying math and science. Researchers and practitioners can enhance their understanding of the experiences of minority women as they transition to postsecondary education with the hopes of retaining their talent to engineering degree completion and ultimately into the workforce. Among US citizens, women comprise more than 50% of the population (US Census, 2010) and 46% of the workforce (U.S. Bureau of Labor Statistics, 2006). In 2008, approximately 427,000 students enrolled in universities in the United States and Puerto Rico to obtain engineering degrees, but only 17.3% of these students were women. Among minority women, only 5,672 African American female students enrolled in engineering in 2008, representing 7.6% of the total female engineering enrollment and 1.3% of the overall engineering enrollment (ASEE, 2011; NCES, 2013); of that group, only 15% or 896 students nationwide received engineering degrees four years later (ASEE, 2011). Although many minority women are admitted into college with the prerequisite skills for and intending to major in an engineering field, few remain in engineering after their freshman year (Bowen, Chingos, & McPherson, 2009; Espinosa, 2011; Malcom, Hall & Brown, 1976; National Science Foundation, 2011, 2013; Ong, Wright, Espinosa, & Orfield, 2011).

In order to facilitate the **inclusion** of minorities and women in engineering and science (Espinosa, 2011; Johnson, 2007; Malcom & Malcom, 2011; National Science Foundation, 2011, 2013), it is important to learn from the experiences of successful minority female students and, through their experiences, try to understand the factors that contribute to their college pathways in science and engineering. Research on the experiences of African American female engineering students can provide some insight into the institutional policies and practices that promote pre-college academic preparation

in engineering, college access to that field, and inclusion in postsecondary engineering degree programs. This dissertation provides important information for the development of initiatives to promote opportunities for diversification in science and engineering careers.

College Access and Urban Community Resources

A system of social networks and cultural contacts can provide students with privileged communications. Networks may include adults in schools and churches, extended family, and community members. These relationships support and nurture goals external to their community. These collective resources form a cultural network for achieving meaningful academic experiences.

Within communities of color, social and cultural networks exist in which vital information is passed along to students about college access, academic preparation, college success, and cultural norms (Solorzano, Ledesma, Perez, Burciaga & Ornelas, 2002; Kuh, Kinzie, Schuh, & Whit, 2005; Tinto, 2012). These networks include extended family, teachers, and friends who cultivate and guide the educational pursuits of community members (Tierney & Venegas, 2005). Black students rely on these interconnected networks in the community to provide necessary resources for college preparation and access. These networks are of particular importance to the college trajectory of minority girls who excel in math and science. The academic success of the Black female students in this study is closely tied to social and cultural resources in their communities that provided information on college entry and academic success (Freeman, 1997; Fries-Britt & Holmes, 2012, Banks, 2009), especially a group called 'fictive kin'. In education, fictive kin may not have a biological relationship, but play a vital role as a community resource. Fictive kin are teachers, neighbors, peer counselors, and school counselors who provide Black students with specific information about academics and college (Freeman, 1997; Tierney

& Venegas, 2005). Once in college, mentors, counselors, faculty members, and administrators can serve as fictive kin, providing information on how to be successful and engage in meaningful activities (e.g., using campus resources, studying, and managing time). Fictive kin networks expand through high school to provide Black students with a range of necessary tools and information on the specifics of the college application process, including helping students complete college scholarship applications and fill out the Free Application for Federal Student Aid (FAFSA), a prerequisite for any student seeking financial aid or college funding (Freeman, 1997; Tierney & Venegas, 2005). Once minority students are admitted into college, peer groups, academic advisors, mentors, faculty members and administrators attempt to serve a similar role as fictive kin. The campus community can provide support through campus resources and campus engagement opportunities with the goal of retaining minority students in college.

THEORETICAL FRAMEWORK

Social and Cultural Capital in Urban Minority Communities

Social Capital refers to the accumulation and transfer of knowledge from one generation to another, often leading to social class reproduction. Bourdieu referred to social capital being relevant in affluent white communities, transferring social mores and norms (Bourdieu, 1977). Using Bourdieu's theoretical framework, access to college resources, academic preparation, and even career opportunities can be reproduced through vital information communicated in formal and informal social networks (Bourdieu, P. 1986). These networks form the basis of social capital and influence student success in college, both inside and outside the classroom (Kuh, Schuh, & Whitt, 1991).

Social capital networks among ethnic groups in urban communities may have dissimilar resources, but can provide similar advantageous resources (Solorzano, & Yosso., 2002).

Bourdieu theorizes that white middle and upper class social networks and memberships help students acquire preferential college and career advantages, but social capital is less useful in understanding social and cultural networks in urban communities of color. Bourdieu's framework does not take into account the cultural nuances of communities of color that may provide networks and resources that support college access and the pursuit of science and engineering majors at selective colleges. In Black communities, social capital is better understood as 'cultural capital.'

Cultural Capital Formation in Urban Communities of Color

Yosso's (2006) research addresses some of the limitations of Bourdieu's work (1977) and identifies the importance of first person narratives in understanding the experiences of marginalized populations as a lived experience where context matters. It is important to understand the perspectives of the black women in this study and their perceptions of the cultural capital derived from their Black urban communities. While social capital is more closely tied to 'social status', net worth, and 'memberships' (Bourdieu, 1986), cultural capital is perhaps more closely associated with 'cultural competency' and community cultural brokers such as siblings, peers, teachers and institutional agents who provide advantageous information about education (Strayhorn, 2010; Stanton-Salazar, 1997). Cultural capital advantages minority students either in the quality of the relationship (family member, teacher, college representative, etc.) or the quantity of the relationship (AP course instructors, after-school activities, pre-college preparation etc.). Consistent with this scholarship, Black collegians have used cultural capital in the form of social networks to persist in college (Banks, 2009; Marsh, Chaney & Jones, 2012; Palmer & Gasman, 2008). This notion is consistent with prior research that supportive relationships, both in and out of the classroom, improve educational outcomes (Bahr, 2008; Adelman, 2006; St

John, Hill, Wooden, & Pasque, 2015) and improve college retention (Pascarella, Pierson, Wolniak, & Terenzini, 2004). Understanding the informal networks and resources in the urban community that provide access to science and engineering fields of study is critically important to diversifying college access. It is important to identify and understand factors contributing to college access among minority women seeking science and engineering majors. This study examines social relationships and resources, narratives and norms, expectations, rules, and values that represent symbolic dimensions of cultural capital (Daly, 2010; Penuel, Riel, Krause & Frank, 2009) the young women perceive as supporting their successful access to college.

Historical Significance of Education of African American Students at a PWI

Few, if any, higher education opportunities were available to African American children, enslaved or free, until sometime after 1837, when the Institute for Colored Youth was founded in Cheyney, Pennsylvania (it did not become a degree-granting institution until 1932). This institution was funded by philanthropists and largely led by Blacks for Black students. Prior to the Emancipation Proclamation (1863), it was unlawful for the majority of Blacks to become educated. However, two institutions were available to provide higher education opportunities for Black students: Lincoln University in Pennsylvania (1854) and Wilberforce University in Ohio (1856). At these institutions, African Americans in leadership roles were responsible for the teaching and curriculum of the select few Blacks able to pursue their higher education aspirations. By the end of the Civil War, approximately 40 Black students had graduated from predominantly white colleges and universities, all of which were located in northern states (JBHE, 2018). After slavery was made illegal in the US, many southern ex-slaves and their families migrated to the north seeking employment and educational opportunities (Diouf & Dodson, 2004). With the onset of the industrial revolution, black families were concentrated in

communities near most large urban cities, where higher paying jobs could be found. Increasing educational opportunities was a priority for many families.

The historical context and migration patterns for many black families in minority urban communities and some of the attributes within those communities that have remained relevant to families include the importance of education firmly rooted in the slave experience (Anderson, 1988, pg. 7). Many of the migration patterns into northern urban areas can be traced back to the south and the slave communities. Within those slave communities, reading and writing was forbidden and even against the law. Education and freedom were closely linked for African American slaves. Before the Freedman's Bureau was formed to assist freed slaves with schooling, literate and free Blacks were integral to the education of former slaves (Anderson, 1988, pg.9). The model of self-education was expanded through increased funding from philanthropists, but educational resources and opportunities for ex-slaves were not comparable to those of white children (Anderson, 1988). According to the black educators responsible for the educational success of ex-slaves, the attributes of Black communities created the conditions for K-12 success and college access (Butchart, 1980; Anderson, 1988; Bullock, 1967).

Siddle Walker and other researchers documented four characteristics of the black schools that were vital to the education of its students (Siddle Walker, 1996; Siddle Walker & Snarey, 2004; Davis, 2018; Edwards, Royster & Bates, 1979): 1) proficient and professional educators with a commitment to ensuring that children received educational opportunities; 2) the integration of extra-curricular activities that provided opportunities for the black students to become proficient in music, sports or other areas; 3) parental support in the schools and their involvement in the success of their children; and 4) visionary leadership to manage the everyday academic, social, and economic growth of the educational environment. Caring about the

academic success of the students was a thematic attribute at the foundation of all of the educational resources provided in the Black segregated schools (Siddle Walker, 1996).

More than two decades after the passage of *Brown v. Board of Education* (1954), in the 1970's and 1980's urban schools remained racially isolated educational environments (St. John & Cadray, 2004). The court-mandated desegregation plans that included reconfiguring residential boundaries and busing minority children to predominantly white schools to achieve 'racial balance or integration' appeared to have little influence on the opportunities for higher education for black children (St. John & Cadray, 2004). Attributes identified by black educators as vital to the African American tradition for educating black children were not reinforced in the new institutional structures or integrated into teacher education programs to support black student success (Siddle Walker & Snarey, 2004). However, Siddle Walker (1996) examined the important attributes of African American teachers documented as vital to the success of Black children. She found that African American teachers in segregated classrooms assumed multiple roles to promote the success of black students. In predominantly minority urban educational systems, the Black community is still important in encouraging and supporting the academic progress and college access of students as well as providing those resources necessary to leave their community and attend college.

CURRENT STUDY

Purpose of the Study and Research Questions

The purpose of this study is to gain an understanding of the first-year college experiences and perceptions of African American women pursuing an engineering major at a Primarily White Institution (PWI). Specifically, social networks and resources on which young Black women rely

to gain access to college and to understand the formal or informal resources that support the development of pre-college academic preparation and choice of major are examined.

Only a few research studies over the last few decades have focused on the experiences of African American women in college (Waxman, Padron, & Gray, 2004), and few researchers have examined the positive values and utility of cultural capital in black urban communities that cultivate and support college going behavior (Bowman & Howard, 1985; Palmer & Gasman; 2008) in engineering and the sciences.

This study fills a gap in the literature by prioritizing the experiences of the young Black women and the important contributions of their predominantly minority urban communities in their engineering trajectory. By doing so, researchers and practitioners gain an understanding of the formal and informal social and cultural networks in these communities that support pre-college preparation and college access in engineering. Little is known about the day-to-day experiences of African American undergraduate women, particularly in the engineering fields where they remain disproportionately underrepresented (National Science Foundation, 2013). First person narratives are used to examine and understand the role of the school, family, and social networks in college access and choice of major. Without a clear understanding of the factors contributing to minority student access in the engineering fields, even the most well intended policy and college programs could be ineffective in improving minority student participation (Fraser, 2002; Reason & Bradbury, 2001; Atwater, Leonard & Pearson, 2015).

To better understand the underrepresentation of African American women in engineering, the study applies Black Feminist Thought as a perspective for understanding African American women's challenges in engineering majors at a PWI. Black Feminist Thought prioritizes and

legitimizes the lived experiences of Black women due to interlocking forms of oppression such as race, gender, class, and nation of origin (Collins, 2000; hooks, 2000).

Study Overview

In this study, the researcher examines the experiences of five Black first year engineering students through their social relationships and resources, narratives and norms, expectations, rules, and values which represent symbolic dimensions of social capital (Daly, 2010; Penuel, Riel, Krause & Frank, 2009) the young women perceive as supporting their successful access to college. Through first person narratives, the social and cultural resources in the community that support the students' decisions to pursue engineering at this PWI are examined. The overall goal of the research study is to gain an understanding of the first-year experiences of these African American women and the role of the urban community (family, school and church) in their college pathway (Figure 1). Specifically,

1. As African American girls in urban communities overcome challenging circumstances to succeed in school, what experiences do they report as creating opportunities for college access at a selective predominantly white institution (PWI)?
2. What experiences do the participants report that help to explain their choice of major in engineering focusing on the role of family, school and their urban community?

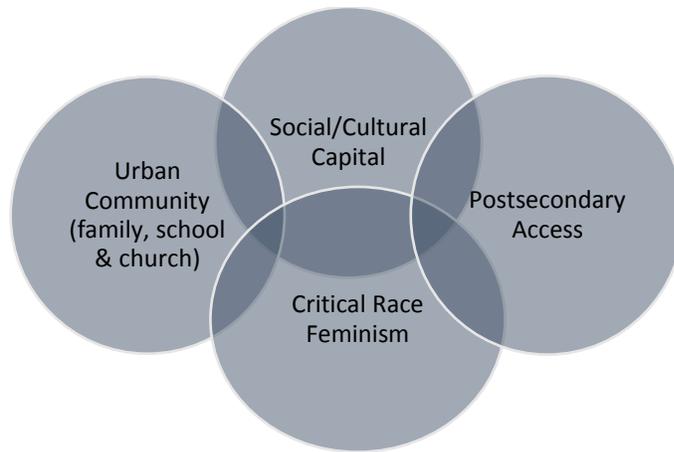


Figure 1 Theory and Concepts

Research Design

The research design includes detailed face to face interviews with the students, observations, and artifacts collected from the institution that provide insight into the institutional practices around recruitment of minority and women to the College of Engineering. First person narratives are used to provide greater detail on the nuanced and multiple roles that may shape the African American female's student experience. Narratives are an approach to gathering data that collects "oral, first-person accounts of experience" (Reissman, 1993, p. 69; Ellis & Bochner, 2000; Pinnegar & Hamilton, 2015). The narrative dialogue draws the reader into the context of the student's life and interprets objects and interactions to give meaning to everyday experiences. First person narratives were chosen as a methodology to give voice to the everyday experiences of Black women on a predominantly white campus pursuing an engineering degree (a male dominated field) to interpret objects and symbolism and give meaning to her environment (Chambers & Chiang, 2012; Banks, 2009). The researcher provides a historical context of the PWI and uses the students' own words to describe the family unit and community in order for the reader to gain a better understanding of the African American student's journey and their unique reasons for pursuing engineering in college (Seymour & Hewitt, 1997).

Through a series of in-depth semi-structured interviews, journaling, and observations the experiences of the female students in their institutional context are examined. A personal narrative “refers to talk organized around consequential events. A teller in a conversation takes a listener into a past time or 'world' and recapitulates what happened then to make a point, often a moral one” (Reissman, 1993, p. 3). The main point of personal narratives is not generalization, but to get a better understanding of the storyteller’s lived experiences. Ellis and Bochner (2000) add that personal narratives usually center on a “single case” that may elicit an emotional response to a traumatic experience (p. 744).

Methodology

A qualitative design was utilized, collecting first person narratives useful for “oral, first-person accounts of experience” (Reissman, 1993, p. 69; Ellis & Bochner, 2000; Pinnegar & Hamilton, 2015). First-person counter-narratives that prioritize the experiences of the respondents are used (Chen, 2013; Harper & Davis, 2012); they provide a greater understanding of the role of the Black urban community in college pathways. The students reflect on their social networks and cultural resources (e.g., family, church members, neighborhoods etc.) and the ways in which the urban community prepared them to be resilient in a college environment that is mostly white and predominantly male (Hull, Bell Scott, & Smith, 1982). The first-person narrative is a way to validate the experiences of the students and better understand their cultural relevance.

