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PATHWAYS TO FAST TRACKING AFRICAN AMERICAN

COMMUNITY COLLEGE

STUDENTS TO STEM CAREERS

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PATHWAYS TO FAST TRACKING AFRICAN AMERICAN
COMMUNITY COLLEGE
STUDENTS TO STEM CAREERS

by

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Dedication

This has been a long journey, with many hours, days, and months of intensive work. This study is especially dedicated to my husband, Gary Andra Jackson, daughters, Deja Jacqueline Jackson, Lola Blessing Jackson, and son Kavari Andra Jackson. This work is dedicated to my father, Stephen Douglass McGregor, Sr. who always told me I am more than a conqueror, and my mother, Jacqueline Wanda McGregor. It is also dedicated to my loved ones, those who have been with me step-by-step in the process and who never stopped giving me their support, time, and prayers. A special thank you goes to my brothers, Stephen Douglas McGregor, Jr., Corey Maurice McGregor, Timothy Preston McGregor, Tony Jackson, Aunt Mary Jane Bates, and sisters, LaTasha McGuire, Cynthia McGregor, April McGregor, Tracey Jackson, Terris Jackson, Monique English and parents Lola Mae Jackson and Charles English. Nieces, Jaquaznae Martin, Alexia Jackson, Anaya Owens, Ayana Owens, Jacqueline McGregor, Zamera Martin, Lela McGregor and Nephews Darcell Jackson, Stephen McGregor III, Charles McGregor, Exavier English, Isaiah Owens I love you all and you will always be in my heart.

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PATHWAYS TO FAST TRACKING AFRICAN AMERICAN COMMUNITY COLLEGE STUDENTS TO STEM CAREERS

by

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The United States is currently facing a shortage of qualified Science Technology Engineering & Mathematics workers. As a result, many STEM jobs are being filled by technically-skilled foreign workers. American institutions of higher education, including community colleges, must identify potential factors that contribute to the lack of interest in STEM majors, as well as the low rate of success of students who enter STEM majors but struggle to finish their degrees. Community colleges perform a larger share of STEM training than is generally understood. As highlighted in the National Science Foundation's National Survey of Recent College Graduates, a surprisingly large proportion (44% overall) of those earning a degree in science and engineering (bachelor's and master's) reported that they had attended a community college.

The purpose of this study was to ascertain the perceptions of African American community college students who are currently pursuing degrees in STEM majors and to examine the factors that influence their success. Qualitative research method of in-depth

phenomenological interviewing was used for this study. This tool provided a strong method of scientific inquiry for understanding the context of the lives of successful African American students in STEM majors.

Findings in this study have African American students identifying the meanings of the experiences of participating in a STEM workforce development program at Minneapolis Community and Technical College. They found the experience of Prioritizing to be the most crucial for them as they prepared for their STEM careers. Students consider Professionalism, Building a Network, Internships & Planning. Students also found advisors to be essential to their overall academic success. Furthermore, faculty members can make a difference in how students perceive their academic journey and how well they perform academically. These findings are also supported by Astin's theory of student involvement, Ladson-Billings Cultural Relevant Pedagogy and Validation.

Many community colleges are in urban areas and serve a very diverse population of students. This study can inform our faculty on best practices to prepare lecture materials, through providing cultural relevant pedagogy that addresses issues African American students are currently facing, which make their academic journey significant. When the academic coursework is applicable to real world situations students reported an easier transition to STEM workforce industries.

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Chapter One: Introduction

This study focused on best practices for accelerating African American community college students to science, technology, engineering, and mathematics (STEM) career pathways. Community colleges perform a larger share of STEM training than is generally understood. As highlighted in the National Survey of Recent College Graduates by the National Science Foundation (NSF), a surprisingly large proportion (44% overall) of those students earning a degree (bachelor's or master's) in science and engineering reported attending a community college. However, similar to the shortage of STEM workers, there are inconsistencies in supply and demand depending on geographic area and specific subject (Ingersoll & Perda, 2009). In its latest report, the National Science Board (2010) documented significant racial gaps in science and mathematics for both African American and Hispanic students as compared to Whites and Asians.

Community colleges conduct a greater share of STEM training than is generally understood. Moreover, it could be argued that noncredit programs and offerings may be uniquely positioned to serve many who would otherwise be ignored. Grubb, Badway, and Bell (2003) claimed that noncredit programs, such as those associated with welfare to work, the Job Training Partnership Act, and the Workforce Investment Act, are reserved for the most underserved and most difficult-to-reach individuals.

Despite this great potential, data specific to noncredit courses are typically sparse or nonexistent in college, state, and national databases (Oleksiw, Kremidas, Johnson-

Lewis, & Lekes, 2007); hence, there is a serious dearth of research on this topic (Ryder & Hagedorn, 2012).

The participation of underrepresented racial subgroups in STEM programs presents yet another picture. Although high school completion for Hispanic students has risen, Hispanic men have one of the highest rates of non-completion, and, as a group, Hispanics still lag in educational attainment at age 25 and older (National Center for Education Statistics [NCES], 2011; Ryan & Siebens, 2012). The mathematics test score gap between Whites and African Americans showed signs of narrowing during the 1970s and 1980s but has subsequently been broadening (Campbell, Hombo, & Mazzeo, 2000; Jencks & Phillips, 1998; Lee, 2002).

Statement of the Problem

A labor shortage exists when the demand for a specific occupation exceeds the supply of willing, available, and appropriately trained workers (Veneri, 1999). The American workforce grew 130% from 1950 to 2000, while the STEM workforce grew 669% in the same time period (Lowell & Regets, 2006). The extraordinary STEM workforce growth was unpredictable and variable by occupation. Some industries and positions were both created and decimated during this half century.

Rising concerns about the ability of the United States to compete in the global economy have led to numerous calls for national efforts to increase the number and diversity of students pursuing degrees and careers in STEM fields (National Academy of Science, 2005; National Governors Association, 2007; National Research Council, 2012;

National Science Board, 2007). In 2009, the Obama administration launched the "Educate to Innovate" campaign to improve the participation and performance of U.S. students in STEM. The U.S. Department of Commerce (2011) projected that STEM occupations will grow faster than non-STEM occupations. A recent policy report by the President's Council of Advisors on Science and Technology (2012) urged colleges and universities at all levels to produce more STEM graduates. The report stated that if the United States is to retain its preeminence in science and technology and remain competitive in a fast-changing economy, it will need one million more STEM professionals over the next decade than it is currently projected to produce (Chen & Soldner, 2013, p. iii).

A recent study by a job search organization for technology positions reported acute shortages of programmers and other skilled workers in "mobile and cloud-based applications" (The Dice Report, 2013, p. 4). There is great national concern that schools in the United States are facing a shortage of qualified science and mathematics teachers. This problem is not a new one; researchers and policy makers have been seeking solutions to the problem for decades (Guthrie & Zusman, 1982). However, comparable to the lack of STEM employees, there are discrepancies in supply and demand depending on environmental area and specific subject (Ingersoll & Perda, 2009).

African American families have lower incomes than their White counterparts, making college tuition a difficult obstacle (e.g., Astin, 1982, 1990). Financial need often makes off-campus work a necessity, which is negatively associated with college persistence in general (Maton, Hrabowski, & Schmitt 2000) and success in STEM programs in particular (Garrison, 1987). However, an expected response to this challenge, financial support, has not significantly increased the number of African American STEM baccalaureate recipients.

There is also a competitive disadvantage in academic background for African Americans majoring in STEM. African American freshmen have lower SAT scores, lower high school grade point averages, and lower participation in advanced high school math and science courses than their Asian and White peers (Elliot, et al., 1995; GandaÂra & Maxwell-Jolly, in press; Ramist, Lewis, & McCamley-Jenkins, 1994; Willingham, Lewis, Morgan, & Ramist, 1990). These factors have a strong and consistent positive relationship with freshman performance in quantitative (math and science) classes (e.g., Elliot et al., 1995; Willingham et al., 1990).

Many studies have reported that SAT scores are less predictive of performance for Black than for White students (e.g., Bowen & Bok, 1998; Breland, 1979; Ramist et al., 1994; Willingham et al., 1990). African American students with respectable SAT scores, who underperform, provide evidence that factors other than pre-collegiate preparation and native ability work to depress minority achievement and persistence. These factors may include academic and cultural isolation, motivational and performance vulnerability in the face of negative stereotypes and low expectations for performance, peers not supportive of academic success, and perceived and actual discrimination (cf. Allen, 1992; Gandara & Maxwell-Jolly, in press; Garrison, 1987; Nettles, 1988; Seymour & Hewitt, 1997; Steele & Aronson, 1995).

Research Questions

This study examined the academic and social factors that influence African American community college students pursuing an associate degree in STEM. By addressing the following qualitative research questions, this study attempted to generate additional information designed to help community colleges and industry understand and collaborate in order to successfully transition students pursuing STEM careers. Research questions:

1. How do African American community college students in STEM majors describe the experiences that accelerated or delayed their overall success?
2. What characteristics appear for African American community college in STEM students who successfully complete degree requirements and transition into industry?
3. How do African American former community college students in engineering and other STEM (non-engineering) majors describe experiences that facilitated or impeded their overall adjustment to industry?

Why focus on African Americans. Higher education institutions in the United States continue to face difficulties in maintaining access, diversity, and equity for all students of color, and in particular for African Americans, who have historically faced a multitude of inequities in access. Statistics reveal that African Americans are 50% less likely than Whites to obtain a 4-year or graduate degree (Thompson, 1991). When taking into account socioeconomic status, African Americans from upper socioeconomic status still lag behind Whites by nearly 13% in obtaining a bachelor's degree, thus suggesting that socioeconomic status makes a small impact on African American performance in postsecondary education (Thompson, 1991).

African Americans continue to enter higher education institutions and persist at lower levels than their White counterparts. The failure to enter college may result from factors beyond socioeconomic status. One such factor is the continuance of de facto segregation in urban areas and institutional quality and access, with African Americans concentrated at 2-year institutions that provide limited education opportunities. Segregation is also present across institutions via unequal benefits and policies applied to Whites regarding admissions (e.g., special admission for children of alumni and/or university benefactors) and resources (e.g., advanced courses in high school, better trained teachers, financial assistance). These and other inequitable policies affect access and retention for African Americans in postsecondary education as a whole, and in particular, to certain disciplines of study (Renner & Moore, 2004).

African Americans face the greatest difficulty in obtaining access to and attainment of STEM degrees (NSF, 1996). Research revealed that the entrance and attainment of degrees in STEM disciplines by African Americans is significantly lower than their White counterparts (NSF, 1996). These trends persist despite an increasing number of minorities (i.e., African American, Hispanic/Latino, and American

Indian/Native American) completing more rigorous coursework and entering higher education (Kuenzi et al., 2006). The U.S. census estimates that the minority population will reach 50% by 2050, signaling African Americans (and other students of color) as the future of STEM workers and professionals across the nation (Anderson, 2006).

In 2000, African Americans made up approximately 12.3% of the U.S. population of 34 million people. The proportion of the total number of African Americans entering undergraduate enrollment increased from 9.6% in 1990 to 11.6% in 1999, while the proportion of those completing science and engineering degrees has also shown improvement from 5.2% in 1987 to 8.3% in 2000 (Babco, 2003). Although trends outline improvements in African Americans obtaining science and engineering degrees, the overall enrollments remain lower than their White counterparts (NSF, 2006).

There is a need for comprehensive research on factors related to entrance, retention, and degree attainment in STEM educational pursuits to specifically target African Americans and other students of color into these fields of study (Kuenzi et al, 2006). It is hypothesized that numerous institutional factors impede and/or discourage African Americans to enter higher education, and more specifically, STEM fields of study.

Educational attainment of African Americans. The National Science Foundation (1996) outlined the general trends for science and engineering bachelor’s degree attainment across race/ethnic groups for 1985–2005 as a positive improvement for students of color (i.e., Asian/Pacific Islander, Hispanic/Latino, and African

Americans), while equally identifying a decline in bachelor's degree attainment during the same period for Whites (Appendix A). Babco (2003) outlined results from a study for years 1987 to 2000, specifically revealing degree attainment among African Americans in the sciences. The results suggested a similar trend of improvement, with an increase of African Americans who earned their science and engineering bachelor's degrees from approximately 5.2% to 8.3% (non-STEM degree attainment was 5.9% in 1987 and 8.7% in 2000).

Although science and engineering degree attainment increased over the years for students of color, the degree attainment still remained less than that of social sciences. Degree attainment revealed that in 2000, two-thirds of African Americans earned bachelor's degrees; one-half earn their master's degree, and 55% obtain their doctorate degrees in either social science or psychology. In 2000, for the majority of African American students, approximately 10.3% obtained a psychology degree, followed closely by computer science at 9.9%. Engineering degrees were earned by 5.6% of the students, and lastly, 2.5% of degrees were earned in agriculture sciences (Babco, 2003).

Gender differences are also apparent within the African American population in regards to higher education pursuits. African American women are more likely to pursue higher education. African Americans males have made great advances in their contributions in Science, Technology, Engineering, and Mathematics, but still remain at a disadvantage to the degree attainment of White males in the same STEM disciplines. In 2000, they earned 60% of all the bachelor's degrees and 63% of the science and engineering degrees awarded to all African Americans (Babco, 2003). NSF data also identified African American women as making great strides in the number of degrees awarded across all institutions and disciplines between 1995 and 2004. African American women have increased the number of degrees from 54,298 to 81,926 and nearly doubled their male counterparts in degree attainment (Appendix B).

The NSF (2008) data set from the division of science resources and statistics, defined by degree type or major choice degree attainment, showcased the difference for African American women and men for degree attainment between 1995 and 2004. Both genders saw an increase in the number of degrees attained in science and engineering over this time period. African American females attained approximately 44% more science and engineering degrees than their male counterparts in 2004, with the majority of the degrees earned in science disciplines (e.g., agriculture, biology, computer, earth/atmospheric/ocean, mathematics, physical, psychology and social sciences). Non-science and engineering degrees comprised approximately 30% in 2004 (Appendix B). For engineering, however, African American men in 2004 surpassed females in the number of engineering degrees by 48%. Non-science and engineering fields (e.g., education, health, humanities, and professional/other/unknown) accounted for 34% of all degrees attained by African American males in 2004.

Purpose of Study

The purpose of this study was to ascertain the perceptions of African American community college students who are currently pursuing degrees in STEM majors and to examine the factors that influence their success.

National scholars have identified that the United States is concerned about losing its dominant position in global innovation and technological expertise. Related to this concern are an insufficient number of U.S. citizens prepared to fill STEM-related jobs (Lowell & Salzman, 2007). An associated threat is that if the U.S. educational system cannot produce an adequate and sufficiently trained workforce, industry and innovation will increasingly be located in other parts of the globe better prepared to provide the necessary resources (Hagedorn & Purnamasari, 2012).

Community colleges have played a significant role in training the STEM workforce. As highlighted in NSF's National Survey of Recent College Graduates, a large proportion (44% overall) of those earning a bachelor's or master's degree in science and engineering reported attending a community college. Unfortunately, this study did not report out the data of African American students.

Discussions of the African American community college STEM majors are almost always limited to the "credit side" of the colleges' services. It may be surprising to some that the headcount in noncredit community college offerings in the fall of 2008 was 5 million individuals. Even though this figure is less than the 7.4 million students enrolled in credit courses, noncredit enrollment represents approximately 40% of community college student engagement and should not be ignored. Many vocational-technical courses, such as those in career-oriented programs, job-retraining programs, and contract programs with local employers, are also offered on a noncredit basis through community colleges (Hagedorn, 2012). To summarize, both community college leaders and scholars have not focused on the experiences that impact African American community college students.

Significance of the Study

America needs to engage community college students in STEM majors. A large percentage of baby boomers are nearing retirement in science, technology, engineering, and mathematics occupations (Barton, 2003; Maple & Stage, 1991), and it has been predicted that by the end of the decade, STEM employment opportunities in this country will increase by nearly 50% (Starobin, & Laanan, 2005).

In a world increasingly driven by technology, living the American Dream requires more advanced education than ever. Literacy and skills in science and technology are becoming increasingly important; in fact, our economy's future appears tied, at least in part, to the strength of a technology-based workforce. More than three decades ago, the United States government made a commitment to help African Americans achieve educational parity with the White majority. Although the commitment remains intact, the goal remains unattained (National Task Force on Minority High Achievement, 1999).

Historically before America collected data about technology in STEM, only 1.1% of American citizens receiving doctorates in science, engineering, and mathematics (STEM) were African Americans, even though African Americans represented 12% of the United States population. In 1992, the percentage receiving STEM doctorates was 1.2%, and by 1995, it had increased to only 2.0% (NSF, 1996a, 1996b), despite the fact that proportionately higher numbers of African Americans aspire initially to science graduate degrees than do Whites (Elliott, Strenta, Adair, Matier, & Scott, 1995). Adding technology to the degree attainment did not increase African American student retention.

Producing sufficient numbers of graduates who are prepared for science, technology, engineering, and mathematics occupations has become a national priority in the United States. To attain this goal, some policymakers have focused on reducing STEM attrition in college, arguing that retaining more students in STEM fields in college is a low-cost, fast way to produce the STEM professionals that the nation needs (Chen & Soldner, 2013, p. iii). This Statistical Analysis Report (SAR) presented data gathered over a 6-year period from 2003 through 2006.