Recruitment and Study Participants

Purposeful sampling techniques (Creswell & Plano, 2007) were employed with predetermined criteria for eligibility. Participants must: 1) self-identify as an ethnic minority and 2) currently be enrolled full-time in a science, technology, engineering or mathematics (STEM) field of study at a PWI in their first year of study. These criteria were used to identify students with a recent transition from high school to

college (first or second semester students) who were expected to have fresh recollections of their initial experiences in their department and/or field of study.

Administrators at the university who had responsibility for minority student programs in STEM were contacted and asked to forward an email about the study from the researcher to prospective participants who met criteria for inclusion. Each chosen participant provided demographic information about their high school preparation, extra-curricular activities, family, peers and community, and participated in semi-structured interviews lasting approximately two hours. Participants also completed a post-interview questionnaire, providing more detailed information on common themes identified from the face-to-face interviews.

Although the young women in the study are from different urban communities, each successfully matriculated to the same PWI and into its selective engineering program. Each of the young women came from an urban city of one million plus residents characterized by segregated residential patterns; each of the women describe their neighborhood as a predominantly minority environment. All attended a public high school in their communities and graduated at the top of their class. The study participants include Valedictorians, Salutatorians and honor students who describe high ability in math and science and grade point averages ranging between 3.2 and 4.0 (Figure 1), which is within the range of the average GPA reported by the targeted institution's engineering data. Most of the students had availed themselves of the academic rigor of the limited AP course offerings at their schools. The women were involved in multiple extracurricular and leadership activities that demonstrated well-rounded preparation for college. In many ways, the women represented the best prepared candidates for college from their schools and communities. Participants had been granted unconditional admission into the

College of Engineering, and each received an invitation to attend a newly designed summer bridge program for first year students.

Table 1. Demographic Profiles of Study Participants

Name	Self- Identified Race	Age	Field of Study	Residence (Urban or Rural)	GPA
Brittany	African American	19	Mechanical	Urban	3.3
Theresa	African American	18	Electrical	Urban	3.7
Shana	African American	18	Electrical	Urban	3.2
Ashley	African American	19	Undecided	Urban	3.4
Amanda	African American	20	Chemical	Urban	4.0

Institutional Context

Kcalb University (not its real name) is a large diverse university classified as Research 1 by Carnegie as an institution with the highest level of research activity (Carnegie, 2014-15). Kcalb is a Predominantly White Institution (PWI), with more than 50% of the student body identifying as White. There are more than 30,000 undergraduate students enrolled at this institution; 7,000 students were first time freshman in 2009 when the study was initiated. In the College of Engineering (COE), African American students compromised 6.8% of the population and approximately 2% of the African American students admitted as freshman. The college of engineering at this university is identified as having several programs ranked in the top ten engineering programs in the country; most of its engineering programs are identified by US News and World Report as ‘selective’. In short, the admissions criteria in engineering attracts highly qualified students for highly competitive programs. The average ACT score is 20 across the country and a score of 24 is described as excellent according to the ACT scorers (US News, 2018; College Board, 2015). The average ACT score among all entering COE students was

above the national average, and many students ranked in the top 5-10% of their graduating classes. The COE has several active engineering student organizations specifically designed to attract women and minorities into engineering such as the National Society of Black Engineers (NSBE), the Society of Hispanic Professional Engineers (SHPE), and the Society of Women Engineers (SWE). The College of Engineering has a narrow recruitment emphasis in relation to minority student recruitment, focusing on specific regional high schools in predominantly minority communities.

Similar to other PWIs in the United States, Kcalb was previously an all-white and all-male institution, and the curriculum and programs were initially designed for that population. Subsequent to the desegregation in K-12 schools after the US Supreme Court decision in *Brown v. Board of Education* (1954), institutions of higher learning began to implement Affirmative Action Plans in compliance with the Civil Rights Act (1964), which made it unlawful to discriminate against college applicants on the basis of race or gender. However, many of the same challenges practitioners in higher education faced prior to desegregation remain prevalent. How do Predominantly White Institutions with curriculums and programs designed for white men engage minority women from predominantly minority communities and provide support for graduation? Some of the answers may be found in understanding communities of color and the lessons that do not transcend K-12 education and help the college-prepared student transition into college.

Data Collection

Five female students were chosen for the study. Each was an African American undergraduate woman in her first year of study who identified a field of engineering as their college major. Prior to a face-to-face interview, respondents were asked to complete a demographic profile on family, high school and college academic preparation as well as extra-curricular activities. The purpose of the demographic profile was to ensure that the respondents met the criteria for inclusion in the study and to guide the questions for the semi-structured interviews. Each respondent met the criteria for inclusion and agreed to a face-to-face interview, lasting approximately two hours. The electronically-recorded interviews were transcribed verbatim. Other methods of data collection included the researcher's observations and journaling, document review and a questionnaire sent electronically to students after their interview that focused on their pre-college and college experiences. The interviews and questionnaires were coded using NiVivo technology to develop patterns consistent with qualitative research data analysis (Lofland & Lofland, 1995). Data from the interviews and questionnaires were content analyzed and additional themes were identified. Content analysis is a systematic process used by researchers to examine the substance of a range of contemporaneous communications (Gall, Borg, & Gall, 2003). Using a set of recurrent themes and supporting contexts, descriptions of and quotes regarding the three major findings in this study are set forth. This paper is one of three papers that individually and collectively present the recurrent themes of these young women's experiences. This paper explores their experiences as they relate to their pre-college preparation and community support in their college pathway and choice of major.

Analytical Framework

Critical Race Theory (CRT) is used as an analytical framework to prioritize the narratives of the Black female students. CRT draws on scholarship that integrates lived experience with racial realism (Ladson-Billings & Tate, 1995; Dixson & Rousseau, 2006; Bell, 1988), employing multiple academic perspectives including women's studies, legal studies, sociology, and history, to examine an individual or group's past and current experiences with race and racism (Bell, 1980, 2000). CRT as a theoretical framework provides a multidisciplinary approach that acknowledges the presence of racism as inherent in American society. CRT provides a useful analytical tool to examine race and alternative explanations for the narratives of racialized populations, pertinent when examining students of color on a predominantly white campus (Harper & Davis, 2012; Patton, Haynes, Harris & Ivery, 2014).

Critical Race Feminism (CRF) uses an intersectional perspective that centers on women of color's multiple identities of race, gender, social class, and national origin. CRF privileges women of color in their everyday lived experiences of oppression and/or discrimination due to their multiple identities and allows a deeper understanding of the intersectionality of race and gender. First-person counter-narratives that prioritize the experiences of the African American women are used (Chen, 2013; Harper & Davis, 2012) to provide greater understanding of the role of the Black urban community in college pathways. The students reflect on their social networks and cultural resources (e.g., family, church members, neighborhoods, etc.) and the ways in which the urban community prepared them to be resilient in a college environment that is mostly white and predominantly male (Hull, Bell Scott, & Smith, 1982). The researcher sought to disentangle the students' experiences with race and gender that are often embedded and clustered, in lieu of research of the 'Black undergraduate experience' or the 'undergraduate female experience', which dilutes or all but erases the African American female experience by

prioritizing the Black male or White woman experience (Crenshaw, 1989; Hull, Bell Scott, & Smith, 1982). The first-person narratives are privileged as a way to validate the experiences of the Black female students and to better understand their cultural relevance.

RESULTS

Each of the five young women in the study grew up in a different urban community, but a consistent theme was the availability and use of academic resources and college-going support they received from their communities as well as the encouragement of family, teachers and peers, and the activities in school that supported their college access. Their communities are described as providing accountability and nurturing to support college going behavior.

Mentorship and 'Caring' Members of the Community.

Shana describes her grandmother's focus on academics and not going to work for a minimum wage job after school, which would have made it possible for her to contribute to her low-income household.

My mother passed away when I was nine years old and I went to live with my Grandmother. My brothers went to live with their father. Grandma did not want me to work, she wanted me to focus on my academics....

Ashley had no plans to attend college until her senior year encounter with her AP Calculus teacher. He talked often in the class about his years working as an engineer, his job responsibilities, and the academic preparation students would need to pursue engineering. His repeated references to engineering and her strong interest in math encouraged Ashley to explore engineering as a field of study.

My AP calc teacher...he was an engineer...he was an agricultural engineer for awhile. He did a lot of stuff ...like we didn't learn that much stuff in his class but we learned a lot about him.....I was like, 'Why are you teaching math?' and he would say like, 'Well because if you are going to be an engineer you are going to need this stuff'...and I would say, 'No I'm not going to be an engineer'....so yeah that's kind of weird but I started looking into it and I saw that engineers do make a lot of money, so I was like ok so what do I like to do. I do not like writing and history so I am good at math and science, so maybe I'll do engineering....and I chose civil engineering.

Brittany describes her love for math and how people in her neighborhood and at her church knew she was 'good in math'. Brittany was unable on her own to match a college major or career path based in math. Her mother's 'friend of a friend' at church, at the urging of Brittany's mother, contacted Brittany by phone to offer support on her good grades and advice on going to college. This person influenced Brittany's college and major choices, providing her with pre-college books and advising on which courses to take and which professors to choose.

...the woman that helped me most introduced me to Kcalb University...my mentor from outside [the university] because she explained to me how this school is really good in math and science. She had me read a couple of things about the school and introduced me to a couple of people that graduated from the school, one that didn't make it and one that did...she told me about some professors and said if they are still there go talk to him.

Pre-College Preparation: Advanced Placement Courses in High School

The importance of Pre-college preparation and AP course is best illustrated by exchanges in face-to-face interviews where the researcher asked: "Now how many AP courses did you take in high school?"

Shana: AP..I think I took...I didn't take any AP courses actually...um...we only had I think a AP history class....I didn't like history and didn't plan on majoring in that...we had an AP bio class....but I couldn't take that because band was at the same time and band was only at one time.....we had ahhh AP English class, but I didn't take AP English, I was in honors English.

Brittany: It was calculus AB and then there was calculus BC...so I guess that calculus AB is more like Calc I and BC is like after calc but not necessarily Calc II and instead of 2-3 of them being in one class they would like all meet and take a bus for the schools in the district like early in the morning, so I didn't take BC I took the AB class and took the AP exam for it.

Ashley: None really...I took Geometry over the freshman summer year and that was just so I could take Calculus, so I could advance...you were supposed to take Algebra, then Geometry, then Calculus and then AP Calculus. So by taking Geometry that allowed me to advance a little bit, but I was actually scared so I never actually took the AP Calculus class.

Amanda: No, I took some classes at a junior college near my house last year.

Theresa: Ummmm...I don't remember any...if I did...like my honors classes or something. I never took the exams.

Summer 'Bridge' Program Preparation

Shana was asked to reflect on why she decided to attend the invitational summer program hosted at the university. She indicated it was because of her grandmother who urged her to go. Shana said she was somewhat of an introvert in high school, but social events and activities at the bridge program like the 'ropes course' where you had to depend on others to survive, helped her become more vocal and become part of a core group of African American peers.

Like I don't want to say I was shy in high school. I really did not talk to people unless they really wanted to talk to me...but the [summer bridge program] taught me that you cannot do it alone, that you really have to get out there and that you might need people to help you, because you can't do college by yourself.

Theresa and Brittany described the important role of their summer bridge coordinator in creating engaging opportunities that supported their transition into the university. Jayna, the program coordinator, was an African American woman. Her caring nature was felt by the students in her phone calls and communications after the program ended. The students felt like she cared about them and their success in the program. Theresa's statement that 'there is something about [Jayna]' may suggest a closeness reminiscent of the fictive kin relationship to others in her predominantly Black urban community.

...there is something about [Jayna] and you just open up to her right away. She will say, 'how are you doing' and your brain wants to say 'ok, yeah I'm doing fine', but then your mouth will say 'I'm horrible' and you just let out everything.

Jayna left the institution and was replaced by a woman whose ethnicity was unknown to the students, although Theresa indicated she wasn't Black. Shana reported: "I mean she (the new coordinator) emails us every now and then but it's not really...Um...I kind of know her, but I don't feel comfortable going through all of that stuff."

Conclusion

The findings in this study suggest that the urban community, especially family, school and the church, had a vital role in creating opportunities for college access and selecting engineering as a major for the young women in this study. The social and cultural resources in their urban communities provided valuable information about pre-college preparation, college access and majors, and support in navigating perceived barriers. The students in the study are top academic graduates from their urban high schools, yet their AP course offerings were few or non-existent. Despite the shortcomings of academic offerings, leadership at the urban schools provided numerous extracurricular activities for the students to engage with diverse persons and gain math skills. The students share experiences of math competitions outside of their community and mentoring by people in church, among family networks and teachers, all a part of their fictive kin network, who guided their pathway to college and engineering, specifically. The inequities and under-resourcing of the urban schools in their predominantly minority communities illustrates the power of the non-monetary resources there that helped the students gain college access, in some of the most selective engineering programs in the country. Leadership and mentorship support for college going behavior was evident in the students' experiences in the urban schools that contributed to their college admission.

DISCUSSION

In this study, five Black women highlight the importance of the support of their urban communities (e.g., families, schools, and churches) and describe their experiences leveraging community relationships and resources to gain access to college and engineering. The findings suggest that the urban community, especially family, school and the church, has a major role in creating opportunities for engineering access for young community members.

A Summer Bridge Programs appears to be important in the transition into college, as respondents indicated the program offered at their PWI eased some of the ‘culture shock’ associated with their transition into college. The cultural aspect of ‘caring’ found among teachers and community members in the African American urban community (Siddle Walker, 1996) are not consistently available in a PWI, where they may be needed most. The positive effects of the bridge program, in fact, appeared to come mostly from the presence of a Black program coordinator with whom the students could identify and who they perceived as caring about them. This coordinator remained in frequent contact with the students during their first semester of college after the summer program ended. It was not clear whether that was part of her job, but the students perceived these contacts as ‘caring’ about their academic success. The ethnicity of the coordinator may also be important; a Black coordinator may provide students with comfort similar to that received in their predominantly minority urban community. This was suggested when the students declined to engage with the new coordinator of undetermined race after their summer program coordinator left the institution.

This study fills a gap in the literature by prioritizing the experiences of the young Black women respondents and revealing the important contributions of their predominantly minority urban communities in their engineering trajectory. This provides researchers and practitioners with a better understanding of the formal and informal social and cultural networks in these

communities that support the development of college going behavior and choice of major. In this study, the five Black women highlight the contributions of family, school and church in their urban communities and describe their experiences leveraging community relationships and resources in order to gain access to college and engineering. Still further, these young women describe how their family and urban community networks supported the formation of pre-college skills and academic preparation in math and science.

Implications

The findings in the study suggest that the African American women in this study gained vital resources from their respective predominantly minority urban communities in order to obtain college access and decide on their choice of major. Similar to the social capital attributes found among affluent families (Bourdieu, P. 1986), the value of the interconnected relationships and resources among family, school and community members of the minority urban community helped form the cultural capital (Yosso, 2006) that created a pathway for college access and engineering. Although the urban schools attended by the women in the study offered few AP courses that would have provided a greater academic foundation for engineering, the young women reveal a resourcefulness of their community that collectively provided information about the admissions process, campus resources and support for other extra-curricular activities that encouraged discipline and mathematic skill development. Siddie Walker (1996) describes this concept in her research of segregated black schools in the south. Despite the inequities of the black schools, students were told repeatedly to work ‘twice as hard to get as much’ as the white student. The young women identify experiences of being influenced by their parents, teachers and mentors to take specific upper level, honors and college prerequisite courses and to participate in multiple extra-curricular and leadership activities in high school (college

prerequisites of math and English, student ambassador, band and math competitions held around the state) and to participate in the summer bridge program as a transition to college. Although the activities did not replace academic courses, the combined activities provided good leverage for their college admissions. In addition, the young African American women reveal mentorship opportunities through teachers and others in their community that helped them to understand how their math acumen was a good match for an engineering major in college, most of whom didn't know about the field of engineering or the career pathway. While inequities persist in our urban schools in many urban communities, where our African American women in the study attended high school, many had expectations for success in college in the same ways they had performed in high school. It is a common misconception for first generation and low-income students to not have a good understanding of what is needed to succeed in college, in the absence of good academic advising from faculty or staff (Bahr, 2008; Elliott & Healy, 2001). Since the young women in this study graduated at the top of their classes, they believed that their high school academic preparation was adequate for their engineering college major at this PWI, until they attended their summer bridge program. The findings suggest that the students' expectations for their academic performance in college dramatically changed during their participation in summer bridge (Tinto, 2012).

Finally, the findings imply that the undergraduate women in engineering did not experience situations during their first year that they felt were attributed directly to their race or gender.

In the study the young women made repeated references to their summer bridge experiences and how the program shaped their understanding of their expectations for engineering academic preparation. The students describe a set of structured activities, led by an

engineer, who was a woman of color over a period of six weeks. The program included academic course work, training in study habits, mandatory tutoring, an introduction to campus support services, along with structured social activities. The summer program introduced the students to the rigors of the college curriculum, but also created more realistic expectations for their first year of study. While the summer bridge program helped the students identify their need for additional academic preparation, it also appears to contribute to the development of the students' negative self-perception of their academic ability at this institution. Students identified the presumption among instructors and peers of prerequisite math knowledge in their first semester that they never had experienced in high school. When the African American female students are unable to perform at the expected levels of their peers, they risk being characterized negatively because of perceptions of their race or gender. Stereotype Threat characterizes this situation if or when female or minority students fall short of the expectations of their instructors or peers, it is presumed simply because of their race and/or gender that the student is unable to perform at the expected level (Steele & Aronson, 1998). When this is presumed students disengage and fulfill the lowered expectations. These experiences only served to reinforce a sense of not belonging in the space. But asking for help represented a dramatic change for these students, who graduated at the top of their classes in high school. Although the students report everyone failing a test in the first week of the summer program, one student perceived the failed exam as a challenge. She reports she had never failed an exam before in her life and the experience made her study even harder. This student sought out tutoring in both the college of engineering and a culturally responsive unit at the institution, Minority Student Services (MSA). The student reports needing to understand other teaching methods due to the diversity of her instructors and that the engineering tutoring services provided tutors with diverse backgrounds and many of whom had

English as a second language. This same student also received tutoring services from MSA unit, which may reflect a tendency to utilize services from culturally similar instructors. The students report not having tutorial instruction with any African American tutors in the College of Engineering (COE). One student notes that the diversity of instruction among her COE tutors was also reflected in her courses, where she describes different teaching methods and different language accents that distracted from her learning. This student's perception of her tutorial experience in the COE helped prepare her for adjusting to different teaching styles. While a six-week summer program is hardly enough time for the students to overcome the academic inequities of their K-12 urban schooling, it provided insight to the students on the academic disparities between what they had learned and expectations for the rigorous coursework that lie ahead. While the six-week summer program hosted by the institution provided the students with academic expectations for the upcoming year, one course during the summer was not enough to adequately prepare the students for their first year of study. In addition, there was little or no follow-up with the students to create a clear plan for student success, after the summer program ended. While the students report some initial contact with the program coordinator after the program ended, it is not clear if this was part of her responsibility or because she cared about the students' success. However, her subsequent departure from the university left a void for the students, who began to develop a mentor relationship with her during the summer. The extension of the summer program into the first year would have provided both continuity of support services and additional engagement opportunities for the students. While the students were able to identify peer networks they formed in the summer program, they were unable to identify other persons from the institution to whom they were in contact on a regular basis, after the summer program. This suggests that there was little or no follow-up with the students after they

completed the summer program. The quality of good academic advice is critical to the success of first year students and without it students are less engaged and more likely to depart the institution (Tinto, 2012). Yet the institutional responsibility should not end there. Finally, the findings imply that the undergraduate women in engineering did not experience situations during their first year that they felt were attributed directly to their race or gender.

Limitations

Similar to all qualitative research, this study has limitations. The study took place in only one institution and included only five African American young women. In this and other qualitative research, the findings are not generalizable across institutions or across or within ethnic groups. These findings represent the educational experiences of five young African American women from different urban communities pursuing engineering at this predominantly white institution. It is the researchers hope that their experiences invoke discussion and further research on the enormous value these students place on their urban communities and the value their families place on educational achievement.

Future Research

Future research studies need to examine the role of other urban minority communities in preparing students for college and encouraging persistence. Expanding this area of research to examine other urban cultural contexts (e.g., Hispanic, Asian) and other social and cultural networks that support women of color would be helpful. Additional research on the experiences of African American women on predominantly White campuses could increase understanding of the needs of African American students after transitioning from minority communities and insight into the types of institutional interventions used to support student success. The preparation for and admission into a highly selective engineering program is a highly

competitive process. For African American women accepted into selective engineering programs at PWIs, it is imperative we understand their social, educational and cultural needs and provide resources that reflect their cultural identity through the high school transition process and on through college graduation. College access to a PWI is not enough; the social and cultural networks in each student's community that helped them to reach their college goals must be explored. Perhaps the answer is not in our institutions of higher learning, but in gaining greater understanding of our urban communities of color that prepare minority women for college.

This area of educational research focused on engineering access could provide useful information for educators and practitioners in the development of programs to attract, engage and retain women of color in engineering and other STEM fields of study. The information may also be useful to policy makers for developing K-12 and higher education partnerships and programs that complement and support the cultural capital found in urban communities of color that nurtures and supports college going behavior. It is the researchers hope that the experiences of these five women will invoke discussion and further research on the vital role of urban communities in the students' educational pathway and the value of its resources in preparing students for engineering.

CHAPTER 2: Tapping Two Worlds: Narratives of First Year African American Women in Engineering at a Predominantly White Institution (PWI)

ABSTRACT

Every fall term, first-year college students leave their homes and communities to pursue their hopes and dreams of obtaining an engineering degree at universities across the country. While some students embrace their new college environment as not too dissimilar from their high school, the five African American women in this study describe a different experience. The young women are met with social, financial, and academic challenges in their first year of study as they transition from predominantly minority urban communities to selective engineering programs at a Predominantly White Institution (PWI). In this qualitative study, the researcher uses first person narratives to gain an understanding of their experiences as they navigate race and gender from their urban community to college. The findings suggest that for many women, the transition to the PWI was fraught with low expectations, social isolation, lack of mentorship and/or very little institutional engagement, which ultimately influenced some of them to leave engineering.

This paper is the second in a series of three papers that study the same group of African American women as they reflect on their experiences in pre-college preparation and college access, first year college experiences in engineering, and persistence.

Keywords: First year college; women/engineering; persistence and engineering; race/gender; urban education

INTRODUCTION

Prestigious universities and selective engineering programs are very competitive. Only a small percentage of African American women are accepted into engineering programs each year (ASEE, 2014), and even fewer remain after their first year of study (Bowen, Chingos, & McPherson, 2009; Hurtado, et al, 2007; National Science Foundation, 2011; 2013). Educational research on the persistence of students in postsecondary science, technology, engineering and mathematics (STEM) fields, provides multiple explanations of why students persist including the development of a peer and faculty support system (Pascarella, 1980; Seymour & Hewitt, 1997; St. John, Hill, Wooden, & Pasque, 2015), financial support (Tierney & Venegas, 2005; St. John, Rowley & Hu, 2009), a sense of belonging (Hurtado et al., 2007), and field-related research experiences that support mentorship and other institutional engagement opportunities (Pascarella, Pierson, Wolniak & Terenzini, 2004). These factors likely also contribute to the persistence of students in STEM fields. In this qualitative study, the researcher seeks to gain an in-depth understanding of the experiences of five African American women in their first year of study in engineering, as they transition from their predominantly minority communities to a large, research-intensive, predominantly white institution (PWI). The findings suggest that minority women may leave partly because of lack of engagement. The study prioritizes the first person narrative experiences of these five African American women, all of whom attend the same public PWI but in varying engineering fields of study. The students are examined within the different contexts (Carnevale, A. P., & Strohl, J. 2013) and insight is gained into their campus engagement.

REVIEW OF LITERATURE

Minority Women and STEM

Minority females represent the largest increase among baccalaureate degree recipients over the last two decades (College Board, 2010, 2015), yet remain the least represented in the Science, Technology, Engineering, and Mathematics (STEM) disciplines (National Science Foundation, 2013; Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline, 2011). Many minority women enter college with the requisite science and math skills to pursue a STEM field of study (Castleman & Page, 2014a).

Unfortunately, many do not transition to college and still others graduate in other fields (Huang, Taldese, Walton & Peng, 2000; Seymour & Hewitt, 1997); among minority women who enroll in STEM fields in college, very few persist past their first year (Hurtado, 2013; Bowen, Chingos, & McPherson, 2009; Espinosa, 2011; Malcom, Hall & Brown, 1976; National Science Foundation, 2011, 2013; Ong, Wright, Espinosa, & Orfield, 2011). This lost talent among minority women could fill vital domestic talent gaps in the highly technical fields needed to meet the demands of a rapidly growing technology-based economy and remain competitive on the global market (Bureau of Labor Statistics, 2007). Currently women comprise over half of the US population (US Census, 2010), and it is projected that by 2020, the domestic minority population will become the majority US population (Hobbs & Stoops, 2002). This further magnifies the need to cultivate existing domestic talent among minority women and diversify STEM fields.

Social and Cultural Networks in Urban Capital

Family Support

Black parents have historically advocated on behalf of their children to pursue a high school and college education (Harris, Wrights & Msengi, 2011; Wilson & Allen, 1987b). It is understandable that many Black families have served as the backbones of support for their college-aged children. Black families provide emotional (e.g., praise and encouragement), financial, and academic support for their children, including first-generation Black collegians (Guiffrida, 2005; Palmer & Gasman, 2008). Black parents also teach their college-aged children to be resilient in order to complete college despite the adversities they may face on college campuses and/or in their personal lives.

Few studies have disaggregated the data in order to better understand family support experiences among Black college students based on race and gender. Palmer, et al. (2008) examined the impact of family support on the college persistence of Black men from an urban area, finding there was intergenerational information sharing between Black men attending college and their families. These Black men identified their immediate and extended families (e.g., grandparents) as helping to motivate them to succeed despite obstacles. However, few scholars have completed studies on the role of family support for Black women in college (Banks, 2009) the studies that have found that Black parents provided financial and/or academic support for their daughters.

Peer Support

Black peers influence each other's ability to graduate from high school and persist into and through college (Marsh, Chaney, & Jones, 2012; Palmer & Gasman, 2008). Black students who participate in informal social networks are likely to be more engaged socially and academically in high school and/or college than peers who lack those networks. Black peers

provide each other with emotional support that encourages them to pursue their educational goals despite the obstacles they may encounter during their educational journeys.

Community Resources

Resources that can be found in the community are also important to the success of Black students. In high school and college, Black students rely on community resources, such as fictive kin. In high school, ‘fictive kin’ includes teachers, neighbors, peer groups, and other community members who provide Black students with information about the college application process and how to fund college, including filling out college scholarship applications and the Free Application for Federal Student Aid (FAFSA) (Freeman, 1997; Tierney, Bailey, Constantine, Finkelstein, & Hurd, 2009). In some predominantly minority communities, Black churches influence college-going behavior and act as catalysts for obtaining college resources (Drezner, 2013). In college, mentors, college counselors, faculty members, and/or administrators may serve as fictive kin who provide information about how to become successful college students by using campus resources, studying, and managing time.

CONCEPTUAL FRAMEWORK: URBAN SOCIAL CAPITAL

In the transition from high school to college, vital information gets passed along to students about college access, academic preparation, college success, and cultural norms (Tinto, 2012; Bourdieu, 1977). This knowledge is known as social capital, but the resources and networks in the urban community may differ from the affluent memberships and intergenerational knowledge more often associated with a higher SES. Social capital brings people together (e.g., community resources, peers, organizations) by providing resources through social networks inside and outside of organizations (Tinto, 2012). In urban areas, Black students have used social and cultural networks in their urban communities that provide family and peer

support and community resources to gain college access (Banks, 2009; Palmer & Gasman, 2008). The networks for college access in the urban community are known to its members, but may not be evident to outsiders or those who are not members of the community. Yosso (2007) describes the attributes that are unique to communities of color 'cultural capital.' Resilience also helps Black students be successful despite obstacles (Fuselier Thompson, 2018). Walsh (2015) defined resilience as “the capacity to rebound from adversity strengthened and more resourceful” (p. 4). Tierney in an anthropological study (1992) posited, "Instead of implying that being 'drawn back' to *one's own culture* is a shortcoming, one might accentuate that ripping one *away* from his or her native culture is *detrimental* and *harmful*. "For all of the women in this study, leaving their predominantly minority urban community to attend college at a predominantly white university was leaving the comfort of their culture and fictive kin.

Barriers to Student Success

Available institutional programs designed to encourage and support student success overwhelmingly favor majority students and those in the higher income brackets (Astin & Oseguera, 2004). Much of the prior research findings suggest that high school course selection (Trusty, 2002), limited access to STEM education (Heller, 2002), socioeconomic status (Seymour, 1994) and affordability (Perna, 2015; Walpole, 2003) create barriers that result in many minority women not entering into or leaving science and engineering majors. Educational research has consistently found that black students attending PWIs have negative perceptions about their college environments that can have similar negative implications for their educational success (Strayhorn, 2008). Black students report feeling undue pressure to prove themselves academically and perceive their university as unsupportive and ‘chilly’ (Fleming; Palmer & Gasman, 2008). Few studies have set out to understand the experiences of African American

women in their first year of engineering and the reasons they leave or stay. Without understanding the experiences of Black female students in the engineering fields, where they remain disproportionately represented, practitioners are unable to meet the needs of students and improve participation rates.

ANALYTICAL FRAMEWORK

A Critical Race Feminism theoretical framework allows the researcher to better understand the multiple identities the students in the study take on and the multiple contexts in which they interact in order to better understand their (Evans-Winters & Esposito, 2010; Wing, 1997, 2003). Critical race feminism uses an intersectional perspective that centers on women of color's multiple identities of race, gender, social class, and national origin. As a framework, intersectionality privileges women of color in their everyday lived experiences of oppression and/or discrimination due to their multiple identities (Crenshaw, 1995; hooks, 2000, Carlone & Johnson, 2007; Malcom et al, 1976). These experiences can occur at home, in the work place, and/or within educational settings (Crenshaw, 1989). By applying critical race feminism as a framework, scholars privilege women of color's.

A Critical Race Feminist Theory (Bell, 2000; Collins, 2000; Evans-Winters & Esposito, 2010) analytical framework is being used to illuminate the first-person counter-narrative accounts of African American women on a predominantly white campus as primary. Personal narratives will be used to identify perceived race, gender, and class experiences that African American female engineering students may identify in their pursuit of an undergraduate engineering degree.