This study is important because it examined the degree to which culturally relevant pedagogy, the theory of involvement, and the theory of validation impact the academic and personal success of community college students. Understanding the relationships among these factors and having a clear sense of their importance can assist community colleges with improving graduation rates in STEM fields.

This study will add to the literature of effective learning strategies in the classroom, particularly focusing on the different concepts related to the use of effective academic and social involvement. Providing literature that recognizes the issues influencing African American students in community college STEM programs may assist in improving retention and graduation rates. To successfully tranisiton students to entry-level positions in the science, technology, and engineering industries.

Definition of Terms

Operational definitions for key terms used throughout this study are often found in the research on college students. These definitions are provided below.

Community Colleges: any institution accredited to award the Associate in Arts, Associate in Science, Associate in General Studies, or the Associate of Applied Science as its highest degree. Comprehensive 2-year colleges as well as many public and private technical institutions are included in this term.

Developmental Education: a comprehensive, research-based framework that empowers all learners to achieve academic, professional, and personal growth through the highest quality of instruction, assessment, and support services. Developmental classes are those that provide students with the knowledge and skills required for college-level work in reading, English, and mathematics.

Fast Tracking: accelerated learning also called intensive, compressed, concentrated, or short-term learning. Acceleration that allows students to complete developmental and college-level courses quicker than in the traditional sequences.

STEM: acronym for Science, Technology, Engineering, and Mathematics, according to the National Science Foundation.

Multiple Pathways: Open pathways to multiple options to programs of academic and technical study that integrate classroom and real-world learning organized around multiple sectors of industry.

Transfer: the movement of students from one higher education institution to another and the process by which academic credits are accepted or not accepted by a receiving institution.

Vertical Equity: takes into consideration differences among pupils and outcomes due to resources. Schools that have more funding and resources should provide resources for underserved populations.

Workforce Development: an American economic development approach that attempts to enhance a region's economic stability and prosperity by focusing on people rather than businesses; it is essentially a human resources strategy. Workforce development has evolved from a problem-focused approach, addressing issues such as low-skilled workers or the need for more employees in a particular industry, to a holistic approach considering the many barriers of participants and the overall needs of the region.

Underserved Populations: these populations include, but are not limited to, members of immigrant or ethnic groups, rural residents, urban or rural youth, unemployed and homeless people.

Outline of Proposal

This study built upon prior research on the academic and social involvement of African American community college students and how it contributes to their success in STEM areas. This scholarship sought to add to the literature related to the role of community colleges in increasing the number of students pursing associate degrees in STEM fields.

Chapter two summarizes the literature on community college students in STEM fields. The literature review draws attention to and explores in detail the different layers of student involvement in STEM, which includes African American students in STEM, developmental education, academic involvement, relationship with faculty, and participation in student peer activities. Additionally, self-efficacy is examined in order to better understand the perception of an individual to define a task and accomplish it. Finally, the role of community colleges in successfully attracting more African American students into STEM fields and preparing students for successful transition into STEM workforce industry will be discussed.

Chapter three presents the methodology that will be used in designing and conducting this study. This qualitative study will encompass interviews, survey data responses, and focus groups. This methodological approach is used to explore and examine the academic and social involvement experiences of community college students who are currently pursuing STEM associate degrees.

Chapter four reveals the results of the data analysis pertaining to the qualitative components and findings generated from the open-ended questions were examined. In this chapter, interview responses from eight African American community college STEM students, three males and five females from STEM workforce development programs were discussed. The findings were presented through individual profiles, and a comprehensive summary of the themes that emerged from the students' voices.

Chapter five presents a summary of the research, conclusion, implications for practice, application of the study and recommendations for future research are included. This dissertation also analyzes literature on how African American students enter community colleges as inexperienced and unaware of resources available to them. They may be aware that certain issues exist, but their pre-college experiences may not have prepared them for the more focused world of STEM in college.

Theoretical Framework

While community college students are taking classes, it is vital that they engage with their classmates, professors, and advisors. These types of interactions lead to the success of many students in STEM who aspire to finish their academic degrees. Student achievement can be dependent on the amount of student involvement. Astin's (1984) theory is possibly the most appropriate when investigating and interpreting student involvement. Astin defined involvement as "the amount of physical and psychological energy that the student devotes to the academic experience" (1984, p. 297). He asserted that the more academically and socially involved individuals are and the more they interact with other students and faculty, the more likely they are to persist.

Rendón (1994) stated that the more students see interactions as positive, and the more they view themselves as integrated into the institution and as valued members of it, the more likely they are to persist. Furthermore, Tinto (1997) found that involvement in the classroom could become a vehicle for involvement beyond the classroom.

Academic involvement is closely related to persistence (Tinto, 1997). Tinto also pointed out that students are more likely to remain enrolled in an institution if they become connected to the social and academic life of that institution. According to Tinto, the academic and social systems of community colleges join both classrooms and social settings in a way that influence student success. These two theoretical frameworks indicate how significant the role of student engagement and positive relationships with faculty and staff can increase student success.

Ladson-Billings (1994) also addressed the need for culturally relevant pedagogical approaches that are student centered and authentic. This perspective is rooted in the belief that students and their culture are intricately intertwined and that teachers can intentionally enhance student learning by embracing and utilizing various aspects of each student's culture.

This student-centered approach considers the historical, social, political, and economic conditions that influence the daily lives of students and, subsequently, come to bear on their schooling. Teachers employing culturally appropriate education integrate these aspects of students' lives into the curriculum and their teaching in order to meet the academic needs of the students, enhance their teaching, and sustain quality teacher–

student interactions. By doing so, the content becomes relevant and comprehensible, thereby empowering all students (Ladson-Billings, 1995).

Culturally relevant education is also closely tied to the ethic of care (Ladson-Billings, 1995). For teachers to utilize such methods, they must have a genuine care for the students they serve. In essence, culturally relevant education is defined as a tangible and learnable approach to education; however, it is also a disposition that drives the interactions that teachers are likely to have with their students (Ladson-Billings, 1994).

Ladson-Billings (1995) suggested that teachers who genuinely care about African American students must understand their students' historical, social, economical, and political positioning and believe that they are capable of meeting and/or exceeding high standard and expectations.

Delimitations

No other potential influences on persistence and academic success were analyzed in this study. The results were generalizable only to similar African American community college STEM student populations. Only students enrolled in major-preparation science and math classes during the summer and fall 2014 semesters were sampled, allowing for a focused approach to individual student perceptions of validation.

Faculty/staff interaction, as it relates to student integration, was the variable used and was augmented with validation and sense of belonging theory. This approach allowed the focus to be on specific behaviors of faculty and students. Utilizing faculty validation alone was appropriate due to the commuter nature of community colleges.

Faculty validation potentially overlooks the other means of student validation such as those provided by peers, family, and other extracurricular relationships.

My position as an African American female researcher with a science background, whose interests are in understanding the similarities or dissimilarities of the journey, provide readers with a rich, description of my personal experiences and connected me to the study (Creswell, 1998). To maintain researcher objectivity I kept a daily journal on the progress of the research and reflected on my role as a neutral observer.

Chapter Two: Literature Review

Community College Students and STEM Education

A number of recent national reports, such as *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future* (Schweingruber, Duschl, & Shouse, 2007), have called for engaging underrepresented populations in science and engineering to ensure a high-quality future technical workforce. Another study by the Rockefeller Foundation (Shaffer, 2008) highlighted the increasingly important role of community colleges in recruiting students into 4-year bachelor degree programs (Shaffer, 2008).

Reports such as *Higher Education Design Principles to Broaden Participation in STEM* (Building Engineering and Science Talent [BEST], 2004) also identified community colleges as a significantly underutilized pool of talent, especially in science and engineering (Lenaburg, Aguirre, Goodchild, & Kuhn, 2012).

Responding to their missions, community colleges are responsible for serving the local community. Thus, they are charged with providing the types of training appropriate for the variety of jobs available in their service areas. Community college vocational programs can often partner with local industries, creating a "win-win" situation in which industries acquire workers who are specifically trained for them, and workers are both educated and employed in their neighborhoods (Hagedorn & Purnamasari, 2012).

An example of how community colleges work with industry can be found in Macomb Community College, located in the suburban Detroit area. Macomb works with local industry to produce workers who can fill technical jobs. The college is committed to increasing STEM Workforce development and has a number of special partnerships and programs with the automotive industry. It offers an associate's degree program, the General Motors Automotive Service Educational Program (ASEP), in which students combine classroom learning with hands-on experience and work with General Motors' products within a General Motors dealership (Macomb Community College, n.d.).

Cisco Networking Academy established partnerships with 700 community college information and communication technology programs (Cisco Learning Network, 2011a). The Cisco partnerships provide online services and training, allowing even small, rural community colleges to provide consistent technical training. As indicated in the Cisco job portal (Cisco Learning Network, 2011b), thousands of vacancies are posted for people holding a Cisco certificate in specific technical fields (Hagedorn & Purnamasari, 2012).

Targeted early-college programs are a major way in which community colleges lead students, especially those from underrepresented groups, to consider STEM majors or careers. Cuyahoga Community College in Cleveland, Ohio, is an example of an institution with programs that help expand STEM access to populations less likely to choose that pathway. Cuyahoga's High Tech Academy enrolls 200 to 300 high school students each year (Cuyahoga Community College, 2010). Students from grades 10-12 spend half of each school day at the college, taking courses in the college preparatory stream or in engineering technology, information technology, or other selected disciplines. This program allows students to earn college credits that also serve as credits towards the high school graduation requirements (Cuyahoga Community College, 2010).

The Biology Department at the Annandale Campus of Northern Virginia Community College (NOVA) has implemented multiple strategies to improve student success in their biology courses. NOVA is the second largest 2-year college in the nation, serving over 75,000 students. The NOVA Biology department has 25 full-time faculty and 60 adjunct professors, all working toward meeting the needs of a very diverse student body (Musante, 2012).

NOVA's biology program has interactive learning opportunities and investigative laboratory experiences, as well as general programs, to help students learn. NOVA found that many students struggle with fact-based courses such as biology, especially students who take courses for a second career or who avoid science courses unless they are a requirement. NOVA's Science Learning Center is available to students who want additional help, offering one-on-one assistance from faculty, group study sessions, and spaces for laboratory review. NOVA has also focused on the unwelcoming atmosphere that can be found in many introductory courses (Musante, 2012).

Two-year colleges offer a variety of pathways for students to earn STEM degrees. An excellent example is Lorain County Community College (LCCC) in Ohio. LCCC's University Partnership program allows students "to earn bachelor's and master's degrees from any of eight Ohio universities without leaving the LCCC campus" (Musante, 2012, p. 24). There are connections between the community colleges and nearby 4-year institutions. These connections are essential to the establishment of agreements for the transfer of college credits. Established relationships between institutions can also lead to opportunities for graduate students to teach at 2-year colleges, which would provide teacher training for these future professors (Musante, 2012).

Underserved STEM Populations

Community colleges are uniquely positioned to increase the number of professionals in the pipeline and to produce more STEM-skilled workers to meet the demand for middle-and high-skilled jobs. The convenience of community colleges is a crucial asset: 90% of the U.S. population lives within 25 miles of a community college, which makes these institutions highly accessible to many people (Baber, 2011).

An extreme achievement gap exists between White and African American students in science, technology, engineering, and math fields. Although African American represent almost 13% of the U.S. population, in 1998 African American students accounted for only 7.9% of STEM bachelor's degrees, while Whites were awarded 69.8% of the degrees. Eight years later, in 2006 when those same students would have had an opportunity to complete a Ph.D., African American earned only 2.5% of STEM doctoral degrees (NSF, 1996). This inequity exists even among well-prepared students and has been attributed to academic and cultural isolation, low-performance expectations on the part of students and faculty, unsupportive peer communities, and both perceived and real discrimination (Gandara & Maxwell-Jolly, 1999; Nettles, 1991;

Seymour & Hewitt, 1997; Steele & Aronson, 1995). Factors such as exclusion from social networks and lack of cultural knowledge about the academic scientific community may also impede the success of talented Black students.

Another asset of community colleges is that they already serve many ethnic and racial minorities, who are expected to grow in numbers. By 2030, people of color will make up 45% of the working-age population, up from just 18% in 1980. Community colleges are well equipped to extend STEM education and training to this growing segment of the labor force. In addition, community colleges are an inexpensive option for the many low-income, low-skilled adults who want and need to boost their education and training. The average annual cost to attend community college is $2,544 per year compared to $7,020 per year at a 4-year public college (Baber, 2011).

The participation of underrepresented racial subgroups in STEM programs presents an opportunity for workforce development. Although high school completion for Hispanic students has risen, Hispanic men have one of the highest rates of non-completion, and, as a group, Hispanics still lag in educational attainment at age 25 and older (NCES, 2011; Ryan & Siebens, 2012). The mathematics test score gap between Whites and African Americans showed signs of narrowing during the 1970s and 1980s, but has subsequently been broadening (Campbell et al., 2000; Jencks & Phillips, 1998; Lee, 2002). The latest NSF science and engineering report documented significant racial gaps in science and mathematics for both African American and Hispanic students as compared to Whites and Asians (National Science Board, 2010).

The need for greater participation of minorities and women in science and math careers, coupled with the fact that nearly half of all minority college students attend a community college, underscores the importance of establishing 2-year college programs for the recruitment and retention of talented minority and women students in math and science disciplines (Quimbita, 1991).

Unfortunately, low transfer rates by men and women of color make their recruitment into STEM from community college populations problematic. Transfer rate estimates range from 25% to 52% (Hoachlander, Sikora, Horn, & Carroll, 2003). Complicated data collection priorities, such as using 6-year windows to assess persistence rates (Chen & Weko, 2009), counting students who do not complete 2-year degrees before transferring as dropouts, and no disaggregation of data (Bailey, Jenkins, Calcagno, Leinbach, & Kienz, 2005) have made it difficult to draw an accurate picture of the dropout numbers for transfers in STEM. Even more troubling is the fact that among women of color who do transfer to STEM at the university level, the retention rate is low (Reyes, 2011). The literature indicates that one solution to increasing retention and graduate rates can be found in changing the timeline for persistence rates and disaggregation of data.

Recent reports pointed to the significant underrepresentation of women of color in STEM fields. There is an urgent need to better facilitate their success in STEM education and career paths. This is a national priority to produce and diversify a U.S.-born STEM workforce to replace retiring U.S. engineers and scientists Hilton (2008).

Women of color transfer students who are not retained in STEM represent a loss of talent and investment. In order to improve retention and advancement in STEM of women of color, we need to understand their unique challenges and implement strategies for addressing those challenges. In addition, we need to understand the unique characteristics of the community college population from which they are drawing (Reyes, 2011).

The characteristics of community college students vary dramatically from those of the general student population at 4-year colleges and universities. The median age of community college students reported in 2008 was 24 years old, with 35% of students being 30 years old or older (Provasnik & Planty, 2008). Fifty-nine percent of those attending 4-year community colleges were women. Over 35% of students enrolled at community colleges were students of color, and 21% of all students enrolled at community colleges were women of color (Crisp, Nora, & Taggart, 2009). Comparatively, students of color comprise 27-30% of the student population in 4-year institutions (Reyes, 2011).

In addition, it appears that the United States has not yet found the answers to these problems. The Lumina Foundation, along with several other philanthropic organizations, has expended more than $100 million in a wide-reaching, multiyear community college program called “Achieving the Dream: Community Colleges Count.”

In the following section I address each of the approaches to adding African American students following the organizational structure of community colleges.

Programs of Study

For more than ten years some states have supported innovative career and technical education pathways that meet both postsecondary and career requirements. For example, California supports high schools, often in partnership with community colleges, by embedding engineering and other applied skills within course pathway structures.

These pathways, also known as Linked Learning, bring together strong academics, demanding career and technical education, and real-world experience to help students gain an advantage in high school, postsecondary education, and careers. Students follow industry-themed pathways, choosing among fields such as engineering, arts and media, or biomedicine and health. Participation in Linked Learning prepares students to graduate from high school and succeed in a full range of postsecondary options, including 2- or 4-year colleges, certificate programs, apprenticeships, military service, or formal job training. The program operates on the premise that there is no one right way to implement a pathway (Baber, 2011).

Career Pathways

Career pathways guide students toward a specific profession by providing a defined list of courses that include expert training in a specified field. The various courses help lead students to complete certificates and/or degrees that identify them as being qualified to work in an in-demand field such as health care or engineering. Some states couple the pathway approach with wraparound supports for low-income adults. The Arkansas Career Pathways Initiative, for instance, is a program that enables community colleges to provide eligible students with career training and college classes. Administered through a partnership between the Arkansas Department of Higher Education and the Arkansas Department of Workforce Services, this program offers students and adults a range of services, including assistance in obtaining a GED, and it provides support for tuition and textbooks, child care, and transportation (Baber, 2011).

Since their inception, community colleges have carried out a number of complex and competing industry needs as part of their open-access mission (Prager, 1988). They often serve individuals who would not otherwise participate in higher education. Various programs have been significant to the evolution of community colleges, such as transfer and vocational preparation, although these initiatives have received different levels of support at different points in time, community colleges have matured, and their learners have become more diverse (Nora, 2003).

In states with especially large community college systems such as California, Illinois, and Texas, community college students make up a far greater proportion of total higher education enrollments. For example, fall enrollments in Illinois confirmed that nearly 350,000 students enrolled in public community colleges compared to 200,000 students in public 4-year colleges. This is nearly a 2:1 margin for community colleges over 4-year schools (The Institute for Higher Education Policy, 1998).