METHODS

As African American girls in urban communities overcome challenging circumstances to succeed in math and science in high school, what experiences do they report as motivating them to pursue and remain in engineering at a PWI? What experiences allow them to overcome perceived barriers and persist towards degree attainment? The use of a narrative inquiry methodology provides the researcher with a more detailed account of the respondent's experiences by identifying a small number of study participants. Narrative inquiry is a way to examine the 'lived' experiences and meaningful stories of study participants (Creswell, 2007). This approach is best suited for capturing the detailed experiences of a single life or the lives of a small number of individuals (p. 55). Narrative analysis is an approach to gathering data that is useful for "oral, first-person accounts of experience" (Reissman, 1993, p. 69). Through narratives, researchers or practitioners can draw out personal experiences (Ellis & Bochner, 2000). A personal narrative "refers to talk organized around consequential events. A teller in a conversation takes a listener into a past time or "world" and recapitulates what happened then to make a point, often a moral one" (Reissman, 1993, p. 3). This passage suggests that the main point of personal narratives is not generalization, but to gain a better understanding of the storyteller's lived experiences. Ellis and Bochner (2000) emphasize that personal narratives usually center on a "single case" that may elicit an emotional response to a traumatic experience (p. 744). The goal of the researcher was to examine a smaller sample size with greater detail.

Recruitment, Site Selection and Data Collection

Recruitment

The researcher used purposeful sampling techniques (Creswell, 2013) with predetermined criteria for selected students: 1) self-identify as a member of a minority group, 2) currently enrolled in a STEM major or had plans to major in a STEM field at the same PWI, and 3) had completed at least one semester on campus at the same public PWI. The criteria were used to identify students with relatively recent transitions from high school to college (first or second semester students), who were expected to have fresh recollections of their initial experiences in their department and/or field of study.

Campus administrators involved with minority student programs helped coordinate and identify undergraduate students for the pilot study interviews. Using the university website, STEM programs were selected and program administrators were contacted via email, given a brief description of the pilot study, and asked to forward information about the pilot study directly to currently enrolled students. Due to the small potential pool of minority students within the STEM disciplines at this institution, prospective participants were asked to contact the researcher directly to protect their anonymity. Despite efforts to cast a wide net, only six students responded to the inquiry. Each of the six students self-identified as African American and were currently enrolled in an undergraduate engineering program. Five of the six respondents were female; the researcher chose to focus on the five female students. Participants ranged in age from 18 to 20 years old with a median age of 18.8 years. The students had a median GPA of 3.5, ranging from 3.2 to 4.0. Each of the five students lived in an urban community of more than 700,000 people and attended a school in their community (see Table 1).

Table 2. Demographic Profile of Study Participants

Name	Race	Gender	Age	Field of Study	Residence (Urban or Rural)
Brittany	African American	F	19	Mechanical	Urban
Theresa	African American	F	18	Electrical	Urban
Shana	African American	F	18	Electrical	Urban
Ashley	African American	F	19	Undecided	Urban
Amanda	African American	F	20	Chemical	Urban

Site Selection

Kcalb University (not its real name) is a large, diverse public university classified as Research 1 by the Carnegie ratings as an institution with the highest level of research activity (Carnegie, 2015). Kcalb is a Predominantly White Institution (PWI), with more than 50% of the student body identifying as White. There are more than 30,000 undergraduate students enrolled at this institution; 7,000 students were first time freshman in 2009 when the study was initiated. In the College of Engineering (COE), African American students comprise 6.8% of the entire student body and approximately 2% of the students admitted as freshman were African American. The college of engineering at this university has several programs ranked as a top ten engineering program in the country, and most of its engineering programs are identified by US News and World Report as ‘selective.’ In short, the admissions criteria in this institution’s engineering programs are highly selective. The average ACT score is 20 across the country and a score of 24 is described as excellent according to the ACT (2015). The average ACT score among all entering COE students was above 27, and those admitted in the Freshman engineering class of 2008-09 had a cumulative GPA above 3.9. The COE has several active engineering student organizations specifically designed to attract women in engineering and minority students such as the Society of

Women Engineers (SWE), National Society of Black Engineers (NSBE), and the Society of Hispanic Professional Engineers (SHPE). Recruitment brochures provided to prospective students reflect pictures of minorities and women on the cover and engaged in engineering projects. Additionally, recruitment information provided to first generation, low income, women and minorities included a brochure to encourage participation in a summer 'transition' program.

Data Collection

Data collection for this study was initially conducted in the 2008-09 academic year. The pilot study included in-depth face to face interviews of first and second semester minority students planning to major in an engineering field of study. The semi-structured interviews lasted on average two hours to allow participants time to reflect in detail on their college experiences. Each of the participants was assigned a pseudonym to protect their anonymity and the confidentiality of their responses. The purpose of the study was to gain verbatim narratives from students on their experiences in their chosen major through face to face interviews (LeCompte, & Preissle, 1993; Schwandt & Burgon, 2006). Each of the interviews was digitally recorded and professionally transcribed verbatim (Creswell, 2013). The interview protocol was semi-structured and consisted of 20 questions. The interview protocol included open and closed ended questions and a self-report questionnaire was sent electronically after the interview. The open-ended questions provided flexibility for the participants to expand on experiences important to them. The interview questions were grouped to include three areas: a) the pre-college experiences of the participants; b) experiences during their transition from high school to college, including any summer programs; and c) expectations, experiences and reflections from their first year of study in engineering.

After the face to face interviews were completed, participants were asked to complete an electronic demographic questionnaire and given the opportunity to complete a more in-depth reflection in three areas: 1) academic preparation for engineering; 2) family, school or community influences on college going; 3) overcoming a specific challenge in college. Using open ended questions, both the interview and participant questionnaire explored experiences that the participants identified as meaningful to them. The self-report questionnaire also provided clarification and validity (Creswell & Plano Clark, 2007).

Data Analysis

The researcher began the analytical process by reading and re-reading each of the electronic verbatim transcripts of the participant interviews. Recurrent themes were placed in chronological order using NiVivo technology. Analysis of the narratives is both inductive and deductive (Creswell, 2013). Inductively, because themes related to the students' experiences before attending the PWI were identified, including those during K-12 as well as during their transition to college and their first year of study. Deductively, themes in the research literature on college access for minority women, academic preparation in math and science, institutional context and perceived barriers to college access, institutional engagement and mentorship were identified. The narrative themes were then organized in chronological order to 're-story' or re-organize participant experiences using fifteen code words (Clandinin & Connelly, 2000). A grand narrative was created to analyze the transcribed responses as a three-dimensional narrative inquiry consistent with Clandinin & Connelly (2000). The grand narrative was placed in sequential order by: 1) The interaction (personal or social); 2) The continuity (past, present and future); and 3) The place (and/or situation). This was done to more closely examine the

narratives within the context of the PWI and the framework of critical race feminist theory.

Trustworthiness and Researcher Involvement

Using a journal, multiple steps were taken to minimize insider and outsider statuses on the research process (Jones, Torres & Armino, 2013). I began this process by reflecting on my higher education minority recruitment experiences that led me to this study and my relationship to the respondents, both as a student and female of color on a predominantly white campus. Prior to each interview I acknowledged my insider identities to build trust and provide a space for open dialogue, shared my desire to bridge research and practice with the participants, shared my commitment to honor each student's 'authentic self' through first person narratives, and offered each participant an opportunity to review the transcribed drafts of their interviews (Creswell, 2013).

Three techniques were used to validate my interpretations of the preliminary findings. First, I shared my findings with the participants as a way of adding trustworthiness to the study (Lincoln & Guba, 1986). Second, I used peer debriefing to minimize bias and to ensure my inferences were credible (Creswell, 2013). Third, I provided detailed descriptions of students' narratives via their audio-recorded and transcribed interviews to promote transferability (Creswell, 2013).

FINDINGS

The preliminary findings suggest that the women had barriers in their transition from their predominantly minority communities to the PWI. Some of the women identify that the professor has a 'different way of teaching' or that the professor '...speaks funny...' Prior to their first semester, the young African American women in this study believed they were academically prepared to confront the rigors of an engineering education at this selective public institution.

However, their expectations for academic success were lessened during summer bridge and further eroded in their first semester. When staff mentors from the summer program were no longer available to them and the program ended, the students lacked support and accountability from others for their academic success. All but one of the students did not maintain contact with their mentors from their urban communities; one had periodic community contact, just to let people know ‘how she was doing’ or she was called by her teacher, parent or adult sibling ‘to check in’ suggesting there was ongoing accountability associated with her academic progress. The edited narratives below provide information about the students’ experiences with high school preparation, mentorship, summer program activities, and college transition. The students’ perceptions of their new environment and the differences within it suggest their challenges with a majority culture. Three dominant themes emerged from the narrative data:

1. Bridge Program

Well ...we were kind of like the guinea pig group 'cause they had this program um...it was called Bridge ordinarily but I guess they wanted to start an engineering version and the point was to take some of the admitted minority students from like...underprivileged areas or like low income areas so they could try to just catch them up because of what they probably didn't learn in high school because you know some high schools are more rigorous than others when it comes to academics....

...they just started it I think it was called STEM-Summer. Nine of us came here and took classes for six weeks and we actually got credit for those classes.we had two students that was in the [upperclass mentor program] that helped supervise us on our visit here. They showed us around and checked in on us at the dorm.”

2. Mandatory Student Engagement Activities through Summer Bridge

Student: Besides classes...umm...we had mentor study sessions, I think two to three nights per week where we had to be in the study area for like two hours no matter if you didn't have homework you find something to do to, you can always study.

Researcher: How many hours per week do you estimate that you utilized these services [university support services in the context of the summer program]?

Student: "From 9:00am to 9:00pm... no basically it was an all day thing because even after class we had counselors and they tutored us and took us everywhere. After classes and after the tutoring sessions which was around 9:00pm we would like go to the movies.

Researcher: So you had social events?

Student: Yes. I would say the most [liked aspect of the program] was making friends. Most of the people that I was with I'm still talking to them, we are best friends now.

3. Student Perceptions

In high school, coming out with a 3.8 you already think that college is going to be a breeze, and that it is going to be easy and that you are going to come in and do exactly what you did in high school. Then the [Summer Bridge] program showed us that you will not be able to do that. Everybody failed the first math test and we were all just surprised and shocked...we thought it was going to be exactly like high school.

If I didn't go to the [summer program] I probably would have had the same mentality that I had coming out of high school that college is going to be a breeze.

I think I have test anxiety or something and need to be tested for that. Basically, I can study the material but when it comes to the test I like freeze, forget everything, or completely break apart and the exam is right in front of me. That is my downfall.

[on attaining a 2.0 GPA in college and a 3.8 in high school] I think it is the rigors of college, all of the studying you have to put in, time management, focus, motivation all of the stuff that kind of goes away during the last four weeks of class. Sleep deprivation...it is just a lot of factors due to being in college. Like frustration that you know you can do it, but you can't

DISCUSSION

This study sought to understand and identify the experiences of African American women as they transition from high school to college and the critical institutional supports that strengthen their engagement. The data suggest the students were appropriately engaged in institutionally-led activities over the summer that included mandatory tutoring, study tables, social events, and mentorship from a program coordinator who herself was a woman of color and an engineer. According to the women in this study, institutional supports should focus on the academic and social integration of minority students along with a range of teaching methods provided by diverse faculty and staff to accommodate different learning styles and support engagement of diverse groups with the faculty. Increased institutional resources to assist the students in their adjustment to the institution were needed.

The extreme contrast in student engagement from the summer to the first year was evident among the young women in their narrative experiences. The loss of their program leader and her mentorship from the summer program seemed to contribute to the students' lack of

engagement. The Summer Program leader was an African American woman who was an engineer. The students rebuffed outreach from the new, non-minority program coordinator who tried unsuccessfully to engage the students later in the school year. While institutions cannot control employee departure, having a consistent minority person as coordinator appears to be important to the students; ideally, this would be someone with whom they have a cultural identity. In addition to mentorship, expectations were clear and accountability from the program coordinators was clear with daily tutoring, social activities and academic classes. The students had regular and ongoing interactions with peers and those who were employed by the institution. However, when the program ended, many of those new networks no longer existed and preparation for creating additional networks was not done, either by the students or the program involvement. The students and COE recruitment materials describe a summer pre-college program that was designed to attract minority and low-income students to the college. The young women in the study liked the idea of attending a summer program with college credit and a monthly stipend. COE recruitment materials describe the target population as ‘at risk’ students, yet none of the women had the perceptions of being a college student at risk of academic failure. The students describe a sense of belonging to the group and social activities that supported team building activities. In addition, there was a true accountability to the group for homework assignments, mandatory tutoring and attending daily classes. Students were told they would not receive their stipend unless they attended class, adding to the incentive to participate and to be accountable for their actions. However, the biggest revelation to these women during the summer was the fact that they had inflated expectations about their math abilities, and college was not going to be as easy as high school. These feelings of inferiority as it relates to their math abilities and expectations for the first year, may be counter-productive in developing stereotype

threat in the students (Steele, & Aronson, 1998), even though that is not the intent of the summer program. The students identify themselves as high achieving from their respective communities and high schools, their pre-college attributes were no longer used to identify their self-concept as it relates to their academic challenges in engineering. The peer to peer support offered during the summer was identified as meaningful experiences that helped to transition the students into a social and academic environment with students, who looked like them. This may have initially contributed to a sense of belonging (Hurtado, et al., 2007) among the students but was not a sustainable model for ongoing support and growth, both academically and in terms of institutional supports.

The lack of continued leadership and accountability from the summer program (or another model) may have contributed to less institutional engagement during their first year. Hiring more minority faculty might provide a departmental context that is more culturally responsive to the recruitment of minority students and also provide greater inclusion. Otherwise, the institution risks ‘ripping these students from their culture’ and expecting them to perform at the same level or higher level as when they were in their own communities. In the absence of social and cultural networks, safety nets, and support systems that the students identified in their own communities, it may be unrealistic to expect these young African American women to achieve at the same or similar levels. These findings are consistent with Tinto’s theory (1993) of social integration and ‘institutional fit’, but additional inquiry is needed to identify the quality and cultural depth of the programs needed to engage African American women and those of other cultures into the institutional fabric of a PWI.

It is also unrealistic to expect that even the most well-prepared minority student from an urban community can easily transition to a predominantly white institution in a selective

engineering program. It is equally unrealistic to anticipate that African American women, who are underrepresented in engineering, could overcome perceptions of social, cultural or academic challenges and achieve student success based solely on a six-week summer program participation.

Limitations

Similar to all qualitative research, this study has limitations. The study took place in only one institution and included a small number of African American young women (N=5). In this and other qualitative research, the findings are not generalizable across institutions or across or within ethnic groups. These findings represent the educational experiences of five young African American women from different urban communities pursuing engineering at this predominantly white institution. It is the researcher's hope that their experiences invoke discussion and further research on the enormous value these students place on their urban communities and the value their families place on educational achievement.

Future Research

Future research should include additional inquiry with a larger sample size to examine the experiences of African American women attending a PWI, as well as the experiences of other minority women in similar contexts. Based on the importance of the summer program expressed by these respondents, future research could work to identify the most effective transition programs to support minority student success in engineering and STEM fields of study.

In addition, a review of institutional policies and programs that support the transition of non-traditional students from high school to higher education may be useful, as would the development of partnership agreements to support the linking of resources and support persons

between high school and college to promote the success of African American women in engineering.

**CHAPTER 3: I looked Around and It was Only Me: A Case Study of an African American Woman in Engineering attending a Predominantly White Institution (PWI)----
Narratives of Race, Gender and Persistence**

ABSTRACT

The focus of this case study originates from a qualitative study examining the first-year college experiences of five African American women in engineering fields at the same Predominantly White Institution (PWI). The women in their own words identify social and cultural challenges they experienced during the transition from their predominantly minority urban community to the PWI. After the first year, two students in the study transferred to other fields and two students left the university. The focus of this case study is to gain an in-depth understanding of the experiences of the one student, who remained in engineering and the complexities of race and gender in a field where minorities and women have been historically under-represented. The case study methodology provides the researcher an opportunity to triangulate several data sources in order to gain a detailed understanding of the student's experiences. The findings reveal fluid and diverse social and cultural networks, that extend from her urban community into college, that support student success and persistence towards degree attainment and career opportunities. The findings are expected to guide future more expansive research and invoke discussion among practitioners in student and academic affairs about institutional interventions to support college diversity, student engagement and the retention of African American women in engineering.

This case study is the third and final paper in a sequence that illuminates the narrative experiences of African American women as they pursue engineering degrees at the same PWI. The papers individually and collectively reflect their experiences.

Index Terms: urban education; African American women/engineering; women/engineering; persistence in engineering; minorities/engineering

INTRODUCTION

In the past few decades, minority women have become the fastest growing group to achieve baccalaureate degrees (College Board, 2010; 2015) yet remain the least represented among engineering degree holders (ASEE, 2011). This trend is expected to continue as minority populations in the US are expected to become the majority by the year 2020 (Hobbs & Stoops, 2002). In order to satisfy the needs of a highly-technically skilled and diversified workforce, more women and minorities will need to be recruited and retained in engineering degree programs. The woman who is the focus of this case study participated in a prior qualitative study (Fuselier-Thompson, 2018) which explored the first-year narrative experiences of five African American women pursuing engineering degrees at a Predominantly White Institution (PWI). This case will help explain the real-life preparation undertaken to access college and pursue engineering at a selective PWI (Yin, 2014).

Both minorities and women remain significantly underrepresented among science, technology, engineering and mathematics (STEM) degree recipients (NSF, 2013). The prior study (Fuselier-Thompson, 2018) was designed to understand the experiences of African American women to inform the policies and practices of higher education in the recruitment and retention of African American women. Specifically, first-person counter-narratives were used to prioritize the experiences of five African American women (Chen, 2013; Harper & Davis, 2012; hooks, 2000) and provide a greater understanding of the role of the Black urban community in their college pathways. The students reflected on their social networks and cultural resources (e.g., family, church members, neighborhoods, etc.) and the ways in which the urban community prepared them to be resilient in a college environment that was mostly white and predominantly

male (Hull, Bell Scott, & Smith, 1982). The first-person narrative is a way to validate the experiences of the students and better understand their cultural relevance.

Researcher/Practitioner Background

I was attending yet another undergraduate science recruitment conference where the best and the brightest students were highlighting their research skills in the hopes of finding the ‘right fit’ in a selective program at a prestigious university. As a recruiter, I was responsible for seeking out well-prepared underrepresented minority students for doctoral programs in several fields of study. There was a cluster of fields that stood out to me because of the difficulty in identifying a highly-qualified pipeline of minority women to pursue a degree in science, technology, engineering or mathematics (STEM). My institution was well regarded in the research community around the world, with highly competitive and selective programs in STEM fields of study. The programs offered attractive fellowships to cover tuition and living expenses in an effort to engage the very best students. The university was in an attractive Midwestern town with a history of legendary researchers, frequently made global news, and had a well-known history of diversity efforts. At each of the conferences I attended, other recruiting institutions had similar prestigious standing and money to support the most qualified minority students. Many of the recruiters assured students of their institution’s diversity efforts, often having other minority students accompany them to recruitment fairs. Yet, year after year, each progressively competitive science and/or engineering conference seemed to yield the participation of the same select few existing minority students, all of whom were women who had received awards and/or recognition for their research acumen or other skill development. Conference organizers were well aware of the significance of such recognition when students apply for graduate school.

This recruitment scenario was repeated year after year. Across the country I would encounter the same institutional recruiters, usually mid-level directors or deans seeking out STEM minority students among the select few who met the criteria for their highly selective institutions. One year I whispered over to my colleague, "...as much as I like seeing all of you each year, we spend a great deal of time and money chasing the same five students across the country". She looked at me, almost in disbelief that I had characterized our cat and mouse game in that way, yet agreed that our recruiting group always seemed to end up vying for a small group of minority students in highly selective technical fields of study. We often shared information about the pending higher education decisions of our small group of select students, in the same way that highly sought-after athletes are discussed in the news, as deadlines approached for the students' decisions on where they would attend. Each year this small group of minority students would disperse to their respective institutions, hoping to 'fit into' their department and institution, where they would see few faculty and colleagues who looked like them or shared similar experiences. Once these decisions were complete, recruiters were already arranging travel to identify the next small group of highly qualified prospective minority students.

The challenges associated with my role as recruiter of minority students for the STEM fields led to my decision to explore historical and research questions associated with this 'complex social phenomena' (Yin, 2014, p.4): the lack of representation of minorities and women in engineering. Why were there so few minority students, especially women, in the doctoral pipeline to research careers, specifically in the science and technical fields of study? What was the trajectory these few successful students followed and could it be replicated for others to increase the pool of prospective students?

With a growing national emphasis on developing domestic talent in the Science, Technology, Engineering and Mathematics (STEM) fields of study to meet the needs of global and expanding industry (NSF, 2013; Goldman, 2012; National Academy of the Sciences, 2010), the researcher wanted to gain insight into the lost talent of the four African American women in the study who left the field and/or institution and information on the lone remaining woman as a way to inform researchers and practitioners. For the purposes of this study, I selected one field and one minority group to narrow my focus and gain an in-depth understanding of my research questions. The researcher identified African American women in engineering as that group, primarily because of their disproportionate underrepresentation among the STEM disciplines (ASEE, 2011). Minority women have made up the highest growing undergraduate graduation rates in the last two decades (College Board, 2015), yet remain underrepresented in the STEM fields of study (National Academy of the Sciences, 2010).

The student in this case was selected from among five African American women in a prior study that examined the first-year experiences of the women admitted into engineering programs at a PWI (Fuselier-Thompson, 2018). The findings revealed the vital role of the urban community and fictive kin (family, teachers, peers etc.) on their college access and choice of major. However, after the first year of the study in engineering, four of the five students departed from the field: Two left engineering to pursue an alternate field, two left the institution because of poor academic performance. This case study examines the events, decisions and social networks of the one remaining African American female engineering student.

REVIEW OF LITERATURE

Historical Context: Women and Minority Access to a PWI

It is important to recognize the historical significance of women and minorities attending predominantly white selective institutions previously unavailable to them because of their race and gender. From 1916-1970, more than 6.5 million African Americans, many of whom were ex-slaves, left the south for northern and western urban communities (Diouf & Dodson, 2004).

During this period, public education was evolving with political challenges to the education of ex-slaves (Anderson, 1988, p.25). Large landowners opposed universal education, in part because their crops (especially cotton) were dependent on low-cost laborers to do the field work previously performed by slaves. Nonetheless, public education was required in the south, but was met with a range of systems under Jim Crow laws to keep the races separate not only in terms of education, but also in social situations and public facilities. In the south, white teachers would not teach black children, so Black teachers taught larger numbers of students in less-resourced schools in Black communities (Anderson, 1988, p. 110),¹ reflecting the separate but equal laws. The US Supreme Court decision in *Brown v. Board of Education* (1954) declared separate but equal in public education was unconstitutional and structured integration began in most parts of this country in K-12 education. After the Brown decision, busing students to segregated schools and residential redistricting was done in an effort to create purposeful integration.

Characteristics of Student Success in Segregated Black Schools

¹ The practice of Black teachers teaching Black students was reminiscent of the slaves and ex slaves who taught their communities to read and write.

Siddle Walker (1996) and other researchers (Davis, 2018; Edwards, Royster & Bates, 1979) identified the four pillars of educational success for working with black students: 1) proficient and professional educators with a commitment to ensuring that the children received educational opportunities; 2) extra-curricular activities that provided opportunities for the black students to become proficient in music, sports or other areas to enhance their professional growth; 3) parental support of the school and involvement in their children's academic progress; and 4) visionary leadership to manage the everyday academic, social, and economic growth of the educational environment. Siddle Walker's (1993) research provided strategies to meet the needs of Black children prior to desegregation, which created court-mandated integration plans across the country. Caring for their students and their aspirations was a recurrent theme that resonated with the black educators of black children. These teachers typically lived in the same community as the students they taught. In other districts, however, black students were bused to school to comply with integration; these students had a different educational experience with little or no connection to their communities.²

Since the Brown case did not address higher education admissions specifically, Blacks and women were not allowed to attend many public institutions of higher learning. Blacks who aspired to attain a college degree had few options prior to the passage of Civil Rights legislation. Historically Black Colleges and Universities (HBCU) started developing in the mid 1800's to provide higher education opportunities for Blacks. The passage of the Civil Rights Act of 1964 made it unlawful for public institutions to discriminate on the basis of race, religion or gender,

² The historical origins of PWIs are also important. In the same way that blacks were bused out of their communities and neighborhoods to attend a school in another community, many black students are now recruited out of their neighborhoods and communities into Predominantly White campuses.

creating opportunities for minorities and women to gain access to some of the all-white, all-male public institutions in this country. Affirmative Action laws came later in the late 1960's and early 1970's, also creating increased opportunities for access in higher education for minorities and women, including financial aid incentives in the form of grants.

Over the past few decades, predominantly white institutions have not kept pace with the need to recruit and retain more diverse engineering students (ASEE, 2011). Despite minority women's increasing number of college degrees, both minorities and women remain disproportionately underrepresented among engineering degree recipients (NSF, 2010). As the country approaches 2020 when the minority population is expected to become the majority, changes in recruitment policies and practices are needed to meet the changing needs of the technology-based economy. While some minority women leave high school planning to begin their collegiate studies in science, technology, engineering or mathematics (STEM) fields, many do not transition into college (Castleman & Page, 2014) or leave the field after their first year (Hurtado et al, 2007). While institutions have become more diverse, the endemic racial practices found in American society permeate the policies and practices of postsecondary education. Minority women continue to face campus microaggressions and discrimination in perceptions of incompetency in the classroom, workplace, and academe. The attrition of minority women in STEM field and the loss of their talent has implications for our country's domestic technological advancement and global competitiveness. Attracting and retaining diverse talent in STEM fields should become a national priority.

Institutional Context

Kcalb University, the site of the study, is a large diverse public university classified as a Research 1 by the Carnegie ratings (2015) as an institution with a high level of research activity.

African American females are one of the least represented minority groups nationally in the field of engineering (NSF, 2008), including in Kcalb's College of Engineering. Kcalb is a Predominantly White Institution (PWI), with more than 50% of the student body identifying as White. There are more than 30,000 undergraduate students enrolled at this institution; 7,000 students were first time freshman in 2009 when the study was initiated. In the College of Engineering (COE), African American students compromise 6.8% of the student body and approximately 2% of the admitted first year students self-identified as African American in the year of the study.

STUDY OVERVIEW

Methodology: Case Study Research

The study is a qualitative inquiry that provides a plethora of information including observations, interactions, documents, and ‘petite generalizations’ (Stakes, 1995) that are used separately and collectively to describe the case (Appendix A). The primary reason a successful African American female engineering student was chosen to be ‘the case’ was what could be learned from the intrinsic and extrinsic information gained from such an inquiry. The case study method (Stakes, 1995). provides the opportunity to include ‘verbatim’ dialogue and/or text, which can provide a unique or cultural perception of situations or ‘petite cases’, or events that occur that are memorable to the study participants which provides interpretive value (Appendix B). Solorzano and colleagues (2002a) refer to cultural interpretation as the counter-narrative, a culturally specific understanding that may be silenced when using a monolithic or quantitative method of inquiry. This case examines the perceptions of a female minority student in a field of study in which females and minorities have been historically underrepresented. In addition, the student attends a university that is predominantly White and a contextual understanding of her

environment is important in interpreting her experiences (Stake, 1995). Verbatim narratives from a prior qualitative study of five African American women (Fuselier-Thompson, 2018), that included the student in this study, have been included in this paper to closely examine her experiences and similarities with the other women (Clandinin & Connelly, 2000).

The case study provides a flexible and fluid method for understanding this student's experiences within the racialized context of the PWI (Stake, 1995; Yin, 2014). The case examines her interactions during academic preparation, in transition to college and her formative years in college. Is race an important factor in her academic preparation and educational trajectory? What impact was the context of her learning environment in high school preparation, her desire to choose engineering as her major and to remain in this field of study despite few women and minority students? The networks (e.g., programs, services and people) with whom this student engaged during her academic preparation are of particular concern.

Case study research involves an experiential understanding and interpretation, relying heavily on the subjective judgement and understanding of the researcher as he/she interprets the information obtained. This type of research is particularly useful when observing human behavior and includes narrative, verbatim quotes, illustrations, and vignettes that allow the researcher to illuminate specific aspects of the case (Stake, 1995). The detailed and personalized attributes of the case study are what appeal to me and make this method of inquiry appropriate for this study. My experiences as a first-generation female minority student attending a large, highly-selective public institution will likely provide cultural sensitivity in the interpretation and understanding of the observations and interviews (Hood et al, 2005). I have tried to remain neutral in my interpretations of this data, as an observer. In order to validate interpretations, I have used vignettes and direct quotations throughout the study, while conducting periodic

member checks with the student (Creswell, 2013) over time, to triangulate my interpretations and observations as accurate (Stake, 1995; Patton, 1990).

My approach to this case study was holistic. I conducted interviews with the student who is the focus of this case study and with others identified by the student, including minority and non-minority engineering students, the student's mother, and university administrators; I also relied on campus observations. In the interviews, some by phone and others conducted face to face, the researcher used a structured interview with open-ended questions to gain insight into the college and campus contexts, while focusing on the research questions. The interviews were professionally transcribed, examined for recurrent themes, and evaluated for issues to explore in greater depth by identifying patterns from the other informative interviewees (Stake, 1995). The follow-up email and telephone interactions provided clarification and a deeper understanding of the intricacies of the contextual environment and the issues being examined. In addition, non-participant observations were made in common study areas and the department of engineering to enhance the understanding of the researcher.

The narratives and 'petite cases' for the single respondent were placed in chronological order based on the timing of these events, dialogues, or program participation in an effort to understand the timing of the effects of the social networks, the duration of relationships, and the importance the student places on an interaction for her college access and transition to the PWI. The data were stored for analysis using NVivo technology. The student was asked to identify informants from four primary groups under study: 1) Family and friends; 2) Peers, both high school and college; 3) Institutional staff, teachers, counselors, professors etc. 4) Others (See Appendices A & B). Verbatim narratives from study participants in a pilot study of five African American engineering students were also included in the verbatim data for case comparison of

other 'lived experiences' on the PWI by African American women in engineering (Schwandt & Burgon, 2006). The timeframe under examination includes high school years through college graduation and first year of employment.

The researcher sent draft documents to the student for her review and to ensure the accuracy of interpretations and provide consistency in the triangulation of data (Creswell, 2013; Stake, 1995; Patton, 1990). Other documents examined included national and institutional data and the College of Engineering's recruitment and retention materials for women and minorities. Non-participant observations in the CoE were also included to gain a deeper understanding of the environmental context in which the student interacts, including the group study areas, the department, the college, and the overall campus; they also allow for a multi-source triangulation of data sources (Denzin & Lincoln, 2000).