Nontraditional and minority students are particularly active enrollees in community college education. Persons of color comprise about 30% of all participants in community colleges, compared to approximately 24% in 4-year institutions (NCES, 2011). More than one half of African Americans and persons of Hispanic origin who enroll in college after high school graduation attend a community college (NCES, 2011). These two groups are the largest minority groups represented in community colleges. There are large numbers of minority students who reside in states that have expansive community college systems, such as Arizona, California, Florida, and Texas (NCES, 1999).

Hispanic students have a higher representation in community colleges, making up 12% of the enrollment nationally but are underrepresented in 4-year colleges, accounting for only 8% in those institutions. Longitudinal analyses conducted by Anglin, Davis, and Mouradian (1995) verified these figures, indicating that Hispanics have a larger population of students in community colleges as compared to other racial and ethnic groups. As a consequence, community colleges have a particularly important responsibility for ensuring that Hispanic students (as well as other minority students) have ample opportunity to succeed and reach their ultimate educational goals (Anglin, Davis, & Mouradian, 1995). Longitudinal results confirmed that, compared to their 4-year college counterparts, a much higher proportion of community college students come from non-English-speaking homes, are recent immigrants, are from low-income families, or all three. Nora (1993) reported that minority student enrollments have been consistent for the last 25 years, with minority students making up only 6% to 8% of all students in higher education, but nearly 60% of total community college enrollments.

Recognizing the multitude of minority students at the 2-year college level, it is unfortunate to learn that, although the financial needs of many community college students are great, community college enrollees are at a disadvantage compared to other college students in securing student aid. Alexander (1998) showed that students attending low-cost community colleges are less likely to secure aid than students attending high-cost, 4-year colleges and universities. His research raises important questions about the principle of vertical equity that various federal and state student aid programs profess to address.

Advanced Technology Education

In 1992, the U.S. Congress created the Advanced Technological Education (ATE) program to boost the nation's supply of highly skilled technicians in math, science, and engineering-intensive industries. Funded and overseen by the National Science Foundation, ATE's 36 centers, located in every part of the country, coordinate efforts among high school and community college educators, business leaders, and government officials to recruit and train workers for rewarding careers in growing sectors of the economy such as bio-technology, chemical technology, nanotechnology, photonics, and information and security technologies. The goal of the ATE program is to strengthen the skills of technicians whose work is vitally important to the nation's prosperity and security (American Youth Policy Forum [AYPF], 2008, p. 4).

“Two-year community colleges have a leadership role at ATE centers and projects, working in partnership with universities, secondary schools, business and industry, government, and non-profit agencies to design and carry out model workforce development initiatives” (AYPF, 2008, p. 31). ATE centers and projects address critical areas in technical training and developing effective pipelines of trained workers for their targeted industries. ATE centers share a number of effective practices, including “the ability to leverage resources, responsiveness to industry needs, focus on innovative professional development, and commitment to reaching out to underserved populations” (AYPF, 2008, p. 31).

ATE centers and programs have successfully leveraged a variety of resources to sustain workforce development. An example is the National Center for Information and Communications Technologies (ICT) at Springfield Technical Community College in Massachusetts, which has been a critical partner in the growth of the Regional Technology Corporation (RTC), an organization created expressly to increase the number of technology-based businesses in the “Knowledge Corridor” extending through western Massachusetts into New York State and Connecticut. Together, the ICT Center and RCT operate a number of training programs through community colleges to attract and retrain information technology (IT) workers as well as to support mid-career professionals. Through the partnership, regional employers have begun to appreciate Springfield Technical Community College as necessary to both building and sustaining the pipeline of skilled workers for the IT fields (AYPF, 2008, p. 4).

Another example of workforce development is the Center for the Advancement of Process Technology (CAPT), which was created through a partnership between the College of the Mainland in Texas City, Texas, and an alliance of regional petrochemical companies in need of skilled employees in the region. Relying initially on funding from the Carl D. Perkins Act and Texas Workforce Commission, the Gulf Coast Process Technology Alliance developed a standardized 2-year Associate of Applied Science degree in process technology. Recognizing that both the curriculum and its development process would be useful to community colleges across the county that are training process technicians, CAPT was created with funding from the ATE program.

Currently, CAPT is with all 50 community colleges in Texas to create 2-year degree programs for careers at refineries and related industries. In addition, the Center is leveraging business partnerships to provide scholarships, internships, and recruitment networks so that students graduate both debt free and linked to available jobs. Lee Rector, Deputy Director, Texas Workforce Investment Council, articulated CAPT's approach to degree development by saying that, for the most part, employers—not educators—have been in the driver's seat and have remained the protectors of quality and relevance of the programs offered (AYPF, 2008, p. 6).

Digital Bridge Academy (DBA) at Cabrillo College, Aptos, California, is one of many ATE projects focused on serving student populations both underrepresented in postsecondary education and across the technological fields. This program is unlike any other of its kind; it takes a innovative approach to supporting at-risk students by sparking their desire to learn about technology. DBA empowers students to learn how to channel this motivation within academic and work environments.

The site at Cabrillo College is more than 90% Hispanic and focuses on preparing students to be successful in math and science coursework through project-based learning. A comparative evaluation of students in the DBA to traditional community college students revealed that 75% of DBA students completed two years of college coursework compared to 32% of the comparison population. The model is adaptable to any college preparing students for knowledge-based careers in any local economy (AYPF, 2008, p. 6).

Biotechnology Education

In 1998, the National Science Foundation funded Bio-Link as the 11th ATE Center of Excellence and the only such center focused on preparation of technical workforce for the biotechnology industry. Bio-Link's National Center, hosted by City College of San Francisco (CCSF), provides leadership to seven Regional Centers, using a coordinated national strategy relying on local implementation. The Regional Centers are located at community and technical colleges throughout the United States: in the Northeast (New Hampshire Community Technical College); the Southeast (Alamance Community College, North Carolina); North Central (Madison Area Technical College, Wisconsin); South Central (Austin Community College, Texas); Northwest (Shoreline Community College, Washington); Northern California (CCSF); and the Southwest (San Diego City College, California). All of the coastal Bio-Link Regional Centers are located in geographical regions that have been identified in *Signs of Life: The Growth of Biotechnology Centers in the U.S.* (Cortright & Mayer, 2002) as concentrations of the biotechnology industry with both research activity and commercialization (Johnson, 2003, p. 349).

Each region also collaborates with local industry and educational institutions in order to meet regional needs and distribute information locally. The location of Bio-Link's National Center in San Francisco has promoted Bio-Link's ability to stay abreast of industry trends. San Francisco is one of the largest biotechnology industry clusters in the world and home of the emerging University of California at San Francisco (UCSF), whose 43-acre world-class research campus in Mission Bay provides incentives and space for new companies in the surrounding development (Johnson, 2003, p. 349). Bio-Link strategically connected the following goals to its mission: (a) provide support for students and technicians; (b) improve instruction and learning; (c) share information and resources; and, (d) foster collaborations and partnerships.

In 2003, Bio-Link added two new programs to strengthen their ability to serve the community college population. An equipment registry was added to provide a national service that operates out of regional hubs. Genentech, Inc. provided $50,000 in seed funding in 2002 to establish this national effort to identify surplus biotechnology equipment from industry and make it available to educators (Johnson, 2003, p. 349).

The additional program is a national and international internship program that directly contributes to accomplishing Bio-Link's core goals. Internships are extremely valuable for students, providing them with technical skills in an industry setting that allows them to experience the real work environment. The internship process exposes individuals to working professionals, helping them to mature emotionally, and become more competitive when they enter the job market. Faculty also benefit from and adjust their teaching practices as a result of participating in industry internships as evidenced by recent experiences of community college faculty at Indiana (Johnson, 2003, p. 350).

Demand from industry for skilled workers has dramatically increased, and biotechnology courses are filled as soon as they are opened. Industry professionals serve as adjunct instructors for some of the courses, and continued quality adjustments are made to content, pedagogy, and flexible time offerings (Johnson, 2003, p. 351).

The University of California at San Francisco has provided essential office space, tours, speakers, and internships, and the California State University Program for Education and Research in Biotechnology has included Bio-Link in its annual conference activities. In addition, industry has provided substantial donations of grant funds, equipment, and supplies that have enabled UCSF to offer additional support for faculty, staff, and administrators to work on biotechnology program improvement and outreach (Johnson, 2003, p. 351).

Growth of the UCSF program and similar programs across the nation provide evidence that community colleges play a key role in the education of the biotechnology workforce. The California legislative hearings on the current and future workforce described the needs of California's biotechnology industry (Johnson, 2003, p. 351).

STEM Early College High Schools

Early college high schools are intensive dual enrollment pathways that target low-income and other at-risk students. The schools provide students with the opportunity to earn one to two years of transferable college credit or an associate's degree by the time they graduate high school. Jobs for the Future (JFF) and industry partners have created or redesigned 280 early colleges, currently serving more than 80,000 students, and the movement continues to grow. As national coordinator of the Early College High School Initiative launched by the Bill & Melinda Gates Foundation in 2002, JFF helped shape and spread common principles of early college to new school developers (Webb & Gerwin, 2014).

Based on outcomes for thousands of students who attended about 100 representative early college high schools, the most recent data showed the success of the design: Ninety percent of early college students graduate high school—12 points higher than the national average of 78%. In addition, the vast majority of early college students earn college credit in high school, and 30% earn an associate's degree or other postsecondary credential with their diploma (Webb & Gerwin, 2014).

JFF and partners are building on this record of success to spread Early College Designs to 56 additional schools and for more than 50,000 additional young people through local, state, federal, and corporate initiatives. Endorsing expansions in South Texas and Denver, with a competitive innovation grant, the U.S. Department of Education praised early college as an innovative model with a proven record of improving student outcomes and closing achievement gaps for high-need students (Webb & Gerwin, 2014).

In North Carolina, of the 71 early college high schools now operating in partnership with the North Carolina New Schools Project, six schools are STEM-focused. There are plans to expand the number to 15 early college high schools focused on one of the following areas: biotechnology and agriculture, health and life sciences, energy and sustainability, and aerospace (Baber, 2011).

Early college high school is a bold approach to education reform, based on the principle that academic rigor, combined with the opportunity to save time and money, is a powerful motivator for students to work hard and meet serious intellectual challenges. Early college high schools blend high school and college into a rigorous yet supportive program, compressing the time it takes to complete a high school diploma and up to the first two years of college (North, 2011).

Since 2002, the partner organizations of the *Early College High School Initiative* have started or redesigned 230 schools in 28 states and the District of Columbia. The schools are designed so that low-income youth, first-generation college goers, English language learners, students of color, and other young people underrepresented in higher education can simultaneously earn a high school diploma and an associate's degree or up to two years of credit toward a bachelor's degree—tuition free. All the schools include the high school grades (grades 9-12); some incorporate middle grades as well (grades 6-12 or 7-12) (North, 2011, p. 4).

Two other examples of STEM-focused early colleges are the Academy for Math, Engineering and Science (AMES) in Salt Lake City, and the Collaborative College for Technology and Leadership ECHS in Statesville, North Carolina. Partnered with the University of Utah School of Engineering and with an emphasis on fieldwork, AMES is designed to provide high school students with opportunities to advance in specialized fields of study (North, 2011, p. 4).

The Collaborative College for Technology and Leadership is a partnership between the Iredell-Statesville Schools, the Mooresville Graded School District, and Mitchell Community College (MCC). MCC offers a wide range of degree programs, including those leading to transfer to the state's university system and to career opportunities in more than 20 fields, as well as additional non-degree programs in almost 30 fields (North, 2011, p. 6).

Summer Bridge Programs

Bridge programs have their origin with the federal Upward Bound program, which began over 40 years ago, and current programs have evolved from that model. In reviewing the literature on bridge programs, Gullatt and Jan (2003) lamented the scarcity of solid research evaluating the effectiveness of these programs. However, the studies that do exist suggest successful bridge programs: (a) establish and expect high standards for program students and staff and provide professional training for the staff; (b) provide personalized attention for students and establish trusting relationships with them; (c) provide adult mentors, counselors, and or advisors; (d) facilitate peer support; (e) integrate the program within K–12 schools; and, (f) provide long-term and strategically timed interventions that coincide with the timing of college-readiness steps such as curriculum choices, ACT/SAT preparation, college application and financial aid processes, and college survival skills (Kallison & Stader, 2012).

Many community colleges have implemented innovative programs to provide an alternative to traditional developmental education by helping students to build competencies and persist in college. Developmental Summer Bridge Programs (DSBP) have become increasingly popular interventions to strengthen student preparation, reduce the need for developmental education, and orient students to college. DSBPs have the potential to help students enter college without the need for remediation, especially when they are close to being college ready (Zuniga & Stoever, 2008). They offer accelerated, focused learning opportunities that can allow students to acquire sufficient knowledge to place into college-level courses. Further, these programs may smooth the transition into college by helping students learn how to navigate college systems and gain comfort with college faculty, staff, and students (Ackermann, 1990).

A higher percentage of program group students passed this first college-level math course. Program group students were also significantly more likely to attempt a college-level reading course and significantly less likely to attempt the lowest level of developmental reading. Significantly more program group students than control group students attempted at least one writing course and passed their first college-level writing course. In addition, during the 2009–2010 academic year, students in the program group attempted one more college-level credit than students in the control group (Wathington et al., 2011).

Overall, the evidence assembled in this look at the impact of the developmental summer bridge programs suggested that students' course-taking patterns are trending in the desired direction. In addition, these results suggested that developmental summer bridge programs might help prepare students to pass introductory college-level math and writing courses (Wathington et al., 2011).

Research on summer bridge programs has suggested that "at risk" or underprepared students who participate in these programs show improvement in their academic performance. Through analysis of pre- and post-test scores, fall registration rates, and course completion rates, Bengis et al. (1991) concluded that summer bridge program participation in New York City colleges was positively related to academic performance. More recently, Navarro (2007) found that the lowest performing cohort of students in the bridge program were 10% more likely that their non-participating peers to successfully pass their courses (Wathington, Pretlow, & Mitchell, 2011). Summer bridge participants, on average, attempt a greater number of college-level credits than the control group, suggesting that the program group had a reduced need for developmental courses because of their program participation (Wathington, Pretlow, & Mitchell, 2011).

Each approach of each level of the community college organization attempted to use innovation to strengthen student success. Despite gallant efforts, African American students were not studied.

Guiding Theories

Culturally relevant pedagogy.

> In the past, a student who was Black was likely not to do well. The Meyerhoff program changed that almost immediately. As soon as Meyerhoff students started earning A's …Becoming very insistent on going into research programs and being successful, all of a sudden you couldn't make that assumption. Looking for success rather than failure (in your Black students). That's a big change. That's a big institutional change. That happened in my department and it happened throughout the institution. (Hrabowski III, Maton, & Schmitt, 2000, p. 54)

Drawing on the works of King (1995), Hillard (2001), and McCarthy (1998), Tillman defined culture as a group's "individual and collective ways of thinking, believing, and knowing. This includes shared experiences, consciousness, skills, values, forms of expression, social institutions, and behaviors. This definition does not presuppose a singular view of African American culture; rather it implies a shared cultural knowledge" (Tillman, 2002, p. 4). Thus, the concept of culture can exist along the many dimensions and considers the commonalities as well as the differences among African Americans.

The argument for culturally relevant pedagogy stems from a long line of scholarship with historical roots—Tillman (2002), Du Bois (1973), Cooper (1988), and

Woodson (1933; 1977), who believed that advancing the education of African Americans took an understanding of the cultural and historical contexts of their lives and that attempts to portray Black people and Black culture(s) by persons who have limited knowledge of Black life leads to inaccurate generalizations (Tillman, 2002).

Ladson-Billings found that excellent teachers of African American students believed that all the students were capable of academic success, saw their pedagogy as unpredictable, always in the process of becoming, saw themselves as members of the community, and they saw teaching as a way to give back to the community (Ladson-Billings, 1995, p. 478).

The three broad propositions that have emerged from Ladson-Billings work on cultural pedagogy are centered on the following:

1. The conceptions of self and others held by culturally relevant teachers;
2. The manner in which, social relations are structured by culturally relevant teachers; and,
3. The conceptions of knowledge held by culturally relevant teachers.

Culturally relevant teachers consciously create social interactions to help them meet the three previously mentioned criteria of academic success, cultural competence, and critical consciousness. The teachers maintain fluid student-teacher relationships, demonstrate a connectedness with all of the students, develop a community of learners, and encourage students to learn collaboratively and be responsible for another.

Culturally relevant teachers encourage a community of learners rather than competitive, individual achievement. They demand a higher level of academic success for the entire class, and individual success does not suffer. However, rather than lifting up individuals (and, perhaps, contributing to feelings of peer alienation), teachers make it clear that they are working with smart classes (Ladson-Billings, 1995, p. 480).