Theoretical Framework

'Institutional Fit' and the Persistence of Minority Women

In this study, the researcher utilizes a psychosocial model designed by Emile Durkheim (1951) and later adapted to be used as a theoretical framework to determine college attrition. Durkheim theorized that the individual and social structure must 'fit' through a series of interactions; failure to 'fit' was compared to social suicide or attrition. Tinto's persistence model (1975, 1993) is based on Durkheim's (1951) classical analysis of the psychosocial factors attributing to a psychiatric patient's social resistance to societal norms resulting in suicide. This psychosocial model of behavioral integration was later applied to student attrition by Tinto (Tinto, 1975; 1993; 2012) and others (Pascarella & Terenzini, 1980; Pascarella, Seifert & Whitt, 2008).

Vincent Tinto's (1993) progressive model of postsecondary persistence is used as a theoretical framework for this study as a way to understand academic progress and the factors contributing to success, as it relates to progress towards degree attainment. As students enter the university environment, Tinto theorizes that each assumes a level of social and academic integration which determines their propensity to persist towards degree completion or drop out. A student's engagement is characterized by their participation in institutionally sponsored activities and interactions with faculty, peers and others on campus or associated with the institution (Pascarella & Terenzini, 1980). Engagement is measured by examining how and in what kind of activities the student becomes involved to enhance his or her social and academic experience (Pascarella & Terenzini, 1980).

Although, Emile Durkeim (1951) modeled the individual and social structure as needing to 'fit' through a series of interactions, the failure to 'fit' was compared to social suicide or attrition. Tinto's earlier model (1977) of 'academic and institutional assimilation' places the responsibility on the student to 'fit into' the culture of the institution without compensating for individual differences in a diverse student body. Although Tinto subsequently focused on individual intellectual and social integration as a precursor for academic persistence (1975), a more recent model (Tinto, 2012) examines institutional characteristics insofar as they relate to cultural integration, academic engagement and the types of institutional support services provided to 'create the conditions for student success'. Tinto equates a level of social and academic integration with a student's increased probability for degree attainment, but in the case of minority students, psycho-social integration may equate to assimilating to the dominant White middle-class culture in order to succeed academically.

Tinto's model accounts for changing majors and student departure, identifying four major components: 1) a student's *self-expectations* for academic success, 2) the *institutional support* that responds to the needs of the student; 3) *campus integration* or the student's level of engagement with on-campus social and academic activities; and 4) the *institutional context* or the conditions at the university that support student success. Tinto's work is pertinent to this study because it examines academic persistence and the intrinsic and external factors influencing that influence it. Each of these factors is important for understanding the influence of family, school and community on this study's female student's academic performance at a PWI.

Tinto's earlier model of student persistence did not account for the changing college demographics nor consider the increased diversity on college campuses (Gurin, Lehman, Lewis, Cantor & Coleman, 2004; Astin, 1993) or the influence of race and power structures (Bowen & Bok, 2000). In the mid to late 1970's when Tinto's model was introduced, college campuses in the US were undergoing a dramatic change in response to Civil Rights and Affirmative Action legislation (The Civil Rights Act of 1964 Pub.L. 88-352, 78 Stat. 241, July 2, 1964), which had earlier made it unlawful to deny educational opportunities based on race (*Brown v. Board of Education*, 1954). In response, predominantly white institutions were admitting unprecedented numbers of minority students. During this same period, the passage of the Higher Education Act of 1965 was intended by policymakers to increase economic opportunity and social equity for women, minority, and low-income students to attend four-year institutions (Congressional Record, 1965). With the increased access and the creation of 'need based aid' programs (Heller, 2002; Gladieux & Wolanin, 1976), women and minorities began to change the demographic of predominantly white institutions.

The unique experiences of African American women are not accounted for in Tinto's earlier model of persistence (1977). Inherently, African American women 'do not fit' into a predominantly white institution or the inherent power structure that replicates white privilege. In addition, much of the research has marginalized African American women, characterizing their postsecondary experiences as either the "Black Experience" grouping them with African American males or the 'Female Experience' grouping them with white women (Hull, Scott & Smith, 1982). The Tinto model does not accommodate the intersectionality of race and gender and the multiple contexts that shape and influence an African American female's experience in engineering and her multiple characteristics (Black, female and engineering student).

Still further, absent from the Tinto model and subsequent discussion of student departure is accounting for the differences in students' experiences according to their cultural orientation and gender, especially as it relates to African American Women. Tinto's more contemporary model of persistence and student departure (2012) adds 'institutional responsibility' to provide the conditions that support student success (p. 115). Given the increased diversity of college campuses over the last two decades and the lack of diversity in race and gender in engineering fields, additional challenges of institutional assimilation may exist for non-majority students attending a PWI. In this case study, the intersectionality of race, gender and field of study may create a challenge for many minority students trying to assimilate into the campus culture, a predictor for Tinto's model of academic persistence.

Subsequent studies have confirmed the importance of Tinto's theory of first year social and academic integration as a critical year for all students, having a significant and continuing impact on academic performance (Terenzini & Wright, 1987). For engineering students, prior

math and science preparation is especially important and has been identified as strong indicators of academic success in postsecondary education.

Factors Contributing to Persistence

The leading debates about why minority women are underrepresented in engineering centers on four major factors: 1) Individual, 2) K-12 education, and 3) Institutional policies or practices.

Individual factors include self-perception and attitudes. One potential barrier to minority girls participating in K-12 math and science revolves around their attitudes and perceptions cultivated in a negative context in their school, community, and/or home (Clewell & Anderson, 1991). Personal theories of success or expectancy-value concepts have shown to influence adolescents' behavioral choices and career interests (Atkinson, 1964; Edwards, 1954).

Expectancy-value theory is one of the major motivation frameworks developed to explain student's gendered choices and achievement in relation to math-related careers (Eccles, 1994). In the model, Eccles shows that individuals select activities based on a perceived belief of their probability of mastering them and the value they attribute to them. She relates the probability of mastering activities to self-concept of abilities, perception of task difficulty and task value, historical events, past experiences, and cultural factors. The value attributed to activities is influenced by four factors: *interest value*--the enjoyment individual derives from participating in the activity; *utility value*--the instrumental value the activity has in helping an individual achieve short- or long-term goals; *attainment value*--the link between the task and personal identity; and *cost*--the tradeoff between participating in the activity or selecting a different one. Eccles also argues that the socialization process (e.g., gender or ethnic roles) influences each of these task values (1993, 1994), consistent with other researchers (Wigfield & Eccles, 1992, 2000). All

individual factors are shaped by experiences, cultural norms, and the behaviors and goals of one's parents, teachers, role models and peers. Cognitive gender differences such as quantitative ability have been used as explanations for the underrepresentation of women in the engineering fields, but the effects have been almost negligible (Hill, Corbett, & St. Rose, 2010). Other individual factors used to explain the departure of minority women from science and engineering fields include stereotypes about gender roles and overt or subtle messages that signal that these fields are dominated by boys and men (Hill, Corbett, & St. Rose, 2010). When girls and women face barriers because of their gender, a perceived *glass ceiling*, they are more likely to *leak out* of the STEM pipeline prior to baccalaureate degree completion (Seymour & Hewitt, 1997). Additionally, perceptions about the utility of math and science in everyday experiences, self-confidence, and self-concept all influence whether or not minority women continue to pursue science or math. Those female students who believe math or science is less valuable or not relevant in their everyday lives are more likely to leave engineering fields (Clewell & Ginorio, 1996).

K-12 school factors account for the departure of some minority women from STEM fields. These factors may include male and majority representations in textbooks of what a 'scientist' or 'engineer' looks like, the lack of peer participation in science and math, and teachers' encouragement or discouragement to pursue STEM majors (Clewell & Anderson, 1991; Clewell & Ginorio, 1996; Hill, Corbett, & St. Rose, 2010). The 'leaky pipeline' is another school factor, which "suggests that girls and boys of all races begin school curious about the world around them—eager and ready to learn about science" (Johnson, 2006, p. 136). However, girls and women become disengaged through negative messages about science and math and thus 'leak out' of the STEM pipeline in K-20 schools and careers (Blickenstaff, 2005). In the US,

many young minority girls leave the math and science pipeline early and the departure increases during middle school (Oakes, 1990). Many minority students lack access to challenging math and science courses in high school, while others are discouraged from taking such courses (NSF-NSB, 2006). Limited access to honors and advanced placement (AP) math and science courses, particularly in predominantly minority serving schools, also contributes (Ndura, Robinson & Ochs, 2003). In high school, minority girls are less likely to enroll in advanced science and math classes overall (Ceglie, 2009; Espinosa, 2011), with many having the perception that honor and AP courses are ‘for white kids only’ (Kerr, 2014). Appropriate math and science preparation in K-12 is fundamental to academic success in technical and engineering fields of study. However, the low representation of minorities and women in foundational K-12 science and math preparatory classes (Chikkatur, 2012; Carlone & Johnson, 2007) presents considerable challenges for pursuing engineering as a college major or career path (National Science Foundation, 2013). The limited curriculum choices along the educational continuum in many minority communities all but preclude engineering or other STEM fields as viable major choices in college.

Institutional factors. Educational research suggests that *environmental factors* such as the science culture (e.g., teaching, pedagogy) may account for fewer women of color pursuing degrees or careers in STEM fields (CITES). In college, minority women may feel discouraged to participate in science majors due to the large lecture classes taught by professors at large institutions, many of whom are unavailable to assist students with the curriculum (Espinosa, 2011; Johnson, 2007). Many science classes encourage team learning, but minority women often feel isolated in their first-year science courses, usually considered ‘gateway courses’ to pursuing STEM majors in college (Hurtado, Cabrera, Lin, Arellano and Espinosa, 2007). Gendered racial

micro-aggressions³ that occur in the mostly male science and math courses also contribute to fewer minority women in science classrooms (Espinosa, 2011; Sonowski, 2002). As a result of chilly departmental and non-supportive institutional climates, fewer women of color may engage in STEM majors. Given all this, it is understandable that fewer African American women and Latinas earned bachelors' degrees and advanced degrees, especially doctorates in STEM fields, compared to their white female counterparts (Bowen et al., 2009; Ong, 2005; Ong et al., 2011).

Contemporary research shows that minority women face discrimination inside and outside college science classrooms due to their race and/or gender, which may further compound the challenge of fostering close social relationships (Carlone & Johnson, 2007; Ceglie, 2009; Marlone & Barbino, 2008; Ong, 2005; Ong, Wright, Espinosa, & Orfield, 2011). Contemporary research suggests that minority women are likely to leave STEM majors due, in part, to the lack of mentorship and not developing a STEM 'identity,' which is usually tied to close research and social relationships, especially with faculty members (Carlone & Johnson, 2007; Johnson, 2006; Ong, 2005); those who remain are able to overcome these barriers (Hurtado et al., 2007). Thus, there is a glass ceiling that must be shattered⁴ by women of color as they pursue undergraduate degrees in the engineering fields.

Understanding the experiences of minority students in their own words and the informal networks and resources on which they rely to access college and engineering specifically, is

³ Micro-aggressions are "brief and commonplace daily verbal, behavioral, and environmental indignities, whether intentional or unintentional, that communicate hostile, derogatory, or negative racial, gender, sexual orientation, and religious slights and insults to the target person or group (Sue, 2010, p. 5). Micro-aggressions can be based on race, class, or gender.

⁴ To shatter the glass means removing obstacles women face while advancing into leadership positions (Cech & Blair-Loy, 2010; Marina & Fonteneau, 2012). In this article, we expand the definition of glass ceiling to include the roadblocks minority women face while pursuing STEM degrees.

important information for practitioners responsible for preparing students for STEM fields of study and developing programs to support minority women in their trajectory towards degree completion. While much of the research has focused on public school failures in the academic preparation of minority women for STEM (Waxman, Gray & Padron, 2003), it is important to understand the experiences of the few minority female students who persist towards an engineering degree (Waxman, Gray & Padron, 2004; Chau, Thampi & Wight, 2010). It is important to understand why some students succeed, despite difficult circumstances, while others fail; that is the goal of this study.

Cultural Capital in Urban Communities for College Access

Cultural Capital Theory provides a framework for the way in which information passes through family and subsequently defines college access and class status (Bourdieu & Passeron, 1977). It is the interconnectedness of the family, individual and group networks that supports educational access, especially as they provide information that promotes postsecondary success.

Cultural capital takes many forms besides sharing of information, including imparting cultural norms and social networks (Coleman, 1988; Hossler et al, 1999). The cultural capital theory facilitates an understanding of the ways in which informal networks, parents, and others influence college going behavior (Gandara & Bial, 2001), academic achievement through cultural wealth (Tierney & Auerbach, 2005), and choice of major (St. John, McKinney, & Tuttle, 2007).

This qualitative case study provides a detailed understanding and gives ‘voice’ and legitimacy to the lived experiences of an African American female engineering student and provides critical understanding about the experiential knowledge of women and racial perceptions in education (Solorzano & Tasso, 2002b). The level of detail provided by the

qualitative approach to the social and cultural experiences and the subtle nuances of race provides us with a better understanding of multiple identities (Tan & Calabrese Barton, 2006, 2008), as this African American female student transcends the educational continuum.

Benefits of Diversifying Engineering

The benefits of learning in a diverse environment with positive opportunities for interaction have proved beneficial for both whites and students of color (Gurin et al, 2002) In Gurin's study of undergraduate students at a selective public research institution, the benefits of a diverse student environment are identified, suggesting that direct peer interaction among racially and ethnically diverse students provides a benefit in student learning outcomes and cultural sensitivity to both minority and majority students.

The Case

This case study of one African American female engineering student currently enrolled in a selective public research institution examines how she perceives the relationships that exist among herself, her high school, her college, and her community. A special focus is placed on the context of her environments, both perceived and factual as determined through examination of institutional data and research, as she transitions and navigates each setting. The case provides information and raises a variety of questions on modes of learning and the importance of socialization as it examines the successful academic trajectory of this particular African American engineering student. The information from this case study will provide a detailed account of the student's academic experiences and useful information for academic learning strategies that support the development of pipeline programs in technical fields of study and institutional diversity initiatives and/or policies.

Purpose of the Study and Research Questions

In this study the lived academic experiences of one female African American undergraduate engineering student attending a highly selective predominantly white public institution are examined. A case study approach is used to locate the formal and informal processes within the student's social/cultural networks that contribute to her higher education access, choice of major, and educational experiences in a highly-selective technical field of study. The overall goal of the study is to gain an understanding of the experiences of this African American woman and understand the role of the urban community (family, school and church) in her college pathway. The study will address two key research questions:

1. How does an African American girl from an urban community overcome challenging circumstances to succeed in school? What experiences does she report as creating opportunities for college access at a selective predominantly white institution (PWI)?
2. What experiences does the respondent report that help explain her choice of major in engineering (e.g., the role of family, school and their urban community)?

This case study will add subtle nuances and particularities to the larger debates involving diversity initiatives, race, and academic engagement in higher education. The study will provide researchers and practitioners spanning the educational continuum with a deeper understanding of this student's experiences in pursuit of an engineering degree and the role of her social and cultural networks as they relate to her pre-college preparation, college access, choice of major, and persistence towards degree attainment.

Recruitment

The undergraduate engineering student who is the focus of this case study is one of a group of participants from a larger qualitative study (Fuselier-Thompson, 2018) examining the

first year experiences of female African American engineering students at the same institution . The student was originally recruited into the sample by contacting administrators of programs that provide services to underrepresented minority undergraduate students planning to major in a Science, Technology, Engineering and Mathematics (STEM) field. Administrators were provided information about the Study and asked to forward the informational email to recruit students who: 1) were currently enrolled and majoring in a science, technology, engineering or mathematics field of study; 2) self-identified as a member of an ethnic minority group; and 3) were willing to participate in a 1-2 hour audio taped interview that examined their experiences at this Predominantly White Institution (PWI). Six engineering students responded to the request, and all but one were interviewed for the qualitative study. Each student completed an Adult Consent to Participate in the study in 2009.