Cultural relevant pedagogy suggests that knowledge is not static; it is shared, recycled, and constructed. Knowledge must be viewed critically. "Teachers must be passionate about knowledge and learning. Teachers must scaffold, or build bridges, to facilitate learning. Assessment must be multifaceted, incorporating multiple forms of excellence. Knowledge is about doing. The students listened and learned from one another as well as the teacher" (Ladson-Billings, 1995, p. 482). Students were affirmed in their ability to code-switch, or move with facility, in language between African American language and a standard form of English, they were supported in the attempts at role-switching between school and home (Ladson-Billings, 1995, p. 482). Ladson-Billings contended that culturally relevant teaching is distinguishable by three broad propositions or conceptions regarding self and other, social relations, and knowledge. With this theoretical perspective, she broadened the notion of pedagogy beyond strictly psychological models. She stated that earlier sociolinguistic explanations have failed to include the larger social and cultural contexts of students and the cultural ecologists have failed to explain student success. Indicating a need for a culturally relevant theoretical perspective on the growing disparity between the racial, ethnic, and cultural characteristics of teachers. This need has created failure and an achievement gap among African American, Native American and Latino students (Ladson-Billings, 1995, p. 482).

Researchers interested in contributing to strengthening African American student success may consider re-educating the candidates we currently attract toward a more expansive view of pedagogy (Bartolome, 1994). This can be accomplished partly by helping prospective teachers understand culture (their own and others) and the ways it functions in education. Rather than add on versions of multicultural education or human relations courses (Zeichner, 1992) that serve to exoticize diverse students as "other," a culturally relevant pedagogy is designed to problematize teaching and encourage teachers to ask about the nature of the student-teacher relationship, the curriculum, schooling, and society.

Theory of involvement.

> Student involvement refers to the amount of physical and psychological energy that the student devotes to the academic experience. Thus, a highly involved student is one who, for example, devotes considerable energy to studying, spends much time on campus, participates actively in student organizations, and interacts frequently with faculty members and other students. Conversely, a typical uninvolved student neglects studies, spends little time on campus, abstains from extracurricular activities, and has infrequent contact with faculty members or other students. (Astin, 1984, p. 518)

Nora's (2003) student institution engagement model emphasized the unique interaction between the student and the institution in addition to prior research around students' interests in and decisions to persist in a STEM major. The model theorizes that students' interaction between themselves and their chosen major is influenced by several student behaviors, and experiences, producing a connection, or engagement, between the student and his or her institution that leads to persistence and degree attainment (Crisp, Nora, & Taggart, 2009, p. 927).

Students bring pre-college characteristics to college, such as high school experiences and prior academic achievement that influence their college experiences and subsequent connection to the institution and chosen degree. Students behaviors and college experiences are also thought to be influenced by environmental pull factors that exert a "pulling away" or a "drawing in" of students into the academic and social campus environments (Crisp et al., 2009, p. 927).

These pull factors are thought to be related to students' attitudes and ability to remain in college and center on variables outside of university life, such as having to work off-campus, attending to family responsibilities, dealing with financial concerns, or attending campus part-time. At the same time, institutional or college experiences (e.g., coursework and academic performance) are said to solidify students' commitments, degree goals, and ultimate persistence decisions (Crisp et al., 2009, p. 927).

Research indicated that minorities tend to view general coursework as separate from a college-prep curriculum (as cited in Simpson, 2001), differing from the views of their nonminority peers who often begin to make occupational decisions, such as taking college-prep courses and engaging in extracurricular activities early on (Stage & Hossler, 1989). For instance, Rakow and Walker (1985) found that there was a statistically significant difference in the number of traditional college preparatory courses taken by White and minority students, with White students averaging about a third of a semester more in college-prep courses and averaging higher in science achievement than Black or Hispanic students. More recently, Hurtado et al. shared similar findings in 2009 (Crisp et al., 2009, p. 928).

Astin's (1985) theory of involvement posed that highly involved students are likely to devote considerable energy to studying, working on campus, participating in student organizations, and interacting with faculty and peers. Although getting involved in the social and academic life of the college is important for persistence and academic growth, students from low-income backgrounds and who are the first in their family to attend college, usually find it difficult to get involved on their own. These students want to get involved but often do not know what questions to ask and may be reluctant to ask those that make them appear stupid or lazy.

Validation theory recognizes the limitations of expecting all students, regardless of backgrounds, to get involved in institutional life (Rendón, 1994). In a validation model, institutional agents, not students, are expected to take the first step to not only promote involvement but to affirm students as knowers and valuable members of the college learning community.

Validation theory poses that college faculty, counselors, and administrative staff take a proactive role in reaching out to students to affirm them as being capable of doing academic work and to support them in their academic endeavors and social adjustment. Because there are stark differences between traditional and nontraditional students, it is important to distinguish between the two groups.

Theory of validation. Research indicated that validating experiences such as encouragement, affirmation, and support have a significant impact on student development in and out of college (Belenky, Clinchy, Goldberger, & Tarule, 1986; California Tomorrow, in press; Rendón, 1994; Terenzini et al., 1994). Although I did not explore this theoretical framework in detail, the literature suggested that the theory of validation is an important factor in retention and graduation results.

In- and out-of class validating experiences are especially important with non-traditional student populations such as returning adults, low-income students, first-generation students, and many women and minority students from working-class backgrounds. Many nontraditional students come to college needing a sense of direction and wanting guidance but not in a patronizing way. They do not succeed well in an invalidating, sterile, fiercely competitive context for learning that is still present in many college classrooms today (Rendón, 1994).

There are two types of validation. Academic validation occurs when in- and out-of-class agents take action to assist students to "trust their innate capacity to learn and to acquire confidence in being a college student" (Rendón, 1994, p. 40). Interpersonal validation occurs when in- and out-of-class agents take action to foster students' personal development and social adjustment (Rendón, 1994). It should be noted that there are some qualitative differences between validation and involvement theory.

Background Characteristics and Student Success

Thomas (1984) reported gender and occupational expectations to be the strongest predictors of college major choice for African American students attending predominantly White and historically Black colleges.

> Among both groups of students, Black females more often chose traditional over nontraditional majors than did Black males. Generally speaking, being male and having high occupational aspirations was predictive of majoring in the biological, technical, and natural sciences, although Black students on White campuses were significantly less likely to elect these majors, irrespective of gender. (Allen, 1992, p. 30)

Gender affected the choice of college major for Black women, both directly and through its influence on career aspirations and traditional sex-role orientations. Black females reported that, during their younger years, they were less concerned with construction or repairing, advanced mathematics, science clubs, and famous scientists; instead they placed more emphasis on helping other people than on the pursuit of financially lucrative careers. "Consistent with Gurin and Epp's findings, Thomas (1984) found that Black women were most likely to plan on entering nontraditional occupations when they attended private colleges characterized by frequent faculty/student interactions and a student culture that emphasized intellectual values" (Allen, 1992, p. 31).

In summary, the evidence suggested that African American students attending historically African American institutions have fewer socioeconomic resources than do both African American and White students attending predominantly White institutions. Their parents have fewer years of schooling, earn less, and have less prestigious occupations than the parents of African American and White students on White campuses. They also have lower high school grade point averages, lower standardized test scores, and, during college, have more limited educational opportunities (that is, fewer academic majors to choose from, more limited educational resources, and lower quality facilities) than their peers on White campuses (Allen, 1992, p. 32).

African American students on African American campuses have advantages over African American students on White campuses in many other respects. For instance, they display more positive psychological adjustments, more significant academic gains, and greater cultural awareness and commitment than African American students on White campuses. In general, the "fit" between African American students and higher education seems more favorable on historically African American campuses than on predominately White campuses (Allen, 1992, p. 32).

In addition to the predominant racial identity of campuses, students' social class origins and gender identity were also revealed by previous research to be important determinants of African American student success (Fleming, 1984; Gurin & Epps, 1975;

Allen, 1992). Students from lower socioeconomic backgrounds experienced barriers to their access and success in higher education. African American women were shown to encounter challenges and problems arising from their unique identity in two (gender and race), if not three (gender, race, and class) discriminated categories. These challenges often represented serious barriers to the satisfaction with and achievement in college of African American women (Allen, 1992, p. 32).

Self-Efficacy and STEM

Self-beliefs are a critical component of most modern theories of human motivation. The central construct in Bandura's (1986, 1997) social cognitive theory is self-efficacy, which he defined as people's judgments of their capabilities to produce designated levels of performance.

According to the beliefs of social cognitive theory, people are more likely to perform tasks they believe they are capable of accomplishing and less likely to engage in tasks about which they feel less competent. Individuals' perceptions of their competencies are powerful motivators that affect the choices they make, the effort and persistence they put forth, and the resilience they show in overcoming obstacles (Zeldin, Britner, & Pajares, 2008, p. 1036).

Self-efficacy beliefs also play a meditational role in that they serve as filters between prior achievements or abilities and subsequent behavior. For example, students who interpret the results of their test scores favorably may use that interpretation to fuel their effort to study hard, so as to perform well on subsequent exams (Zeldin et al., 2008, p. 1036).

People form their self-efficacy perceptions by interpreting information from four sources: (a) authentic mastery experiences; (b) vicarious experiences; (c) social persuasions; and, (d) physiological indexes (Bandura, 1997). The first two sources relate to student perceptions while the third and fourth are externally measured outcomes. Bandura theorized that the most influential source of information comes from the interpreted results of past performance, which he called mastery experiences. These past performance accomplishments can create a strong sense of efficacy to accomplish similar tasks in the future. Alternatively, repeated failure can lower efficacy perceptions, especially when such failures occur early in the course of events and cannot be attributed to lack of effort or external circumstances (Zeldin et al., 2008, p. 1036).

The second source of self-efficacy information is the vicarious experience gained by observing others perform tasks. By observing the successes and failures of others, people gather information that contributes to their judgments about their own capabilities. Modeling has the greatest influence when the models observed are perceived to be similar to the observer and in situations in which the observer has little personal experience (Zeldin et al., 2008, p. 1036).

Student Attrition and STEM

The intensity of STEM courses taking in the first year, the type of math courses taken in the first year, and the level of success in STEM courses bore stronger associations with this outcome than did many other factors. Specifically, taking lighter credit loads in STEM courses in the first year, taking less challenging math courses in the first year, and performing poorly in STEM classes relative to non-STEM classes were associated with an increased probability of switching majors for STEM entrants at both the bachelor's and associate's degree levels. Accumulating higher levels of withdrawn/failed STEM credits was also a critical factor for switching majors among bachelor's degree STEM entrants (Chen & Soldner, 2013).

With respect to the outcome of leaving college without earning a degree or certificate, results indicate that STEM entrants' overall college performance and level of success in STEM courses were better predictors than many other factors. Poor performance in college (as reflected by a lower cumulative grade point average [GPA] through 2009) and high levels of withdrawn/failed STEM courses were associated with an increased probability of dropping out of college for STEM entrants (both bachelor's and associate's). Less success in STEM courses than in non-STEM courses (as reflected by earning lower STEM grades relative to non-STEM grades) was also associated with an increased probability of dropping out of college for STEM entrants at the associate's degree level (Chen & Soldner, 2013).

Developmental Education

As minority students progress through their academic careers, their interests in science and mathematics weaken as their achievement in these classes declines (Peng, Wright, & Hill, 1995). A disproportionate number of Hispanic and African American students are often assigned or incorrectly placed in developmental or remedial courses based on faulty achievement test scores (Catsambis, 1995). Consequently, they are limited in the number of science and mathematics courses they take and, in the end, are unlikely to be prepared for high school and/or college-level STEM coursework (Oakes, 1990; Peng et al., 1995; Simpson, 2001). Moreover, once in college, students (both minority and nonminority) may face additional challenges during introductory mathematics and science courses, often referred to as “gatekeeper” courses.

Research on these courses tells us that some introductory mathematics and science courses (such as biology, chemistry, or calculus) may serve to discourage students from earning a STEM degree as a result of highly competitive classrooms or a lack of engaging pedagogy that promotes active participation (Gainen, 1995; Seymour & Hewitt, 1997).

> The goal of developmental education is to build up the basic skills in English and mathematics of academically unprepared students so that they are successful in college-level work. Rigorous evaluations suggest three major conclusions about reform efforts: multiple mathematic pathways are critical, accelerated developmental education courses must be implemented, and development education curriculum must be created based on evidence based best practices. (Zachry Rutschow & Schneider, 2012)

Only 20% of students referred to math remediation and 37% of those referred to reading complete a gatekeeper course in the relevant subject area within three years (Liu

& Roohr, 2013). Many students referred to developmental education fail to complete a college course because they never enroll in their first remedial course: between one-fourth and one-third of referred students never enroll in developmental education.

These students do not necessarily leave college. In some colleges or states, remediation is not mandatory and in most colleges, students can take courses in subjects for which the remedial course they were referred to is not a prerequisite. It may be that students, perhaps with the collaboration of some faculty or counselors, simply do not comply with the regulations (Handel & Williams, 2011).

One interpretation is that the developmental education obstacle course creates barriers to student progress that outweigh the benefits of the additional learning that might accrue to those who enroll in remediation. Developmental education literature is consistent with the research cited earlier that suggested remedial services do little to increase the chances that a student will be successful in their first college-level course.

An alternative explanation is that these students have a better understanding of their skills than the counselors, armed with widely used assessments (Bailey et al., 2009, p. 257). Short-term, focused reforms tend to have modest effects that fade within a semester or two. One common approach is a learning community in which cohorts of students co-enroll in developmental courses linked with college-level courses (Zachry Rutschow & Schneider, 2012).

Single-semester learning communities have produced modest, positive effects on the number of developmental credits earned by students during the program semester, but the effects tend to diminish within one year. When enhancements, such as tutoring, advising, and book vouchers are added, learning communities can lead to higher graduation rates but mostly for students who are already college ready. Similarly, summer bridge programs, which give high school seniors a last-minute opportunity to brush up their skills before taking college placement tests, have generated higher pass rates in college-level math courses, but the effects also fade within a year (Zachry Rutschow & Schneider, 2012).

Comprehensive reforms may lead to more sustained effects than approaches that address only one or two obstacles facing students. However, these programs are more costly and difficult to scale up. For example, preliminary analysis of the Accelerated Study in Associate Programs (ASAP) at the City University of New York (CUNY), an unusually multifaceted program that provides an array of support services and incentives designed to help developmental education students graduate, shows that it increased the proportion of students who completed their developmental coursework by the end of the first semester (Zachry Rutschow & Schneider, 2012).

Programs that accelerate students through developmental education hold promise. For example, the Accelerated Learning Program (ALP) at the Community College of Baltimore County placed developmental English students into mainstream college-level English courses while enrolling them in a companion course in which the same instructor provided additional guidance. Students participating in ALP were more likely to take and pass the first two college-level English courses, compared with students who enrolled in developmental courses (Zachry Rutschow & Schneider, 2012).

To dramatically increase completion rates, comprehensive, long-term reform strategies that address all aspects of a community college student's experience are needed. For example, Completion by Design is a program that aims to help colleges implement structured and systematic changes—from entry to completion—to provide students with the most efficient and direct path to a degree. Achieving the Dream is another example of a large-scale initiative program that tries to change the institutional culture of colleges by helping them collect and analyze student performance data, which can inform system-wide reform strategies (Zachry Rutschow & Schneider, 2012).

Summary

While community colleges play a vital role in increasing skill sets for African American students who form the STEM workforce pipeline, there is considerable variability across those institutions (Baber, 2011). Improvements to existing community college education programs are critical to meeting regional workforce demand. Recent studies show that combining academic rigor with career and technical education, work-based learning, and specific guidance or mentoring designed to move African American students toward postsecondary goals improves graduation rates and boosts scores in reading, mathematics, and science (Baber, 2011). The literature is scant in examining African American community college STEM students transition to the workforce.

There are several examples in this literature review of STEM-focused initiatives that will strengthen the skills of African American students and increase the pool of future qualified African American candidates. Continuous focus on early college high schools appears to be promising for STEM workforce development.

Community colleges that align programs of studies with career pathways, collaborate with industry partners for workforce demands, and continue to address underserved populations will strengthen the country's ability to create more qualified African American STEM candidates. With high leverage, low-cost investments, community colleges can continue to generate industry-certified workers for regionally in-demand jobs and prepare an increasingly diverse segment of the population for rewarding careers in STEM professions (Baber, 2011).

Chapter Three: Methodology

Research Design

For this study, the qualitative research method of in-depth phenomenological interviewing was used (Seidman, 1998). This tool provides a strong method of scientific inquiry for understanding the context of the lives of successful African American students in STEM majors.

The purpose of in-depth interviewing is not to get answers, nor to test hypothesis, and not to “evaluate” as the term is normally used (Seidman, 1991, p. 3). Of the many techniques (e.g., observation, field research), interviewing is recommended as one of the most suitable and valuable tools to discover how humans construct multiple social meanings (Seidman, 1991).

The epistemological approaches used for this study were Astin’s theory of involvement, Ladson-Billings’overarching theory of cultural relevant pedagogy and Validation Theory. Theory strategies were incorporated into the research process. These strategies were not confined to the interview process but occurred throughout the entire research process. Research strategies included continuously asking questions, using research notes, exploring challenges, making constant comparative analysis, and open-ended questioning (Charmaz, 2002).

This study examined the background characteristics of African American community college students, as well as their experiences during attendance at a community college, which may help to predict their success in STEM fields. The life experiences, personal stories, and reflections of African American community college students was explored in order to understand the contextual realities within which the opportunity for their participation in the STEM fields has been facilitated or denied (Giscombe, 2007).

Since this analysis sought to discover how African American community college students construct social meanings through their life experiences and through personal and academic interactions with others, the primary source of data gathering was in-depth interviewing (Seidman, 1998).

The qualitative method produced a non-threatening environment where researcher and participants shared and explored the pleasant or delicate, negative or positive, and critical issues around their perspectives of disparity, tensions, etc., in their world in an in-depth and honest way (Gallagher, 1993, p. 253).

After identifying the individuals as the unit of analysis, using the quantitative analysis research method—to identify how African American community college students give meaning to their life experiences, interactions, and achievements in the STEM fields—would have been inappropriate (Giscombe, 2007).

Understanding this journey to achievement in STEM areas required the presence of the Black students' voices (Casey, 1993). The perceptions and beliefs of the Black students reflected their unique life experiences and the discourse they faced moving throughout academic environments of higher learning (Casey, 1993).

In drawing from the philosophical perspective that public educational institutions are social institutions (Casey, 1993), education is seen as a progression and school is a lived experience and that "understanding the meaning of the process and/or experiences constitutes the knowledge to be gained when using an inductive mode of inquiry" (Merriam & Clark, 1991, p. 257). Because this study sought to understand the educational process and its link to the complexity of human systems and social interactions of African American community college students, this interpretive research approach was most appropriate (Merriam, 1990).

The in-depth phenomenological inquiry is one in which the researcher engages each participant in two separate interviews. The interviews had two different foci: the first focus was the establishment of the historical biography of the participants' life experiences in the context of the phenomenon being studied; second, the exploration of the participants' life experiences as they presently exist; and the reflections and responses of the participants to the events and experiences relative to the focus of the study (Giscombe, 2007).

The academic outcomes and behaviors of African American students become more meaningful when placed in the context of their lives and in the lives of people with whom they interact (Seidman, 1998). The findings of this study apply to the general population of African American community college students in STEM fields; more importantly, the findings provide information about the complexity of the African

American students’ experiences (in community colleges) in the context of their achievements in the STEM fields of study (Miles & Huberman, 1994; Patton, 1989).

Rodriquez (2001) explored the limitations of this methodology, using aggregate numbers to explain all social phenomenon and concluded that it is limited because it is unable to give us an understanding of the social realities, of the life experiences, that facilitated or denied access into science and science education. Therefore, the approach used in this study represented a paradigm shift from “gap gazing” (Rodriquez, 2001)—that is, the current fixation with the cumulative numbers of African American students in STEM fields—to an approach that places the patterns of personal individual experiences at the center of the analysis (Giscombe, 2007).

Seidman (1991) also stated, that “interviewing encourages people to reconstruct their experiences actively within the context of their lives” (p. 8). If science reform effort is seeking to uncover truths about experiences for African Americans to achieve in the natural sciences and to understand the meaning they make out of their experiences–“subjective understanding” (Schutz, 1967)–then research efforts that provide inquiry into their lives are necessary and provide one of the most effective approaches for validity and reliability (Seidman, 1998).

Using narrative as a way of knowing about the educational practices in science and its connection to the social world of the participants is based on the assumption that reality is constructed by the experiences of the participants (Merriam, 1990). Consequently, Merriam submitted that narrative is an alternative approach to the popular traditional forms of inquiry, which are dependent on numbers to explain the complexity of the issues, structures, processes, and policies that shape and are shaped by the life stories of the underrepresented African Americans in the natural sciences (Giscombe, 2007).

In summary, the following key points, as adopted from Erickson (1986), Denzin and Lincoln (1994), and Seidman (1998), characterize this qualitative study and best describe the logic and reasoning for choosing this methodology. In this study African American students' voices were at the center of the discourse, and were key to understanding the phenomenon of the journey to their success in higher education, in science, technology, engineering, and math.

Therefore, it was reasonable to consider the stories of how African American community college students construct social realities in the context of the journey. Making meaning of their experiences as they interact within their communities and their social worlds were sources of rich, deep, and valuable data. The use of in-depth phenomenological interviewing (Seidman, 1998) was a more effective way for gathering a rich source of data than some lifeless instrument (such as a questionnaire or inventory of a biography). This instrument allowed for a more reliable analysis and increased the validity of the findings to develop a composite picture of African American students in the wider social context of the scientific community. Present theories and perceptions about the underrepresentation of African American students in STEM fields were challenged to sufficiently explain the phenomenon and to provide significant solutions (Rodriquez, 2001).

Semi-structured interviews. Using Seidman's (2006) model for conducting phenomenological, individual in-depth interviews, this study included the perspectives of eight African American community college STEM majors. Students who had completed at least one year in a STEM workforce development program were selected randomly from the Minneapolis Community and Technical College. Each student participated in two semi-structured interviews. Individual interviews allowed the researcher to delve more deeply into the participants' experiences and clarify issues, which were unclear to the researcher (Ritchie & Lewis, 2003). Additionally, these interviews supported an "undiluted" focus on the participants and were uniquely suited for "research that requires an understanding of deeply rooted or delicate phenomena" (Ritchie & Lewis, 2003, p. 36), making their placement within this in-depth phenomenological study of African American students in STEM at a community college appropriate.

Building rapport involved building confidence within research participants, and ultimately, moving towards a sense of trust within the researcher/participant relationship (Glesne, 2011). To establish trust within the researcher/participant relationship confirms a sense of honesty and integrity within the interview process and facilitates the interview process for research participants (Glesne, 2011). The remaining questions in the interview protocol drew from prior research of student success and students of color.

This study employed a qualitative approach in order to build a complex holistic picture of African American STEM students during their experiences participating in a community college workforce development program. I interviewed eight African American students majoring in STEM areas from Minneapolis Community and Technical College. This institution was selected because of the large population of African American community college students at MCTC African Americans represent 35%. (Appendix G). MCTC was an idea choice because of my professional relationship with administrators who helped identified the students and gave me access to data about the institution.

Upon administering my study I endeavored to interview 15 students and was able to interview 8 students. In this chapter I provide descriptions of the settings of the interviews and other data collection details below. Next, I provide a detailed description of Minneapolis Community and Technical College's STEM Workforce development program from which the students were obtained. Following the program description, a description of the eight African American STEM majors and their transition to industry is provided.

Qualitative Analysis

The data for the qualitative analysis was gathered from open-ended questions and semi-structured interviews. Ten open-ended interview questions focused on the experiences that accelerated or delayed the overall success of African American community college students majoring in STEM fields. The research questions were:

1. How do African American community college students in STEM majors describe the experiences that accelerated or delayed their overall success?
2. What characteristics appear for African American community college in STEM students who successfully complete degree requirements and transition into industry?
3. How do African American former community college students in engineering and other STEM (non-engineering) majors describe experiences that facilitated or impeded their overall adjustment to industry?

Participants. Interview participants in this study were African American community college students who are pursuing an associate degree in STEM. A total of eight students, three males and five females between the ages of 20 and 48 were interviewed.

Data collection. All interviews were transcribed verbatim and an overview of the qualitative findings of this study is provided in this chapter. Interviews were embedded into the typed transcripts as remarks. Interviewing is considered the main method of data collection in qualitative research but particularly within phenomenological studies. The purpose of phenomenological interviewing is to describe the meaning of a concept or phenomenon that several individuals share (Marshall & Rossman, 2006). One of the greatest advantages of conducting phenomenological interviews is that "it permits an explicit focus on the researcher's personal experience combined with those of the interviewees" (Marshall & Rossman, 2006, p. 105). The interviews utilized in this study were semi-structured in nature, allowing the interview to progress naturally. An interview protocol was used that consisted of working topics and questions. Probing questions were used as needed to obtain as much data as possible from participants. Each interviewee participated in two, one-hour semi-structured interviews conducted during September and October of 2014.

Student interviews. There were 16 hours of interviews and 12 pages of field notes collected, which resulted in 40 pages of transcripts. All student participants were from the greater twin cities metropolitan area. All first interviews were face to face and second interviews were conducted over the phone. For the second interviews there were six interviews lasted 60 minutes with the exception of two, which lasted 90 minutes. There were 10 hours of interviews and 8 pages of field notes collected, which resulted in 25 pages of transcriptions. Upon completion of the interviews copies were given to the participants to ensure accuracy. While maintaining the privacy of the interviewees identity I shared summaries of the notes with administrators with institutional research and they confirmed that the information was accurate.

Data analysis. Creswell (2009) viewed data analysis as an interactive process and drew attention to six steps in the analysis in qualitative research. I followed these steps through my qualitative analysis. The interviews were recorded using digital records and transcribed verbatim from the audio recording. Each interview transcript was read multiple times without taking notes to gain an understanding of each interview. After an understanding was reached, each interview was reread while taking notes and questions were noted in the margins. Next, the coding process began. Coding is the organizing of interview information into segments of text before giving meaning to the information (Rossman & Rallis, 1998). Each interview was then grouped by themes to organize and categorize the findings. The fourth step in the process was to generate descriptions from the coding process, and the fifth step was to explain how the themes were represented in the findings. Lastly, the data was interpreted. This process was carried out to analyze the open-ended questions during the interview.

Ethical Considerations

Approval for the use of human subjects was obtained through the Institutional Review Board (IRB) at the University of Texas at Austin before any information was collected (Appendix E). The researcher was aware of the sensitive nature of this data and complied with all restrictions on the use of data containing important participant information. No data from students were reported without aggregating the results to maintain anonymity of the individuals.

Delimitations of the Study

This study is focused on African American community college students majoring in STEM fields at Minneapolis Community and Technical College. In addition, this study was designed to focus exclusively on students who participated in workforce development programs pursuing certificates, diplomas, and associates degrees. Consequently, the experiences of students participating in other academic disciplines and attending other institutions may be different.

Limitations of the Study

The target population for this study encompassed African American students who may have similar demographic and background characteristics. Therefore, the experience of other ethnicities may vary from the target population. Additionally, the qualitative data of this study was self-reported. Therefore, students who decided not to respond to all the questions limited the findings. Furthermore, the qualitative findings were limited to the recollection of community college students and their past experiences.

Validity. The findings of this study are not intended to generalize the experience of African American community college students who have been successful majoring in STEM fields. I believe that there is transferability (Creswell, 1998) of the results from this study to other contexts in which readers can identify with their own journey as African American students or make connections to meanings or events as described by the participants in this study. I believe the findings in this study have increased the research knowledge base for policy makers, institutions, and individuals who seek to address the issues of education reform in community colleges targeting STEM fields. The lived experiences and the life worlds of individuals are complex (Gallagher, 1993; Miles & Huberman, 1994; Seidman, 1998); therefore, reflections, perceptions, insights, and expectations of their experiences can generate knowledge that will help others understand the impact of sociocultural forces on the meanings they attach.

Summary

An overview of the qualitative methodology used to design and conduct this study is provided in chapter three, which is organized into five sections. The first section provides details of the background characteristics of African American community college STEM students. The chapter also includes the research design, semi-structured interviews, validity, ethical considerations, delimitations of the study and the limitations of the study.

Chapter Four: Findings

Chapter four reveals the results of the data analysis pertaining to the qualitative components, and findings generated from the open-ended questions that were examined.

Analysis of the Data

After transcribing, I read each interview in its entirety at least two times in order to get a sense of the textural meanings of the participants' statements, and of who the participants are as humans. I did line by line coding of the transcripts, often while listening to the taped interviews. Many of the codes came from in vivo terms found in the data. For example, "prioritizing" was a term I heard during my second interview. I liked the term, and once I decided on the "prioritizing" term as a code for experiences that were occurring often, I was able to go back to the first interview and use it as the code for other words, phrases, and stories that described the experience of "prioritizing" short and long-term goals.

Next, I grouped the codes into larger categories that I referred to as subthemes, and a few in vivo terms became the title of subthemes. For example, I have a subtheme titled "making valuable connections." I actually heard the word "valuable" or "connection" used, but more often, these two words are the label I used to describe the meaning of a phrase and/or passage. I also used the in vivo code "prioritizing" as a subtheme. Then, I created a structural diagram (Table 2) to assist in reflecting upon these subthemes in order to look for relationships across the subthemes to create broad themes. From these broad themes, I have constructed an account of the essence of the mentor-mentee relationship.

Summary

An overview of the qualitative findings of this study is provided in this chapter, which is organized into five sections. The first section provides details of the background characteristics of African American community college STEM students. This section also includes the community college experiences of the African American community college STEM workforce development students.

Adjustment Factors

Question one was, related to adjustment factors, where students were asked, “What factors help you to adjust to MCTC? Please explain what factors contributed to your successful completion and transition into industry. Feel free to include factors at both your community and at Minneapolis Community and Technical College.” Three themes emerged from student responses: (a) the guidance of advisors and professors played an important role in students’ success, (b) building friendships and meeting other students from the same field allowed students to share experiences, develop a sense of belonging, and feel more engaged in classes, and (c) being involved with different organizations and activities on campus helped students learn about the college and meet new people. This resulted in reduced struggle with homework and greater success in passing their classes.

Workforce Development

The information about Minneapolis Community and Technical College's STEM Workforce development program came from visiting the college website, my experience as a former employee of MCTC, and talking to staff from the program. Minnesota is uniquely positioned to grow its bioscience industry. The state has 19 Fortune 500 companies as well as an internationally renowned medical technology cluster. State leaders have made it a goal for Minnesota to capitalize on these assets and become a global leader in the biosciences by 2025. MCTC has developed partnerships within the local industry and community, and students benefit in numerous ways from these alliances, including possible industry internships, seminars by guest speakers from industry, and industry and research laboratory tours.

The Minnesota High Tech Association (MHTA) named Minneapolis Community and Technical College's Biotechnology Program as one of 36 finalists for the 15th annual Tekne Awards, which will be held on Thursday, Nov. 13, 2014 at the Minneapolis Convention Center. The program is a finalist in the workforce development award category, which honors innovative approaches to training workers in transition or youth with technology skills and successfully matching them to jobs that meet the needs of Minnesota companies.

The Academy of Science and Mathematics prepares students through certificates, diplomas, and associate degrees for transfer and careers in science, engineering, and math. This academy also prepares students for higher learning and professions in fields such as research, mathematics and statistics, microbiology, biotechnology, and physics. The Biotechnology program is taught by faculty members with research and business experience, as well as industry instructors, visiting scientists, and mentors. The Biotechnology program is housed in MCTC's Science and Allied Health Center, which opened in fall 2009. Biotechnology lab facilities include a wide variety of instrumentation, biosafety cabinets, fume hoods, HVAC systems and cold, dark, and tissue-culture rooms.

The program provides students with "hands-on" laboratory training in technical skill sets widely required and recommended by local biotechnology industry; 4-year graduates lacking necessary hands-on skills can register for specific individual courses. The program also provides students with a strong foundation in biological and chemical sciences with an emphasis on critical thinking, problem-solving, oral and written communication, teamwork, and basic computer and math skills.

Giving Meaning to Participants' Opinions

The themes in this chapter provide an understanding of what the students experienced. In chapter five, the focus of the discussion will be "what these behaviors and actions meant to the students."

This study was designed to explore the responses of African American community college STEM students to the following research questions:

1. How do African American community college students in STEM majors describe the experiences that accelerated or delayed their overall success?
2. What characteristics appear for African American community college in STEM students who successfully complete degree requirements and transition into industry?
3. How do African American former community college students in engineering and other STEM (non-engineering) majors describe experiences that facilitated or impeded their overall adjustment to industry?

When exploring these questions, five themes emerged from the students' stories: (a) making connections; (b) mentor "like family"; (c) STEM-specific stress; (d) creating mature STEM adult professional; and (e) improving mentees' self-esteem and efficacy. The findings are interlaced within elements of Astin's (1984) involvement theory. An important aspect of Astin's theory is the belief that students' academic and social interactions influence their academic success.

Qualitative Findings Interviews Summary

This section presents the qualitative findings through an analysis of individual profiles, and a summary of emergent themes: prioritizing, professionalism, building a network, internships, and planning. When presented collectively, these themes provide an understanding of how African American community college students from STEM majors describe their overall academic and social adjustment experiences. Based on the data collected from the interviews, a deep solid description of how these students perceived their overall experiences was obtained.

Table 1

Background of Interview Participants

Pseudonym	Credentials	Classification	Major
James	Associates in Science	2nd year student	Computer Science
Sarah	Associates in Science	Graduated 2012	Bio-technology
Anthony	Associates in Science	3rd year student	Engineering
Natalie	Associates in Science	2nd year student	Bio-technology
Penny	Associates in Science	Graduated 2013	Nursing
LaToya	Associates in Science	2nd year student	Business Admin
Jessie	Associates in Science	Graduated 2013	Nursing
Marie	Associates in Science	3rd year student	Nursing

Individual Participant Profiles

The participants had the following STEM majors: one computer science major, two biotechnology, three nursing majors, one engineering major, and one business administration major. The participants' names have been replaced with pseudonyms. All of the participants were born in the United States. The father of one participant was born in the United States, but his mother is an immigrant from Nigeria. All other participants' parents were born in the United States. Two participants are single mothers.

I also provide descriptions of each student with identifying information about each participant so the reader can identify the dyads of specific experiences as they are presented in the results of the analysis. All of the mentee participants' parents have a minimum of high school diploma, with the parents of two participants holding bachelor's degrees in STEM.

James is 20 years old and majoring in computer science. He was raised in Saint Paul, Minnesota and went to a very diverse urban high school where he was engaged in music, math, science, and the arts. He contributes his choice of careers to his interest in technology and his father's career in computer science.

Sarah is 25 years old and finished in biotechnology. She was raised in Minneapolis, Minnesota and attended an urban high school located in a suburb of Minneapolis. During high school she participated in special education and had an Individualized Education Plan. She was also engaged in several student leadership organizations during high school, which lead to her decision to attend a community college.