Minorities and women are significantly underrepresented in the field of engineering and in this College of Engineering. Each student reported they attended high school in an urban community or close to a large metropolitan city. The goal of the prior study was to better understand the perceptions and experiences of non-majority students, specifically female, African American engineering students to gain more knowledge about the students' experiences so that researchers and practitioners could develop policies that encourage and support the engagement, recruitment, and retention of more African American women (and other minority groups) into the field of engineering. By doing so, institutions can support the degree attainment of a more diverse student population in engineering and ultimately into the workforce.

Due to the small numbers of engineering students in the College of Engineering, additional measures were taken to safeguard the identity of the minority students, including conducting follow-up student interviews and discussions at campus locations external to the

College of Engineering. Interviews were audio taped, professionally transcribed and all identifying information associated with the respondents was masked using codes and pseudonyms. Study participants were assured that no identifying data would be used in publications associated with the study. In addition, the real names of people and places were changed to pseudonyms to make identification more difficult. All students, staff, and faculty interviewed were legal adults. All participants in this study were assured that their decision whether to participate would not in any way affect their status either in the engineering department or at the university.

Data Collection

Data collection for this study was initially conducted in the 2008-09 academic year. The pilot study included in-depth face to face interviews of first-year, undergraduate African American women planning to major in an engineering field of study. The semi-structured interviews lasted two hours on average to allow participants time to reflect in detail on their college experiences and obtain verbatim narratives on their experiences in their chosen major (LeCompte, M. D., & Preissle, J., 1993; Shweder, R. A. 1996). After the interviews, participants were asked to complete an electronic demographic questionnaire (e.g., name, age, type and location of high school, and influential resources) and provided the opportunity for more in-depth reflection in one of three areas 1) academic preparation for engineering; 2) family, school or community influences on college; or 3) overcoming a specific challenge in college (See Appendix B). Both the interviews and participant questionnaires explored experiences the participants identified as meaningful to them in their college-going process. The self-report questionnaire provided clarification and validity (Creswell & Plano Clark, 2007) as well as additional detailed accounts from the students. Among the five women in the study, only one

student remained in engineering after the first year and IRB approval was obtained for her to remain in the study. She agreed to ‘episodic interviews’ for the next four years, 2009-2013. These interviews were conducted by phone or face-to-face and included additional individuals the student identified in her network (e.g., parent, administrators, teachers); review of documents at the college and the university and on campus observations by the researcher were also undertaken. Data from the prior study (Fuselier-Thompson, 2018) were used to compare and contrast the individual experiences of the student who is the focus of this case study.

Minimizing Bias and Researcher Involvement

Using a journal, multiple steps were taken to minimize insider and outsider statuses on the research process (Jones, Torres & Armino, 2006). I began this process by reflecting on my higher education minority recruitment experiences that led me to this study, and my relationships with the study participants as a student and female of color on a predominantly white campus. Prior to each interview, 1) I acknowledged my insider identity to build trust and provide a space for open dialogue; 2) shared my desire to bridge research and practice; 3) shared my commitment to honor their ‘authentic self’ through first person narratives; and 4) offered the opportunity for each participant to review and check my transcribed drafts of their interviews (Creswell, 2007).

Findings and Interpretations

High School Academic Preparation for Engineering

Shana, an African American female high school student who aspires to be an engineer describes her high school demographics:

“The high school...um...it was on the south side of Chicago. It was predominantly Black, maybe a handful of White and Hispanic students...it really wasn't any Asian people”.

Despite her ideas about being adequately prepared academically for college, she acknowledges the difficulties her high school peers faced in the transition to college.

“Researcher: Can you tell me a little about your high school?”

Student: No, it was um...it wasn't a vocational school but there was different requirements...so if you were college-bound you would take additional requirements of English and math.

Researcher: So out of the seniors that graduated, how many would you say went on to college?

Student: Umm...I would say about half, but I would say that not all of them are in school now after their first semester...they're back at home.”

According to Shana, her predominantly minority, urban high school graduates students at a higher rate than most of the nation's minority-serving high schools. Extracurricular activities had a significant role in Shana's high school years and she credits these activities with providing her an outlet to ‘come out of her shell and learn how to relate to people.’ Shana describes her participation in

...volleyball, basketball, track, tennis and key club, a volunteer organization and we do a lot of stuff, volunteer at soup kitchens, clothes drives and stuff like that...oh and then there's BPA (Black Professionals of America)...um I was a student mentor, a student council...ambassador, we would take people around that are new to our school you know...[BPA] is kinda like a weekend retreat when like, it's something about

diversity...it's like taking you outside of your comfort circle, so you get to know people in other years [attending her high school] and other areas or parts that go to your school that you don't know."

Saving it for the last extracurricular activity to discuss, Shana became exuberant about her participation in the *Math Olympiad*, a voluntary math competition at her high school that arranged in monthly competitions similar to the athletic competitions.

"[Math Olympiad]...is hmm...you can choose to be in it...it's a group of 8-12 students and if you like math and you want to compete with other neighboring schools..it's like basketball games and stuff ...you go once a month and you go in the evenings and you compete and do math problems either in groups or individually or like orally..."

It was Shana's love of math and competition that influenced her to begin exploring college as an option and engineering as a major and appears have been an intrinsic motivator to enhance her learning of the subject and achieve academic success.

The High School/College Transition

Brown vs. Board of Education was extended to colleges and universities in 1964 as part of Title VI of the Civil Rights Act prohibiting institutions of higher learning from receiving federal funds if discriminatory policies or practices were present. Yet, fifty years later, PWI remain predominantly white. Harper (2006) in his analysis of US Department of Education data illustrated that African American males made up only 4.3% of all students enrolled in US Higher education in 2002, the same as in 1976. In response to low college graduation rates among minority students, many selective public research institutions developed transition programs or summer bridge programs to provide remedial services to newly admitted minority students in an

effort to increase retention rates among college students considered at risk (Trent, 1975). From an interview with the respondent:

“Researcher: Did you participate in a summer bridge program?

Student: Yes, I did the Summer Eng Program (SEP)...we were kind of like the guinea pig group cause they had this program...um it was called Bridge ordinarily but I guess they wanted to start an engineering version and the point was to take some of the admitted minority students from like...underprivileged areas or like low income areas so they could try and catch them up because of what they probably didn't learn in high school because you know some high schools are more rigorous than others when it comes to academics...

And I actually appreciated that ...cause when we got here, you know, everyone comes here being at the top of their high school and my high school is not like the same as like a Washington Tucker or a big high school in the city...so I realize that I am kinda behind”.

Shana seemed to be familiar with research on minority females in engineering. She readily acknowledged her need to overcome challenges from her high school academic preparation and developed a plan to address areas in which she felt deficient. Shana's academic challenges were all too familiar to many minority students transitioning from predominantly minority serving urban high schools to predominantly white selective public institutions.

“The fact is that fifty years later many of the social political and economic problems that the legally trained social engineers thought the Court had addressed through *Brown* are still deeply embedded in our society. Not only in K-12, but also in postsecondary education, Blacks lag behind Whites in multiple measures of educational achievement ...” (Guinier, 2004).

Shana's was different from her peers. While the other minority students interviewed discussed being overwhelmed with the academic gap between themselves and majority students, Shana chose to accept her academic gap as a challenge.

Yeah...when I got to class and the physics professor said what does a ----- graph look like? And everyone is doing like this (showed me a type of graph using her hands) and I was like what? So that made me go home and do a lot of studying.

Since engineering students have advanced-level math and science prerequisites for college admission, the researcher inquired how many Advanced Placement (AP) courses Shana had completed during high school. She seemed almost embarrassed when the topic of AP courses became a topic of inquiry. Her body language was closed [crossing her arms and pausing before her response], and for the first time in our interview she did not make eye contact.

AP..I think I took...I didn't take any AP courses actually, um...we only had I think an AP history class...I didn't like history and didn't plan on majoring in that...

It was clear Shana understood the significance of AP courses, since many engineering students entered college with AP credit for several advanced level courses. The interviewees in the earlier study also understood the significance of such classes, but only one had taken AP courses at school.

College Expectations

Racial disparities in postsecondary educational access and degree attainment have a history that spans many decades in the US. Critical Race Theory (CRT) provides a contextual framework for understanding historical educational inequities in a way that sheds light on societal differences by race and their impact on educational access and achievement (Lynn & Parker, 2006). The articulated goal of the pivotal *Brown v. Board of Education* case was to make

education the great equalizer among the races, to provide equal access to education and improve social and economic conditions in the Black community. The decision was intended to desegregate K-12 education and improve on the social and educational inequities between Whites and Blacks. Through greater educational access, it was believed that Blacks could achieve greater opportunities for social and economic advancement. However more than fifty years later, the goals of the *Brown* decision remain unfulfilled (Bell, 2004), with the majority of students of color still in low performing schools compared to their white counterparts.

I wanted to observe engineering students working together on team assignments, which are frequently required in engineering fields. I asked the CoE where students studied. In this area, students were grouped by ethnicity and many spoke a foreign language. The groups were clearly closed to members outside of that ethnicity who did not speak the language. White male students were also observed together in what appeared to be homogeneous groups. After four trips to the same study location, mono-ethnic groups were observed in each instance. On one occasion, two African American male students were seen in an ethnically diverse group, and one white female visited an all male group but did not remain with the group for more than half an hour. The group continued to work after she left.

In 2008, a National Science Foundation study reported that 65,715 Engineering Bachelors Degrees were awarded in all fields of engineering to US Citizens and Permanent Residents. Whites accounted for 45,383 degrees awarded compared to 3,101 for African Americans in the same year (NSF, 2008). Through this case study, I hoped to gain an understanding of the successful trajectory of one student despite the statistical and historical odds against her success. I couldn't help but wonder about the benefits of the study groups I observed and the value of the information exchanged among the students. Why weren't these groups

ethnically diverse? Were the networks represented by these homogeneous groups formed prior to arrival at College? Is it possible for students of other ethnicities to permeate these ethnically-closed groups?

Peer Socialization

Shana describes overcoming shyness in high school and a common theme evident in her interactions was her perception that the activities removed her from her comfort zone. During her summer transition program, Shana describes team building activities at a camp located in a rural area some distance from campus. This experience was designed to engage students to work together and communicate toward common goals. Shana describes lifting her peers through a large spider web [figuratively] and “Yeah...and you know you have to communicate with people because you know you don’t want to get dropped (laughter).”

Similar to her high level of extracurricular involvement in high school, Shana was also very involved in activities once she was enrolled in the College of Engineering. “I am a tutor at the Minority Center and this year I am a mentor for the college of engineering for admitted freshman that come in the fall and what else, and oh, last year I went to Taiwan and Hong Kong last winter break in the International Program for engineers.” Shana has had a wide range of social networks beginning in high school and developing in more diverse ways in college, including her opportunity to study abroad. Her international opportunity broadened her social network. Her wide range of on-campus activities allowed her to obtain information from many sources including culturally diverse peers, institutional leadership, and industry professionals. This wide range and diverse set of social and cultural networks was distinct and different from other minority students interviewed. In fact, Shana was asked to design a program for incoming minority engineering students, which appeared to be based on the academic and career trajectory

she was following and information from her diverse and informative network. Shana describes being valued and perceived as a ‘good student’ in her study group, which is ethnically diverse and includes mostly Asian students and one other female.

Peer Support for Incoming Minority Engineer Students

By her second year of study, Shana was providing tutorial services in the Minority Student Activities (MSA) offices, where she had received services during her first year. She reports that learning ways to teach the material to different learners helped her in her own classes with the diverse teaching methods of her instructors.

I was able to meet some of Shana’s peers during an orientation for first-semester minority engineering students. Shana was a presenter along with other engineering students. The daylong event was completely organized by undergraduate students, many of whom identified as minority (which some noted during their presentation). Peer messages included a video about ‘Lose with Mr. Booze’ regarding the dangers alcohol when trying to keep up with your academic coursework. Students talked about their experiences having professors or teaching assistants (TAs) who spoke unintelligible English, creating challenges in the classroom. Students were encouraged to seek out professors they could understand, ask upper classmen for tutorial help, and get involved in engineering organizations to identify the ‘best courses to take’ and the instructors to avoid. Students were made aware of gender- and culturally-specific engineering organizations such as Society of Women Engineers (SWE), Women in Engineering (WIE), National Society of Black Engineers (NSBE), Society of Hispanic Professional Engineers (SHPE) as well as discipline-specific organizations including Society of Automotive Engineers (SAE) and the BAJA car design and race competitions. Shana was a member of SWE and NSBE, holding a position of leadership in both.

During the course of my observations, it was clear that these minority engineering students were providing vital information to the incoming students. Information being shared was a recurrent theme among the young women in the earlier study (Fuselier-Thompson, 2018) during their summer program attendance and into their first year. They learned information that could not be included in recruitment brochures or verbalized during the general orientation for all students. What was unique about *this* information? Was there something unique and specific about their experiences or did each class of minority students feel they had something unique or culturally-specific to add? I continued to listen and observe as the incoming students took copious notes. Students provided insight on the ‘best’ study locations based on their field of study and specific information about selecting a field of engineering. Some minority students who were completing their last year of study provided power point presentations on their design projects, the companies they chose to work for during the summer and also addressed questions on salary offers to give students an idea of their career opportunities. This event began at 8:30am in a lecture hall on campus with both groups (incoming and current students) thoroughly engaged in the discourse; a steady exchange of dialogue between students who were truly interested in each other’s academic success. While the upper-class students spoke with authority, there was a feeling of kinship with the entering students as they shared information that had contributed to their successful navigation of barriers in their respective engineering programs. Upper-class minority students acknowledged the dramatic difference between the classes offered at their high schools and their first-year college courses in engineering. It was not clear whether the students felt ill-prepared for the curriculum, but the contrast was repeated by presenters. What was clear from the warnings from upper-class students was that good grades in their first year required a great deal of work, studying and collaborating with others, despite

good grades in high school. This message was reinforced by each of the speakers, who encouraged taking advantage of study groups and support services. Upper-class students discouraged new students from relying on their high school performance as an indicator of their college engineering program success.

Building Social Capital for Academic Success

When asked to design her own program for incoming minority engineering students, Shana details an intricate design of social networks that includes family, students, staff and faculty.

...it would be a yearlong program and you would have to meet at least once a month with a mentor or upperclassman or buddy and they would check on your progress, like if you didn't have any one to talk to or you had any questions and you had someone to talk to if you were not real sure about something, and make sure they kept their grades up first semester...and keep them in the area [meaning the field of engineering].

Shana emphasized the importance of on-campus relationships with faculty and administrators.

...get them [incoming students] involved somehow with some of the professors and ...they should have some type of opportunity where they can research with professors like over the summer...actually that is what I am doing this summer. I will be researching down here [referring to this specific campus]. I think there should be some type of program that hooks them up with professors during the first year so that they begin thinking about it before it is too late. So they have

something to do that is related rather than going home and working in a random store.

Shana appeared to have a good understanding of the leadership hierarchy within the college and indicated she would have discipline-specific advising because she did not feel her adviser from another discipline or a non-engineer could provide quality advising on course selection. Additionally, she points out that

...the biggest thing in my program if I had to make one would be like leadership to make sure that they have a support system and resources for them to go to but I don't know how to make that happen but a mandatory 'get to know your Dean' and advisors but actually they are not as bad as people make them out to be. I actually have good relationships with the Dean in the college and the advisors.

In addition to campus relationships, Shana points out the importance of engaging in career exploration by developing industry interests early in a student's academic career.

"Also make sure they attend at least three, I'd say three corporate visits. 'Cause you know companies make visits here all the time, not just for NSBE meetings but in general...so just go, you know just to talk to them and see what they do, so you can know early if that's what you want to do and that would be my program."

Shana describes other relationships that influenced her decision to pursue engineering including her calculus teacher, who was an engineer and a mentor she met through her predominantly African American church. Shana maintains both her mentor relationship and periodically checks in with her Calculus teacher to update him on her progress and explore academic and career opportunities. Shana describes her parents having an expectation for her to

attend college due to her excellent academic progress as a high school student, but reports they were not influential in her decision to pursue engineering as a field of study.

DISCUSSION

Among the five African American women who began in the pilot study in 2009, one student remained in the field of engineering. Shana reported that her experiences with social and cultural networks in her community were vital to her college access and choosing engineering as a field of study. Shana's older siblings also had a role in emphasizing college attendance in their expectations for her after high school. Although Shana reports that her parents emphasized college preparation courses, it was her teacher, an engineer, who identified engineering as a field of study. Shana indicates that her teacher taught an upper level math class and would identify concepts needed to be successful in engineering. It was this teacher's expectation of her college pathway in engineering that led Shana to explore engineering as a major. She attended a PWI because it was identified as a 'good school' with selective and high-ranking engineering programs. Shana describes very fluid and purposeful social and cultural networks. For example, Shana identifies some of her 'home girls', slang for other African American women from her hometown, who she hangs out with or engages with in social activities both on and off campus. Shana was quick to deny studying with her home girls. Her primary study group includes all male Taiwanese students, a group she was invited to attend. Shana also participated in group projects with them. Shana was encouraged by her Taiwanese group members to complete an internship in Taiwan, so that she would graduate with global work experience. Shana applied and completed an internship in Taiwan after her second year in engineering. Shana remained part of this group for three years.

Shana has also interacted with members of the Society of Women Engineers (SWE) and the National Society of Black Engineers (NSBE), in which she became an officer. These groups afforded Shana the opportunity to meet other female engineering students and other minority students, locally and nationally, as well as discover career opportunities through NSBE-sponsored events, and she became acquainted with the Dean of the College of Engineering at her school and other administrators as a result of her leadership role in NSBE.

While Shana was expanding and diversifying social and cultural networks in college, she also maintained periodic contact with teachers at her high school who wanted to know how she was doing. Her family (siblings and mother) did ‘random’ checks, as she describes them throughout the school year just to see how she was doing. Shana’s social and cultural networks in her first year was remarkable in contrast to her peers in the study who had minimal institutional contacts. The case study data are consistent with Tinto's theory of ‘institutional fit.’ What is unique about Shana’s networks is that they include cultural networks from her urban community along with new ones created through SWE, NSBE, and on campus. Many African American women do not make it beyond the first year of engineering at a PWI, Shana shared with the researcher that the first year of study goes fast and by the end of the year, ‘I looked around and it was only me’, referring to the loss of the other African American women in engineering.

Limitations

Similar to all qualitative research, this study has limitations. The study took place at only one predominantly white institution and reflects the experiences of one African American female student. The findings are not generalizable across institutions or across or within ethnic groups given the significant variability that exists across students’ experiences in college and in

engineering. These findings represent the experiences in the unique educational trajectory of one African American woman, who utilized specific resources to persist towards her engineering degree.

Future Research

Future research studies with other minority groups are important to understand not only the role of their community in providing college access in engineering, but also the experiences of students who persist in engineering and those who depart. A deeper and more meaningful understanding of the needs of African American and other minority students during the high school to college transition from predominantly minority communities would provide useful information to support their success in higher education. The preparation for and admission into a highly selective engineering program is very competitive. For those African American women who are accepted into selective engineering programs at PWIs, it is imperative we understand their social, educational, and cultural needs and provide resources that reflect their cultural identity through the high school transition process and on through graduation. College access to a PWI is not enough. The social and cultural networks in each student's community that influence a student's college choice should be examined. Perhaps the answer is not in our institutions of higher learning, but in understanding urban communities of color and how they prepare their students for college. The researcher hopes the experiences of this student will invoke discussion and further research to understand the experiences of others, so that higher education practitioners can provide the kind of support services that helped her persist to degree attainment.

Limitations

Similar to all qualitative research, this study has limitations. The study took place in only one institution and reflects the experiences of one student in comparison to a small number of African American young women (N=5). In this and other qualitative research, the findings are not generalizable across institutions or across or within ethnic groups, given the significant variability that exists across students' experiences in college engineering. These findings represent the educational experiences in the unique educational trajectory of one African American woman, who utilized specific resources to persist towards her engineering degree.

Future Research

Future research studies would be important among other minority groups to understand not only the role of their community in providing college access in engineering, but also to understand the experiences of students who persist in engineering and those who depart. A deeper and more meaningful understanding of the needs of African American and other minority students during the high school to college transition from predominantly minority communities would provide useful information to support their success in higher education. The preparation for and admission into a highly selective engineering program is a highly competitive process. For those African American women, who are accepted into selective engineering programs at PWIs, it is imperative we understand their social, educational and cultural needs and provide resources that reflect their cultural identity through the high school transition process and through graduation. College access to a PWI is not enough, the social and cultural networks in each student's community that influenced the student's college milestone should be examined more often. Perhaps the answer is not in our institutions of higher learning but in gaining greater information from our urban communities of color that prepare minority women for college.

It is the researchers hope that the experiences of this student invoke discussion and further research to understand her experiences and others, so that higher education practitioners can provide the kind of support services that replicate her persistence towards degree attainment.

SUMMARY AND CONCLUSION

The goal of this research study is to gain an understanding of the unique first year experiences of five minority women in pursuit of engineering degrees at a Predominantly White Institution (PWI) and the contributions of their urban community to their college pathway. The three-essay dissertation examines two research questions specifically, 1) As African American girls in urban communities overcome challenging circumstances to succeed in math and science in high school, what experiences do they report as motivating them to pursue engineering at a selective predominantly white institution (PWI)? and 2) What is the role of family, school and community networks in gaining college access and their choice of major?

The three-essay dissertation addresses these questions by examining the academic trajectory and illuminating the first person narrative experiences of the African American women, all of whom attend the same PWI. The papers individually and collectively provide insight into the experiences of the five students, exploring issues of college access and choice of major and the role of their urban community. The first essay examines the pre-college and summer bridge experiences of the five students in preparation for their first year of study and the social and cultural influences from their urban community. A second essay focuses on the high school to college transition of the five students, and the challenges they face as they traverse two very different worlds, leaving predominantly minority communities to attend a PWI. The women identify challenges they experienced during this transition as they traverse multiple contexts. The focus of the third and final essay is a case study of the one student, who remained in engineering after the first year.

The historical context is important to understanding the educational trajectory of these young women. Specifically, as it relates the education of slaves, ex-slaves and education after the

decision in Brown (1954). Throughout these periods of time, for many Blacks education was considered their ticket to freedom. Blacks taught other blacks and without formal instruction on how to do so, methods on instruction were passed through the generations. With the outlawing of slavery large networks of blacks migrated from the southern rural communities to northern cities, seeking work and freedom. Even with the creation of the Freedman's Bureau to assist in educating ex-slaves, black community methods for teaching blacks was maintained in the northern urban cities. Although few opportunities existed in higher education, students continued to be educated by other blacks in the select few colleges and universities. So confident in the methods of instruction, a framework for the education of black students was provided by black educators as a roadmap, after the Brown decision (1954). The forced integration of schools sent many black students out of their communities and into white schools. The transition from black communities to all white schools during desegregation is similar to the transition experienced by the students in this study as they transition from their predominantly minority communities to a PWI.

The papers address the subtleties and complexities of race and gender in engineering fields of study, where minorities and women have been historically under-represented. Singularly and collectively, the three papers illuminate the experiences of five African American women who pursued engineering at this PWI in their own words. The findings suggest that these women relied heavily on the resources in their separate predominantly minority urban communities to gain access to college and to prepare for and identify engineering as a field of study. Course selection, extra-curricular activities and participation in the summer bridge program were purposefully planned by those in their social and cultural network or fictive kin, to compensate for under resourced schools and limited college access in their urban communities.

The social and cultural resources in their community, that support the students' academic ascension to college appears to contradict the prevailing research that urban communities cannot and do not prepare black students for college. In fact, the talent among these young women was not lost in the transition from high school to college because of the caring networks of family or fictive kin, teachers, church and community members who guided and mentored their pathway to college and engineering, specifically (Castleman & Page, 2014b). In addition, the findings suggest that the characteristics of teaching black students, recommended by black educators in the south before Brown (1954), are still found in urban minority communities. The four characteristics identified by Siddle Walker (1996) of school visionary leadership, caring teachers, strategic extracurricular activities and proficient teachers. Despite having attended under-resourced schools in the different urban communities, similar to the challenges of ex-slaves, school leadership made available many extracurricular activities that supported the academic development of the students in alternative ways. For example, participation in a 'mathathlete' or 'math olympiad' was considered prestigious in the urban schools and students were able to leave their community for math competitions in other more affluent communities. Also, another student had the experience of being a school ambassador, which provided her exposure to diverse visitors to her school and community, which she felt enhanced her communication skills and provided her skills "...to interact with anybody...you know even the big people [important visitors], who visited our school". These opportunities in and outside of their community provided these students with interactions, observations and information about skills needed for college.

The students had significant involvement with extracurricular activities in their urban communities, but few choices as it relates to Advanced Placement classes in their schools. But

the students were able to persevere and meet the unconditional admissions requirements for selective engineering programs at a PWI. However, the students relate a difficult transition for them from their predominantly minority communities to the predominantly white campus. While the summer bridge program appears to have buffered the transition with an introduction to the rigors of the academic expectations in engineering, provided mandatory tutoring and support services and culturally responsive leadership and mentorship (African American woman, who was also an engineer), many of the students expressed feelings of inadequacy. As a short-term support to a significant transition, it was not enough for four of the five students. While this summer program was designed to end at the start of the first year, many of these students were not engaged enough in the institution and had not yet developed that replacement fictive kin network from their urban community.

In the case study, the one student who remained in engineering and subsequently graduated had begun the development of social and cultural networks (Study groups with Taiwanese engineering students, social outings with other African American students, attending NSBE meetings) on campus but also had accountability and contact with members of her urban [home] community. When compared to the other women in the study, the student in the case study had amassed significantly more institutional contacts, which supports the research on institutional engagement (Tinto, 2012). However, Shana's networks were diverse and flexible and also helped her traverse her two worlds of the urban community and PWI as well as gain greater social capital within the institution. Shana, the student in the case study, participated in a summer program in Taiwan, at the urging of her Taiwanese peers to have a global experience and ran for a NSBE leadership role in her second year, encouraged by her African American

peers. She's confident that these roles helped support her personal and professional development, leading to other influential social and cultural networks.

However more research is needed to understand how institutions can support the transition of well prepared and high achieving minority students from urban communities into a PWI. More research should focus on the kind of peer to peer support and other social and academic integration programs that could be implemented beyond summer bridge to enhance and support the work already being done in predominantly minority urban communities. Given the fast pace of technology and the growing need of industry, we cannot afford as a country to lose any of these well-prepared STEM students and if the students don't 'fit' the institution, then it is incumbent that we prepare programs and policies to insure the institution meets the needs of an increasing diverse student population. The growing minority population in the US, the continuous trend of bachelors degrees among minority women, many of whom who meet the math and science requirements for a STEM discipline at the time of admission, creates the conditions for pursuing untapped resources and understanding how we can better meet their needs in college.

The findings are expected to guide future more expansive research and invoke discussion among practitioners in student and academic affairs about institutional interventions to support college diversity, student engagement and the retention of African American women in engineering.

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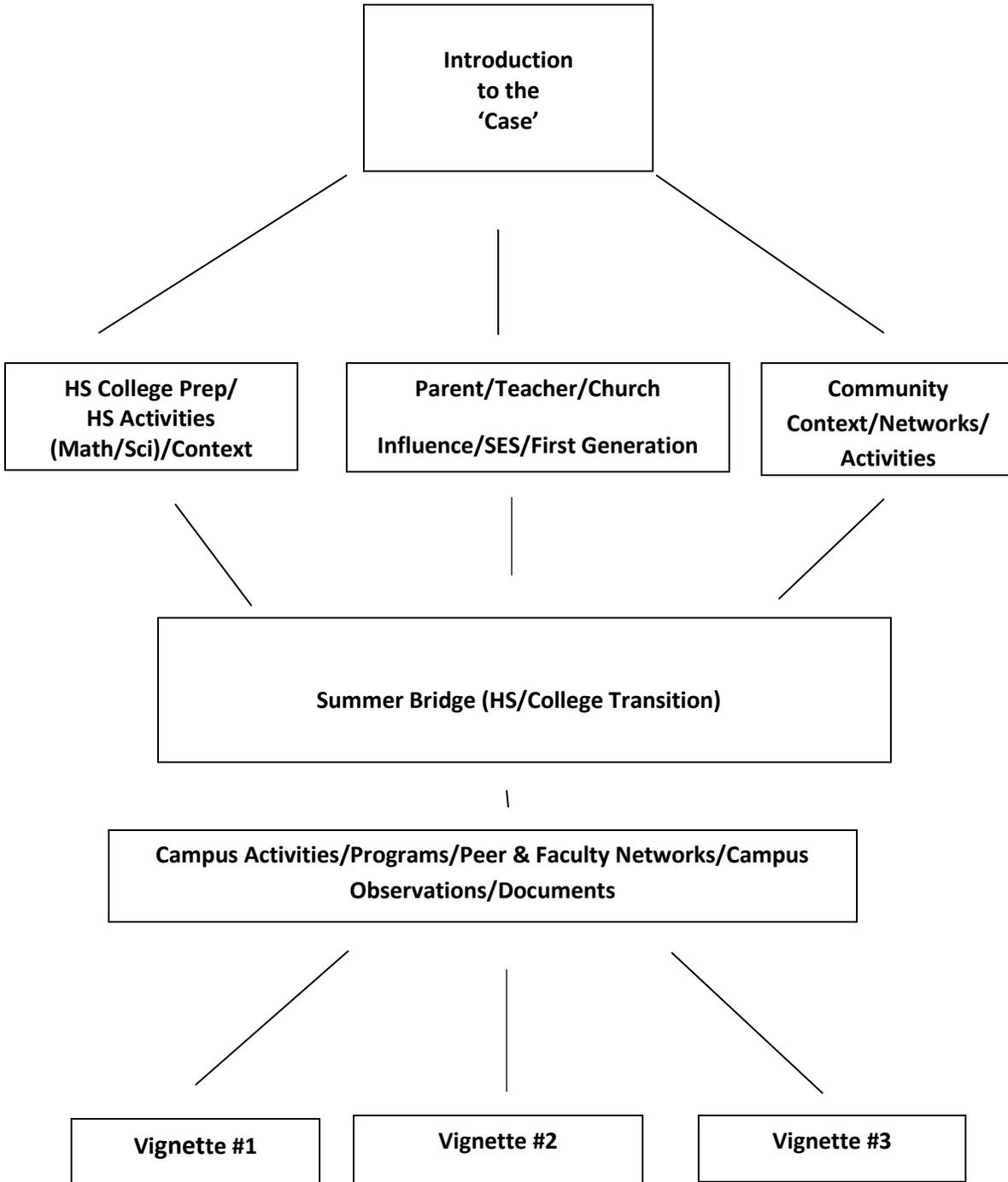
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APPENDIX A

Figure 2-Layout for the African American Engineering Student Case Study



APPENDIX B

Figure 3-Case Study Design of an African American Female Engineering Student