Anthony is 22 years old and majoring in engineering. He was raised and attended high school in Saint Paul, Minnesota. While in high school he was actively involved in cross-country running and the math team.

Natalie is 25 years old and majored in biotechnology. She was raised and attended high school in Minneapolis, Minnesota. While in high school she was active in the writing club and often got involved in community related activities. Natalie was participated in writing poetry in high school and leads a poetry student organization in college.

Penny is 28 years old and majoring in nursing. She was raised and attended high school in Minneapolis, Minnesota. While attending high school she was actively involved in academics but not as involved in extra-curricular activities. Penny has seven years of work experience and decided to attend the local community college to obtain a degree to advance her career. She also is a single parent of two children.

Latoya is majoring in business administration. She grew up and attended high school in Minneapolis, Minnesota. While in high school she was actively involved with music and dance. She was also involved with the Black Student Association and Student Government. Latoya is an entrepreneur and would like to open a retail store in the future. She is also a single parent and has one child.

Jessie is 44 years old and majoring in nursing. He is originally from Kansas City, Missouri and decided to fulfill a lifelong dream of earning his nursing degree. He currently resides in Minneapolis, Minnesota, and has over 20 years of experience as a nursing assistant in a local nursing home in an urban area in Minneapolis. Jessie does not have any children but has several nieces and nephews that he has taken care of since moving to Minneapolis.

Marie is 48 years old and majoring in nursing. She is originally from Des Moines, Iowa and has three children. While attending community college she worked full-time in a hospital and aspired to be a registered nurse. Throughout her career she has worked in the health care industry in lower level positions. She had her children at a young age and was unable to attend college until later in life. Upon completing her associate of applied science degree she has continued working for a local urban hospital. Two years ago she decided to return to school to get her bachelors degree in nursing. She plans to graduate in May of 2015.

Themes

After the interview data were coded the community college data, I organized the data into ten subthemes. After reflecting upon the subthemes, they were found to coalesce into five themes (Table 2). The themes are: (a) Prioritizing; (b) Professionalism; (c) Building a Network; and (d) Internships (e) Planning.

Table 2

Themes and Subthemes

Themes	**Subthemes**
Prioritizing	Decision Making Skills Family Stressors Social and Academic Interactions
Professionalism	Time Management Life Skills
Building a Network	Defining Valuable Connections Internal and External Networks
Internships	On the job training
Planning	Career Advising Pathway Planning

First, I will talk about themes connected to question one: How do African American community college students in STEM majors describe the experiences that accelerated or delayed their overall success? The theme related to question one are Prioritizing, findings that emerged were decision-making skills, family stressors and social and academic interactions.

Secondly, I will talk about themes connected to question two: What characteristics appear for African American community college STEM students who successfully complete degree requirements and transition into industry? Themes related to question two are Professionalism, and Internships.

Thirdly, I will discuss themes related to question three: How do African American former community college students in STEM majors describe experiences that facilitated or impeded their overall adjustment to industry? Themes related to question three are Planning, and Building a Network.

Theme 1: Prioritizing. This theme was derived from three subthemes*:* Decision Making Skills, Family Stressors and Peer Pressure. The dilemma for African American students becomes one of negotiating the academic demands of school while demonstrating cultural competence (Ladsons-Billings, 1995). Six of eight of the African American community college students who were interviewed described experiences where they perceived obstacles with environments where the majority of their peers, family members, and friends have not attended college. According to the six students this makes it difficult for students to prioritize their academic goals, which in some cases lead to poor decision-making skills. Two of the interviewees did not mention the lack of family members who did not attend college. These two emphasis shared the importance of internships and mentorship. All of the interviewees described prioritizing problems. These situations included times where they felt they had to choose employment, extra-curricular activities, and family obligations over their academic goals.

James mentioned that he took on a lot of different projects–ranging from computer science to things that have nothing to do with his major. “Other obligations have slowed me down and I had to figured out how to do it without being stressed out.

Managing all this has slowed me down, but I love doing what I'm doing so I deal with it."

Sarah stated,

> Procrastination was my biggest enemy. Living in the community that I was in. I was surrounded by a lot of people who weren't doing what I was trying to do. Changing my mindset, pursing my goals and prioritizing became challenging.

Anthony shared his thoughts by saying,

> I was on overload, working three jobs and taking 16 credits, which was too much. It's better to slow down and do the best you can as opposed to doing too much. I felt overloaded because engineering is such a demanding field and I had to change something to be successful.

Natalie explained that she delayed herself;

> I don't think it was anyone else's fault. I don't think it's anything to be said negative about the institution. I had to get over myself and find the courage to just do it. Financially there was a delay because I have been working fulltime so that I would be able to pay tuition out of pocket.

Of all the students Penny was the student with the most family stressors. It was disappointing to hear that the institution had not support this student who has so driven did not receive institutional support. All of the students would have benefited from support, in regard to financial aid.

Family stressors. Penny explained that her older son was sick and hospitalized;

> "Due to his sickness I was force to quit the nursing program. Now I'm just taking general classes for my liberal arts. This has delayed [me] from getting my nursing degree. I had to prioritize and what was most important to me was making sure my child was healthy. My teachers didn't support me during this time and other times when I had to put my family first. It has been really frustrating but like everything else I have experienced, I had to move on and figure out a way to reach my goals."
>
> "After having my daughter things changed, I had financial obligations and other expenses that I had to put first. I ran out of financial aid and was forced to leave school until I could repay my debt. The main thing is I didn't qualify for financial aid and it caused me to have debt and I had to pay that off before moving forward to registering for more classes."

Social and academic interactions. All eight Students viewed social and academic interactions as an influential factor in making friends, interacting with other students of the same or different majors, and meeting professors in their field of study. In addition, students found that these interactions helped them with their professional development. On the other hand, five of eight students expressed that they missed not being involved with any academic or social group because they did not have time or they were not inspired by anyone else to participate. All eight students mentioned that a lack of role models at the institution made it difficult to be academically successful.

Anthony stated that he is not in any groups, "…but I kind of wish I was, because then I'd be able to stay on campus and communicate with some of my peers. It would be nice to meet others like me who are interested in the same careers goals."

James explained that programs that have been helpful, "BSA, Black Student Association, Black and African students that get together and share a bond, hang out and talk about current events. Media arts club towards my other projects art, video games, music passion."

Unlike James who described judging different projects, Sarah stated her problems were centered around organization. Anthony was overwhelmed by challenges related to academics and work life balance. Sarah thought that social groups were helpful. Despite the lack of support Anthony, implied were unspoken suggestions that he needed more support from faculty and staff. Natalie expressly did not want to identify any problems with faculty or administrators. In her own words, she also pointed to the lack of financial aid. To summarize all of the students in different degrees felt a need to more effectively prioritize time and money.

"I was able to engage with people outside of my program and wasn't always focused on my studies."

Two students also got involved with a video gaming club that was affiliated with the school. All the students shared that getting involved with a Black student organization provided multicultural support to discuss topics important to them, although some admitted that due to family obligations they were not able to participate.

Theme 2: Professionalism. Subthemes for this category are *Time Management* and *Life Skills.* As participants described professionalism they often made reference to being able to manage time and how important it is to have life skills. Student participants defined *Life Skills* as the ability to communicate professionally, having manners, and being polite to people that you interact with in the workplace.

Students described theme two, professionalism, as they shared what skills they thought would be most helpful as they transitioned from college to industry. All eight interviewees conveyed as though professional grooming was a necessary development for successful transition to STEM career pathways.

Sarah shared that,

> One thing I learned was the importance of professionalism and being on time. On the job my work and reports must be prepared and ready to go with no excuses. It seems like professors don't have high expectation at the community college.
>
> I understood this to mean that professors don't have high expectations for African American students. While attending my community college I found myself seeking out people to help me obtain the skills necessary for my desired career field. It wasn't part of my program so I connected with the career center and began attending workshops and trainings so that I would be a good candidate for a high paying position. Sarah was the only student who mentioned the career center as a resource.

All of the students agreed that teamwork is a critical skill to prepare you for the workforce and they spoke highly about the opportunity to work in teams as a positive skill for the workforce. Anthony stated that,

> being a team player, solving problems with your colleagues, and learning how to communicate with people in groups have been important. Being driven, motivated, and passionate about what you're doing is also key. Even if you don't necessary have the greatest job, with the best pay, show up like you're the CEO.

Each student also mentioned leadership skills, and three of the eight students interviewed plan to own businesses. Two male students have successfully started business ventures through video game creation and website design. The third student, a female planned to start a business in technology. While her plans were vague her excited was noticeable. These three students felt the goal of owning their own business was a motivating factor for successfully completing their STEM degrees.

James shared,

> Owning my own business is my goal and this will take strong leadership skills on my part. Using resources to learn about the best companies and doing the research to identify what skills are requirements in your field is critical. I learned to review job descriptions and explore professional biographies to prepare myself for the interviewing process in the nursing field.

The life skills most mentioned by interviewees are being patient, a good listener, and resilient.

Theme 3: Building a network. The subtheme for this area is Making Valuable Connections. All Participants were very candid about the relationships they have established that created opportunities. All believe that networking was a stronger influencer of job opportunities than having a degree from the community college. Overall, the students believed making the right connection is a survival skill in the competitive field of STEM.

All of the participants in this study agreed that building a network was essential throughout their college journey. This research study consists of well supported statements made by students that relate to making connections, the importance of mentors, seeking out potential employers, and connecting with colleagues who have similar interests.

Penny stated,

> Finding mentors was important for me since I was a first generation college student. Having mentors that have gone through the educational process helped me to navigate through my experience at a community college.

> Natalie agreed with Penny but, emphasized the relationship between mentorship and how that fast tracks students. I was surprised that Natalie was the only student that mentioned how mentorship fast track, she has had life experiences and appeared mature.

> Natalie shared,

Being connected to good people helped me to navigate my way through the program. Reaching out to mentors, professors and staff who could give good advice certainly accelerate my ability to complete my degree. One word of advice I would tell future students to consider moving forward is, “It’s really hard to move in the way that you desire to if you are not connected to people who are doing what you want to do.” Building a network of people doing what I was aspiring to do has really made the difference for me.

Latoya offered an alternate view of the benefit of mentoring, she believed that connecting with a lot professors and networking would help her to reach her ultimate goal. She stated that being a member of the Black Student Association was a great way to network with positive people:

We are constantly discussing issues that impact our community, which is helpful since a lot of time our classes don’t address things we are dealing with outside the classroom. I discovered during [my] community college experience that I wanted to be a professor. When I graduated from MCTC I decided to apply to the McNair Scholars program so that I could get my bachelor’s degree, do research in material science and pursue my Ph.D. I was able to talk to several community college professors who gave me helpful advice. These mentors also explained the politics of higher education and what institutional racism is which has been helpful.

Anthony was unique in advancing his financial goals he talked about how networking has helped with the promotion of his video game:

I have had a lot of support from my college; student organizations supported me by marketing my video game. I have learned multiple facets of video gaming, music, arts, and programming combining all of the skills, and learning more about the business side, legal side was an eye opening experience.

Anthony also shared that the college, recognized him by showcasing his video game during a college wide event:

Anthony described the opportunity to showcase his video game as life changing he strongly recommended that connecting with student organizations on campus was critical. Making this connection has been life changing; I would recommend that all students get actively engaged in student organizations on their campus. Both traditional and nontraditional students had issues in common pertaining to family stressors.

Theme 4: Internships. The subtheme for internships is On the Job Training. Two of the eight students had paid internships. Six had on the job training and all eight participants believed that experience in the field helped to move them forward with their academic goals. All the students expressed an interest in working right now and shared how financial obligations make it impossible for them not to work. Often times they have turned away student internships because they are unpaid or have small stipends. Marie stated, “The student who can afford to volunteer as an intern for three months or more doesn't come from my community. Most of my neighbors, family members, and friends have to work. One student shared thoughts about how working as an unpaid intern wasn't feasible because of his living expenses." Two students shared how much their paid internships have influenced their academic journeys.

Anthony explained passionately,

> I believe that working at my internship has helped me to move through my coursework faster because it's giving me experience in my field. My internship is also boosting my morale because I have experience, which makes me feel more secure. Working as an intern for an engineering firm allows hands-on experience that you don't get in college. Obtaining an internship prepares you for the workforce, going to college helps you get the degree to get the job, but it's doesn't give you the hands on experience.

Jessie spoke confidently about knowing what you want to do with your degree is important, "getting an internship allows you to experience what you can to do with the degree you are studying to obtain. My experience as an intern gave me the confirmation I needed; I knew nursing was my calling."

Theme 5: Planning.

"*I know what the end goal is; but it's the steps to get there that aren't clear*."

Latoya, Business Administration student

The subtheme for Planning is *Career Advising and Pathway Planning*. Students mentioned a strong desire to have a plan handed to them. All explained that if they would had known exactly how many courses they had to take they would have planned better. They suggested that an action plan assignment should be given to all incoming workforce development students. The students that are parents agreed that planning saved them time and money, because they have a timeline and if the money runs out they won't be able to continue attending community college.

Penny shared that she felt as if you need a strong foundation behind you, more support from counselors, instead of the runaround at community colleges. Penny spoke rapidly and in fragmented sentences. Penny was the only student that disclosed she had learning disabilities. Unlike the other Penny showed up with an academic plan that showed what she needed to be successful. It was obvious that she was upset because she did not receive the support she knew she needed.

> The college didn't look at my Individualized Evaluation Plan (IEP) from high school, they told me you're an adult now, and you don't need this. Which was actually not true because that was the way I learned. There was no transition to disability services. I was so new and no one bothered to help me navigate my way through.

> She felt that she needed a strong foundation of academic guidance. Community colleges should be more supportive and every student should be assigned an academic advisor that they have to see before registering would have been more supportive through advising and showed me how to navigate.

Despite her frustrations about the lack advising, Penny described how she navigated her way through the run around and was finally able to identify a mentor. She was happy that she was able to find a path that helped her to successfully complete her degree. Which supports the culturally relevant pedagogy work of Ladson-Billings.

My situation was God ordained, I had professors that became my mentors, or I probably wouldn't be where I am today.

This student's perspective supports Ladson-Billings (1995) in cultural relevant pedagogy, which reminds us how important it is for educators to receive cultural competency professional development.

Other students described experiences that were not as dramatic as Penny. Latoya describes being proactive and identifying her pathway to a management career.

Latoya shared,

I plan to apply for management positions, so currently I'm communicating with health care human resource departments to see if there is an opportunity for me to job shadow someone in management. I want a clear understanding of what the roles and responsibilities of a health care manager is before I apply.

Both Latoya and Marie's comments connected to the theory of involvement. Marie suggested that students utilize advisors to help you create a path to complete your degree.

> "Be intentional to make sure you are taking classes you need. Advisors should be explicit and say: here is the pathway for your major, so that you don't take classes you can't use for your degree. I wasted time taking classes I didn't need and it messed up my financial aid. It took me a while to get back on track. That shouldn't happen to students. Especially people like me who don't have a lot of money and time to play around. I want to get back to work, not be in school forever. Planning is necessary and it should be mandatory not optional to meet with an academic advisor. I think it takes a lot more for some students than it does others. We need job coaches, life coaches, and success coaches to cheer for us, encourage us and keep us on track."

Marie's comment connects to Astin's (1984) theoretical framework, which connects the amount of physical and psychological energy a student devotes to the academic experience.

Summary

Rendón (1994) stated that the more students see interactions as positive, and the more they view themselves as integrated valued members of the institution, the more likely they are to persist. In this study, a high level of student involvement in academic and social clubs was common among African American STEM students. Findings from questions showed that students found being involved in group activities as being important to making friends and networking.

Role of the Researcher

A qualitative researcher understands that he or she is an integral part of the data because he or she creates a relationship with the individuals studied. In semi-structured interviewing, the researcher must use instincts and intuition in order to determine the next question to ask a participant after instantly processing and analyzing the answer just given. This inherently implies a certain amount of subjectivity, and the questions that are asked in the moment, and the analysis of the data afterward, have the influence of the researcher's personal history behind them (Seidman,1998).

I have a vested interest in helping African American community college students find accelerated pathways to STEM Careers. As a former Dean of Academic Affairs and a passionate administrator, I constantly found avenues to encourage students, who in many cases were forced down pathways that lead to disappointment and loss of time and money.

Over the last ten years of my career I have worked with students in community colleges and believe that they deserve to complete their degrees and find gainful employment. At an early age I watched my father prepare as he went to teach at a local technical college. I didn't understand why he took his job so seriously until I was reintroduced to community colleges through a mutual friend.

Visiting the community college changed my career as an educator. My educational background is diverse. I was surprised to see that many of my special education high school seniors had decided to make the local community college their next journey.

I believe I built rapport quickly because my students knew of my connection to the local community college and were familiar with some of the STEM workforce development programs I implemented while working as a community college administrator.

I am the same race as the participants, and I have an undergraduate degree in a STEM field. I will be sharing a comment in chapter five where my teaching, administrative, and personal connection to the STEM fields are important for analysis of a portion of data provided during many interviews.

My role as the researcher was to encourage the participants to tell stories, so the interviews were conducted in a conversational and developing manner. Because I was constantly listening for opportunities to ask for "meanings" behind actions taken in the stories—being focused on this task, I believe it was not difficult for me to remain objective.

Trustworthiness Issues

The nature of qualitative research can lead to issues of trustworthiness of the data. This potential problem was dealt with during the first interview to clarify the intent of the participants' responses. Participant interviewees may not have been honest in their responses during interviews and could have given answers they believe this researcher was expecting. This potential problem was dealt with by having multiple interviews, and repeating questions a second time to see if consistent answers were provided.

The potential for researcher bias must be acknowledged due to the researcher's connection with the university. In the case of this study, some participants revealed sensitive data, such as disagreements with mentors, disagreements with mentees, and sensitive racial issues. By virtue of protecting the participants involved, I felt obligated to keep the exact version for some data from the view of the public. This potential problem was dealt with by presenting the data that is offered in rich descriptions and detail so that the reader can follow the researcher's decision-making process, and by acknowledging my potential biases.

Chapter Five: Conclusions and Recommendations

Introduction

My interest in this topic was sparked by a question: How can we fast track African American STEM students at community colleges to career pathways? Using a theoretical framework of Ladson-Billings' Cultural Relevant Pedagogy, Validation Theory and Astin's Theory of Involvement, I collected and evaluated the literature and began on this journey.

This study employed a qualitative approach using phenomenology since its purpose was to describe how African American STEM community college students experienced a workforce development program at Minneapolis Community and Technical College. The student participants of this study were purposefully chosen because of their participation in a program that targets students for STEM industries.

The students all volunteered to take this journey with me and often had encouraging words for me as I explained why this study was so important to the body of research. All of the participants in this study were American born African American students. All of the participants described themselves as coming from households where going to college provided a ticket out of poverty, and they were expected to perform well above the average college student.

Semi-structured interviews prompted by the data contained in Appendix F were used to collect data in order to capture the meanings of the participants' experiences. The findings of this study demonstrate experiences; these experiences are presented as they apply to the research questions; and they are presented so the reader can observe the judgments this researcher made of their experiences. The findings of this study support many previous findings about best practices in college degree attainment, but it uncovered something that is rarely found in the literature: why “what works,” works, and specifically how to get programs that provide resources to African American STEM students.

Summary of the Study

Chapter one describes the importance of increasing the representation of African American community college students in STEM fields. Furthermore, it highlighted the national need at all educational levels to be engaged in promoting and supporting greater representation of African American students in STEM fields.

Chapter two exhibits an overview of the literature, including the academic and social experiences that contribute to the success of African American community college students. Astin’s (1984) theory of involvement, Validation and Ladson-Billings Cultural Relevant Pedagogy provided a foundation for understanding the various involvement factors that impact students during their academic life. These experiences play an important role in students’ academic success, including their level of academic and social adjustments to community college and the workforce industry. Lastly, it explored the role of community colleges and their critical function in the development of STEM Workforce.

Chapter three presents the qualitative methodology used to design and conduct this study. The following was also described in this chapter: research questions, research, validity, ethnical considerations, delimitations of the study, limitations of the study and design, in-depth phenomenological inquiry setting, population, and the environment where the interviewing took place.

Chapter four reveals the results of the data analysis pertaining to the qualitative components, and findings generated from the open-ended questions were examined. In chapter four a description of which themes were connected to the research questions. Interview responses from eight African American community college students, three males and five females, which included three students who successfully completed an Associates of Science Degree in STEM and transitioned into the workforce. The findings were presented through individual profiles, and a comprehensive summary of the themes that emerged from the students' voices was given.

Chapter five presents a summary of the research, conclusion, implications for practice, application of the study, and recommendations for future research. This chapter also analyzes literature on how African American students enter community colleges unaware of resources available to them. They may be aware that certain issues exist, but their pre-college experiences may not have prepared them for the more focused world of STEM in college.

Discussion of Findings

There were five themes that were identified as having meaning to the student participants. These five themes emerged from analysis of the data using the theoretical frameworks of Ladson-Billings' Culturally Relevant Pedagogy and Astin's theory of Student Involvement. The five themes are often interconnected; therefore, the discussion of the findings cannot be precisely contained into each theme.

My first theoretical framework is Astin's Theory of Student Involvement, which refers to the amount of physical and psychological energy that the student devotes to the academic experience. Thus, a highly involved student is one who, for example, devotes considerable energy to studying, spends much time on campus, participates actively in student organizations, and interacts frequently with faculty members and other students. Conversely, a typical uninvolved student neglects studies, spends little time on campus, abstains from extracurricular activities, and has infrequent contact with faculty members or other students (Astin, 1984, p. 518).

The five themes identified as having meaning to the students were:

1. Prioritizing
2. Professionalism
3. Building a network
4. Internships
5. Planning

In this chapter each of the five themes will be analyzed as they related to each research questions. I will present the findings among themes, and the discussion findings as they relate to each research question.

Research questions:

1. How do African American community college students in STEM majors describe the experiences that accelerated or delayed their overall success?
2. What characteristics appear for African American community college in STEM students who successfully complete degree requirements and transition into industry?
3. How do African American former community college students in STEM majors describe experiences that facilitated or impeded their overall adjustment to industry?

The Perspective of the Students

How do African American community college students in STEM majors describe the experiences that accelerated or delayed their overall success?

The characteristics that students felt accelerated their overall success or delayed their progress was Prioritizing which included having good time management skills, knowing how to deal with family stressors, pressures from peers, and making meaningful social and academic interactions on campus.

Using the framework of the Astin theory of student involvement three elements recommended by Astin were met academic engagement, social engagement and evaluation connect to the data.

The importance of prioritizing was expressed by all of the students, two interviewees touched on the importance of this theme in a memorable way.

Prioritizing became a characteristic of success, as students discussed the various pressures they had financially. Students also mentioned that many of their professors did not fully understand the challenges students faced daily, such as balancing work, family, and education Ladson-Billings (1995) reminded us that not only must teachers encourage academic success and cultural competence; they must help students recognize, understand, and critique current social inequities. The data I collected affirmed Ladson-Billings theoretical framework, which suggests academic and professional development.

Participants were also asked to share characteristics that appear for African American community college in STEM students who successfully complete degree requirements and transition into industry. Out of the responses came the Professionalism theme. All of the students believed students had a broad understanding of the business world, and make an extra effort to display professionalism daily gives students a successful transition to the STEM career of choice.

Penny explained that although she didn't have her nursing degree she believed that showing up ready and always appearing to be a manager in training has been her secret weapon. She stated, “Even if you don’t necessarily have the greatest job, with the best pay, show up like you’re the CEO.” Professionalism also included being able to work in teams, using critical thinking skills, connecting social and academic skills in the workplace, and having an understanding of how to solve problems.

James also shared thoughts of how he had to learn about the legal business, marketing business, music business, art industry, and publishing industry when he decided to create his video game. Throughout that process he shared that his success came from connecting with student organizations on campus that could support his work and individual faculty who invested their social capital into his idea. Astin (1984) stated that the amount of student learning and personal development associated with any educational program is directly proportional to the quality and quantity of student involvement in that program. James description of his experiences definitely can be linked to Astin’s theoretical framework.

Students were also asked to describe experiences that facilitated or impeded their overall adjustment to industry. I was fortunate to have three student interviewees that had completed their degree and successfully transitioned into the STEM workforce industry. The students all agreed that Building a Network of people who could help to advise you, recommend you, and share resources is critical to your overall success as a professional. They also believed that finding mentors was important, since the majority of them were first generation college students. Sarah stated, “Having mentors that have gone through the educational process helped me to navigate through my experience at a community college."

Another key to success was Obtaining an Internship, which led to several students finding jobs in the field at entry-level positions. Anthony shared that he believed working at his internship helped him move through his coursework faster. "This internship is giving me experience in my field, which is also boosting my confidence. I have experience, which makes me feel more secure about my future as an electrical engineer."

Implications of Cultural Relevant Pedagogy and Student Involvement

Astin (1984) focused attention on the level of student involvement inside and outside the classroom. Findings from questions showed that students found being involved in group activities as being important to making friends and networking. This resulted in reduced struggle with homework and greater success in passing their classes. The findings also highlighted the fact that students tended to emphasize the importance of their interactions with advisors and faculty members at both institutional levels (community college). Moreover, students expressed that they felt more engaged and felt a sense of belonging by participating in academic and social organizations.

Using Ladson-Billings' framework of Culturally Relevant Pedagogy in combination with Astin's theory of Student Involvement, the study investigated the experiences of African American community college STEM students. These two theories were used as a frame of reference to "explain" the experiences that took place with the African American community college students in STEM workforce development programs at Minneapolis Community and Technical College.

The students descriptions varied depending on the framework used to describe their meanings. Using two frameworks allow me to see feelings of frustration and discomfort. While this is one of the most diverse campus in the state of Minnesota Ladson Billings work prompts a sense of urgency around issues related to cultural competency.

Hilliard (1998) shared the view that until school districts and schools make a substantive shift in the underlying structural and ideological paradigm, as it relates to the academic excellence of students of color, only illusionary restructuring will take place. Hilliard argued that for true restructuring to take place, school districts and schools must shed traditional paradigms that emphasize varying levels of expectation based on students' racial, ethnic, or cultural identities. He suggested that basing expectations on such factors inevitably leads to pedagogical misunderstandings and flawed, low expectations. Hilliard called attention to the significance of intellectual capacity in today's global society, and he contended that holding such low expectations could prove limiting and detrimental to African American students. Lee (2005) shared Hilliard's perspective, stating, "Now, in the 21st century, the demands of what it means to be educated are more rigorous and demanding than ever before. The capital of the 21st century is, without doubt, knowledge" (p. 46). With so much at stake, Hilliard maintained that African American students' engagement in the teaching and learning process must be re-conceptualized in a way that affirms and values their intellectual potential and cultural strengths.

The student participants reflected on the importance of building a network throughout the interviewing process, and several shared feelings of not always understanding the professor, feeling isolated and misunderstood. These theoretical frameworks of Ladson-Billings confirm how essential it is that educators begin to address the need to create pedagogy that includes the African American experience and engages their voice through out the community college experience.

When African American students enter into STEM programs, they bring behaviors, values and personal attributes that may not be those of the predominantly White professoriate culture of the U.S. and African American students have historically been marginalized in the STEM community. Research of broad STEM workforce development is linked to western science and reveals a culture with in its own epistemologies (Jegede & Okebukola, 1999). These students must deal with the cultural clashes between the students' life-worlds and the world of Western science in order to learn STEM effectively and meaningfully (Jegede & Okebukola, 1999).

Pascarella and Terenzini (1991) stated that the degree of effectiveness and accessibility of an instructor has a positive influence on the academic performance and overall institutional satisfaction of students. Moreover, according to Seymour and Hewitt (1994), successful students from science, mathematics, and engineering (SME) majors greatly value faculty attitude and pedagogy.

Implications

Findings in this study have African American community college students identifying the meanings of the experiences of participating in a STEM workforce development program at Minneapolis Community and Technical College. African American community college STEM students found the experience of *Prioritizing* to be the most crucial for them as they prepared for their STEM careers. These findings are directly supported by Astin's theory of student involvement and indirectly supported by Ladson-Billings framework of Culturally Relevant Pedagogy.

Conclusion

The purpose of this study was to examine the academic and social experiences of African American community college students in STEM workforce development programs. This study built on earlier research regarding the experiences of community college African American students. Much of the current research conducted by Laanan (2003), Tsapogas (2004), Townsend and Wilson (2006), and Jackson (2010) emphasized the STEM fields.

Understanding the academic and social involvement experiences of community college students is fundamental to increasing the representation and participation of individuals pursuing degrees in STEM disciplines. During interviews with students in this study, none of the students relayed experiences of differential treatment based on gender from other students in the classrooms or campus environment.

Recommendations for Minneapolis Community & Technical College

As suggest by the data collected in this study on African American community college STEM Workforce students, some of the initiatives that community colleges should consider putting into practice are the following:

1. Community colleges should encourage faculty and staff to broaden their knowledge cultural competency to support African American STEM community college students.
2. Community colleges should encourage African American community college STEM students to become more involved in academic and social groups.
3. Community colleges should have high expectations for African American community college STEM students academic performance, and goal setting.
4. Community colleges should have advisors with more concrete strategies for selecting the right classes and for creating a career plan.
5. Community colleges should encourage African American community college STEM students' participation and involvement inside and outside classroom with mandatory academic activities.

Application of the Study

The findings of this study can be useful for African American STEM community colleges, by faculty, academic advisors, financial aid officers, academic and student life organizations, and academic support programs. In addition, this study can be useful for programs that are related to the recruitment, retention, and assistance of successful completion and transition to the workforce for African American community college students in STEM areas. African American students depend on advisors for courses requirements and recommendations. Over the past year I have made ten presentations in eight states and the exchanges with colleges and scholars have taught me the experiences of African American community college students are similar.

African American community college STEM students consider advisors to be essential to their overall academic success. Furthermore, faculty members can make a difference in how African American community college STEM students perceive their academic journey and how well they perform academically. The findings demonstrated that students tended to report that the more they interact with their instructors inside and outside the classroom, the more positive their academic adjustment was.

In addition, African American community college STEM students expressed that when they were involved in different organizations and activities on campus, it helped them learn about the college, which helped them to navigate through pathways to success. African American community college STEM student involvement also develops a sense of belonging. Many community colleges are in urban areas and serve a very diverse population of African American community college STEM student. This study can inform faculty on best practices to prepare lecture materials, through providing cultural relevant pedagogy that addresses issues African American students are currently facing, which make their academic journey significant. When the academic coursework is applicable to real world situations African American community college STEM students reported an easier transition to STEM workforce industries.

Recommendations for Future Research

Academic and social involvement is a significant factor in helping African American community college students majoring in STEM fields. Understanding the impact of these factors on student success is essential in increasing the representation of students in STEM disciplines. Increasing the participation of African American community college students in STEM is vital to responding to the shortage of qualified U.S. individuals in STEM disciplines.

President Obama has publically recognized the need for assisting and supporting educational programs with a main role to recruit, retain, and graduate individuals in STEM areas. In order to address the lack of interest in STEM majors, it is necessary to identify potential factors that contribute to it. As a result, there is a need for longitudinal studies that follow African American community college STEM students from early grade school and throughout their post-secondary education in order to further understand their academic and social involvement and how it impacts them.

Understanding the experiences of African American STEM community college student will influence academic and social involvement will help find adjustment factors that could help community colleges to engage African American STEM students succeed academically in the areas of STEM.

Lastly, it is essential that community colleges engage themselves more in increasing the number of African American community college students in STEM fields to ensure that the United States continues to lead the world in science, technology, engineering, and mathematics.

Researcher Reflections

"I have never encountered any children in any group who are not geniuses. There is no mystery on how to teach them. The first thing you do is treat them like human beings and the second thing you do is love them." Dr. Asa Hilliard

This study analyzed actions and behaviors among African American STEM community college students at Minneapolis Community and Technical College, which is the largest and most diverse community and technical college in the state of Minnesota. This study examined research practices that strengthen academic excellence for African American students, and increase STEM workforce development opportunities targeting students in community college settings. Cultural and ethnic diversity as a whole has made some progress, however within the profession there are still pedagogical barriers. The notion that African American children require "special" instructional strategies or need to be "fixed" persists throughout education dialogues (Lemons-Smith, 2008). In reality, African American children merely require the same high quality instruction typically provided to their White counterparts. This belief was a grounding principle of Dr. Asa Hilliard's work and has been echoed by other prominent scholars in the field, such as Irvine (2003), and Ladson-Billings (1994). Community colleges perform a larger share of the STEM training than is generally understood.

Moreover, it may be argued that noncredit programs and offerings may be uniquely positioned to serve many who would otherwise be ignored (Grubb, Badway, & Bell, 2003). As a community college administrator I have spent over 12 years working with underserved communities. It has been my belief, since before I began this research endeavor, that by looking at those who have been identified as successful in the development of African American STEM community college students, I could uncover the solution to increased success and college completion.

Culturally relevant research approaches both recognize ethnicity and position culture as central to the research process. A theoretical framework for culturally relevant research approaches for African Americans is based on culturally congruent research methods, culturally specific knowledge, and cultural resistance to theoretical dominance. This also includes culturally relevant data that informs theory, interpretations, and practice (Tillman, 2002).

Dr. Asa Hilliard strongly challenged the efficacy of superficial, Band-Aid-type school reform efforts. Stating that if schools are truly committed to valuing and promoting the academic excellence of all students they must systematically examine core ideology around the teaching and learning process. In 1991, Hilliard championed a different paradigm explaining the importance of believing in students' natural talents and genius ability, valuing cultural and lived experiences and establishing environments with norms of scaffolding student learning and creating educational experiences built on strengths.

Ladson-Billings' theory of culturally relevant pedagogy supports a paradigm shift reflecting on conceptions of self, others, and social knowledge (1995). King's work also recommended conceptualization of research on teachers' internalized racism and how this impacts the process of teaching and learning (1991). Hilliard also suggested that powerful teachers find ways to promote academic excellence regardless of circumstances. They value artifacts from student homes, families, and communities. They also explicitly reject the pervasive notion that students living in poverty do not bring valuable experiences that broadens the knowledge of the teaching and learning process (Lemon-Smith, 2008).

My familiarity with the examples of lived experiences that I shared with my student participants was painful and healing simultaneously. I believe that I have been able to ask the sensitive questions that did provided data to gain insights into the challenges of fast tracking African American STEM Workforce Development students. By doing such, we are provided with a lens in which to view the problems at the macro level in STEM education for African Americans community college students.

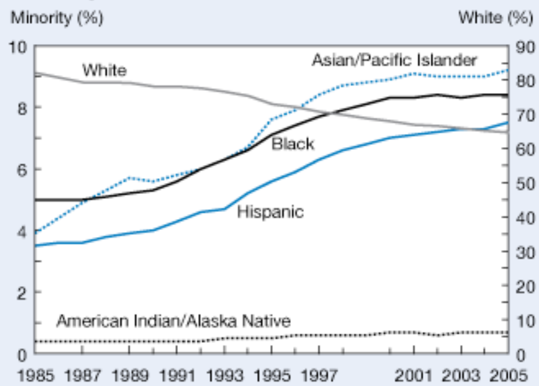
Implications from this study have strengthened my sense of self, and provided a space for my scholarly voice to be used as a social change agent in educational research. It is my hope that this study will serve as a resource to educators implementing policy and practices that reflect the teachings of culturally relevant pedagogy and student involvement theory, which will create opportunities for African American STEM students in community colleges.

Appendices

Appendix A

Science and Engineering Bachelor Degrees by Race/Ethnicity 1985-2005

Figure 2-16
Minority share of S&E bachelor's degrees, by race/ethnicity: 1985–2005



NOTE: Data not available for 1986, 1988, and 1999.

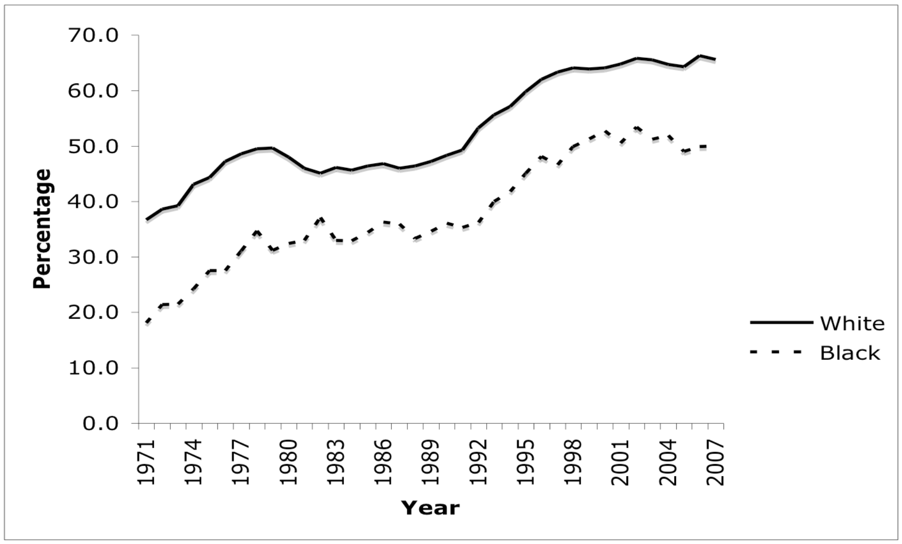
SOURCES: National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; and National Science Foundation, Division of Science Resources Statistics, WebCASPAR database, http://webcaspar.nsf.gov. See appendix table 2-28.

Science and Engineering Indicators 2008

Source: "The Condition of Education: Student Effort and Educational Progress, " by National Center for Education Statistics, 2008.

Appendix B

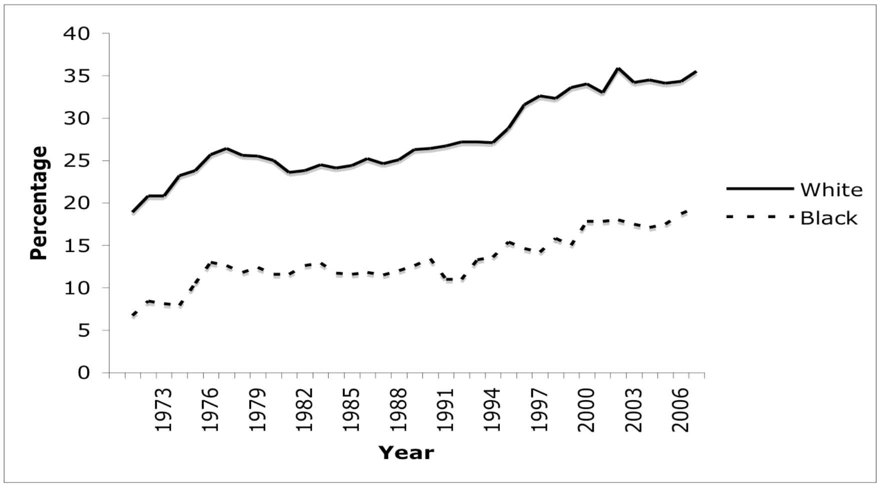
Percentage of 25-29 Year Olds by Race/Ethnicity with Some College, 1971-2007



Source: "The Condition of Education: Student Effort and Educational Progress, " by National Center for Education Statistics, 2008.

Appendix C

Percentage 25-29 with Bachelors Degree or Higher 1971-2007



Source: “The Condition of Education: Student Effort and Educational Progress, “ by National Center for Education Statistics, 2008.

Appendix D

Percentage Distribution of First Time Community College Students Degree Attainment

National Center for Education Statistics

Table S1-A.
Standard errors for table 1-A: DEGREE GOAL: Percentage distribution of first-time beginning community college students' educational goals when first enrolled, by selected student characteristics: 1989–90, 1995–96, and 2003–04

	1989–90			1995–96			2003–04		
Selected student characteristics	Below bachelor's degree	Bachelor's degree	Above bachelor's degree	Below bachelor's degree	Bachelor's degree	Above bachelor's degree	Below bachelor's degree	Bachelor's degree	Above bachelor's degree
Total	0.36	0.39	0.22	2.53	1.78	2.59	1.11	1.05	1.18
Sex									
Male	0.46	0.59	0.36	2.88	1.98	2.51	1.40	1.67	1.82
Female	0.50	0.48	0.35	3.70	2.04	4.01	1.30	1.35	1.45
Race/ethnicity									
White	0.46	0.41	0.28	2.88	1.75	2.69	1.59	1.47	1.40
Black	0.86	1.32	0.98	5.71	7.08	6.44	2.18	2.66	2.48
Hispanic	0.85	1.29	0.96	4.57	4.43	6.62	2.13	2.68	2.96
Asian/Pacific Islander	†	†	†	†	†	†	2.61	4.14	4.21
American Indian/Alaska Native	†	†	†	†	†	†	6.40	†	15.59
Age when first enrolled									
18 or younger	0.50	0.58	0.36	1.79	2.51	1.65	1.14	1.83	1.76
19–23	0.66	0.81	0.43	3.02	3.89	3.17	1.23	1.61	1.80
24–29	1.15	1.08	0.88	11.24	12.24	8.20	3.07	3.87	4.47
30 or older	1.06	0.86	0.71	7.84	5.58	5.48	2.55	2.38	2.26
Highest education attained by either parent									
High school or less (including GED)	0.61	0.59	0.48	5.48	3.94	4.49	1.51	1.75	1.89
Some postsecondary education (including associate's degree)	0.59	0.77	0.59	2.88	4.73	5.27	1.56	2.87	2.32
Bachelor's degree or higher	0.44	0.64	0.59	1.98	2.53	3.32	1.33	1.91	2.10

See notes at end of table.

Source: "The Condition of Education: Student Effort and Educational Progress, " by National Center for Education Statistics, 2008.

Appendix E

OFFICE OF RESEARCH SUPPORT

THE UNIVERSITY OF TEXAS AT AUSTIN

P.O. Box 7426, Austin, Texas 78713 · Mail Code A3200
(512) 471-8871 · FAX (512) 471-8873

FWA # 00002030

Date: 10/20/14

PI: Norma V Cantu

Dept: Education, CCLP Higher Education Administration

Title: PATHWAYS TO FAST TRACKING AFRICAN AMERICAN COMMUNITY COLLEGE STUDENTS TO STEM CAREERS

Re: IRB Exempt Determination for Protocol Number 2014-06-0035

Dear Norma V Cantu:

Recognition of Exempt status based on 45 CFR 46.101(b)(2).

Qualifying Period: 10/20/2014 to 10/19/2017. *Expires 12 a.m. [midnight] of this date.*
A continuing review report must be submitted in three years if the research is ongoing.

Responsibilities of the Principal Investigator:

Research that is determined to be Exempt from Institutional Review Board (IRB) review is not exempt from ensuring protection of human subjects. The Principal Investigator (PI) is responsible for the following throughout the conduct of the research study:

1. Assuring that all investigators and co-principal investigators are trained in the ethical principles, relevant federal regulations, and institutional policies governing human subject research.

2. Disclosing to the subjects that the activities involve research and that participation is voluntary during the informed consent process.

3. Providing subjects with pertinent information (e.g., risks and benefits, contact information for investigators and ORS) and ensuring that human subjects will voluntarily consent to participate in the research when appropriate (e.g., surveys, interviews).

4. Assuring the subjects will be selected equitably, so that the risks and benefits of the research are justly distributed.

5. Assuring that the IRB will be immediately informed of any information or unanticipated problems that may increase the risk to the subjects and cause the category of review to be reclassified to expedited or full board review.

6. Assuring that the IRB will be immediately informed of any complaints from subjects regarding their risks and benefits.

7. Assuring that the privacy of the subjects and the confidentiality of the research data will be maintained appropriately to ensure minimal risks to subjects.

8. Reporting, by submission of an amendment request, any changes in the research study that alter the level of risk to subjects.

These criteria are specified in the PI Assurance Statement that was signed before determination of exempt status was granted. The PI's signature acknowledges that they understand and accept these conditions. Refer to the Office of Research Support (ORS) website www.utexas.edu/irb for specific information on training, voluntary informed consent, privacy, and how to notify the IRB of unanticipated problems.

1. Closure: Upon completion of the research study, a Closure Report must be submitted to the ORS.

2. Unanticipated Problems: Any unanticipated problems or complaints must be reported to the IRB/ORS immediately. Further information concerning unanticipated problems can be found in the IRB Policies and Procedure Manual.

3. Continuing Review: A Continuing Review Report must be submitted if the study will continue beyond the three year qualifying period.

4. Amendments: Modifications that affect the exempt category or the criteria for exempt determination must be submitted as an amendment. Investigators are strongly encouraged to contact the IRB Program Coordinator(s) to describe any changes prior to submitting an amendment. The IRB Program Coordinator(s) can help investigators determine if a formal amendment is necessary or if the modification does not require a formal amendment process.

If you have any questions contact the ORS by phone at (512) 471-8871 or via e-mail at orsc@uts.cc.utexas.edu.

Sincerely,

James P. Wilson

James Wilson, Ph.D.
Institutional Review Board Chair

Appendix F

Research Questions

Pathways to Fast Tracking African American
Community College Students to STEM Careers

1. Please describe experiences that have accelerated your academic and career goals?

2. Please describe experiences that have delayed your overall success to reaching your academic and career goals?

3. What characteristics do you think are necessary to successfully transition into a STEM career position?

4. Please describe experiences that have prepared you for your current employment?

5. Have there been any challenges that hindered your ability to transition to STEM employment?

6. What programs have helped you to be successful in college?

7. Who are the faculty members and professionals at your college that have supported your academic success?

8. Are you involved with any student organization(s) on campus or off campus, how have they helped to support your academic goals?

9. What challenges do you face as a college student? Please describe any past or present challenges.

10. Do you have any suggestions on programs that would be helpful for community college students majoring in STEM fields?

Appendix G

Consent for Participation in Research

Title: Pathways to Fast Tracking African American Community College Students to STEM Careers

Introduction:
This study is focused on best practices for accelerating African American community college students to STEM career pathways. Community colleges perform a larger share of STEM training than is generally understood. As highlighted in NSF's National Survey
of Recent College Graduates (NSRCG), a surprisingly large proportion (44% overall) of those earning a degree in science and engineering (bachelor's and master's) reported that they had attended a community college. However, similar to the shortage of STEM workers, there are inconsistencies in supply and demand depending on geographic area and specific subject (Ingersoll & Perda, 2009).

Purpose of Study:
The purpose of this study was to ascertain the perceptions of African American community college students who are currently pursuing degrees in STEM majors and to examine the factors that influence their success. While community college students are taking classes, it is vital that they engage with their classmates, professors, and advisors. These types of interactions lead to the success of many students in STEM who aspire to finish their academic degrees. Student achievement can be dependent on the amount of student involvement. Astin's (1984) theory is possibly the most appropriate when investigating and interpreting student involvement.

What will you be asked to do?
If you agree to participate in this study, you will be asked to participate in individual interviews. This study will take approximately two 30 minutes individual interviews and will include approximately 15 study participants. With your permission, your participation will be audio recorded.

What are the risks involved in this study?
There are no foreseeable risks to participating in this study.

What are the possible benefits of this study?
The data collected from this research project will help to provide literature to help future African American community college STEM students successfully complete and transition into the workforce industry.

Do you have to participate?
No, your participation is voluntary. You may decide not to participate at all or, if you start the study, you may withdraw at any time. Withdrawal or refusing to participate will not affect your relationship with The University of Texas at Austin (University) in anyway.

Will there be any compensation for participating? Participants will not receive compensation for participating in this study.

What are my confidentiality or privacy protections when participating in this research study?
This study is confidential and to ensure the confidentiality of the information shared by the participants, the researcher will use pseudonyms instead of participant actual names on the interview tapes. Participants will also be assigned pseudonyms to protect their identity and in some instances, quotations will be edited for clarity. Also, the identities

of individuals they referenced , locations, and events will be altered to protect the confidentiality of the study participants.

If you choose to participate in this study, you will be recorded. Any audio recordings will be kept for 1 year and then erased. The data resulting from your participation may be used for future research or be made available to other researchers for research purposes not detailed within this consent form.

Whom to contact with questions about the study?
Prior, during or after your participation you can contact the researcher Tina M. Jackson at 612-269-8974 or send an email to tmjackson@utexas.edu
This study has been reviewed and approved by The University of Institutional Review Board and the study number is 2014-06-0035.

Whom to contact with questions concerning your rights as a research participant?
For questions about your rights or any dissatisfaction with any part of this study, you can contact, anonymously if you wish, the Institutional Review Board by phone at (512) 471-8871 or email at orsc@uts.cc.utexas.edu

Participation
If you agree to participate please sign this form and return to the researcher.

Signature
You have been informed about this study's purpose, procedures, possible benefits and risks, and you have received a copy of this form. You have been given the opportunity to ask questions before you sign, and you have been told that you can ask other

questions at any time. You voluntarily agree to participate in this study. By signing this form you are not waiving any of your legal rights.

____
Printed Name

Signature	Date

As a representative of this study, I have explained the purpose, procedures, benefits, and the risks involved in this research study.

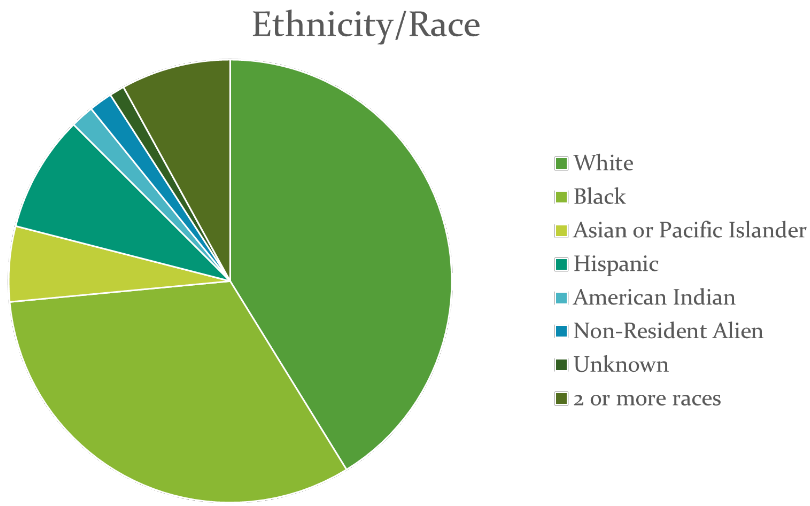
Print Name of Person obtaining consent

Signature of Person obtaining consent	Date

Appendix H

Minneapolis Community & Technical College Demographics

Enrollment (Fall 2013) 13,874 | Gender Female: 53% Male: 47%



Source: Office of Accountability, Minneapolis Community & Technical College (2014)

Appendix I

Graduation Rates

Student Right-To-Know Graduation and Transfer-Out Rates[1]			
Minneapolis Community and Technical College	Graduation Rate	Transfer-out Rate	Combined Rate
Total Cohort	13%	25%	38%
Race Ethnicity			
American Indian or Alaska Native	*	*	*
Asian	19%	21%	40%
Black or African American	9%	26%	34%
Hispanic of any race	9%	26%	34%
Native Hawaiian or other Pacific Islander	*	*	*
White	18%	28%	46%
Two or more races	6%	25%	31%
Nonresident Alien	22%	22%	43%
Unknown race and ethnicity	*	*	*
Gender			
Female	13%	27%	40%
Male	13%	24%	36%
Financial Aid			
Pell Grant Recipient	10%	24%	34%
Received Subsidized Stafford Loans, but no Pell	24%	28%	52%
Received neither Pell nor Subsidized Stafford Loan	15%	28%	43%

Source: Office of Accountability, Minneapolis Community & Technical College (2014)

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Vita

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