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The purpose of this qualitative study was to investigate how institutional agents and interpersonal networks contribute to the development of social capital in a pre-college academic enrichment program that focuses on science, technology, engineering and mathematics (STEM). The study used a social capital framework to examine the perceptions held by eight African American high school seniors who had participated in a STEM Pre-College Program for at least four years.

Using an instrumental case study design, data were gathered through semi-structured interviews, observations, and focus groups interviews. The three themes that emerged from the analysis of data were: (a) institutional agents as extended family (b) institutional support through dialogue and discourse, and (c) empowerment. The themes revealed that African American students' interpersonal relationships with supportive and nurturing institutional agents can provide empowering STEM information, resources, and opportunities (social capital). Development of this social capital empowers students in terms of their self-efficacy to engage in advanced-level mathematics and science high school courses, STEM college majors, and STEM careers.

AFRICAN AMERICAN STUDENTS' PERCEPTIONS OF THE DEVELOPMENT OF SOCIAL CAPITAL IN A SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS (STEM) PRE-COLLEGE PROGRAM

by

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Approved by

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APPROVAL PAGE

This dissertation has been approved by the following committee of the Faculty of The Graduate School at The University of North Carolina at Greensboro.

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CHAPTER I

INTRODUCTION

America's scientific and technical labor force, as well as its capacity to promote innovative research will be directly related to its ability to effectively educate its youth in mathematics and science (Building Engineering and Science Talent [BEST], 2004). For this reason, many current scientific reports and research are focusing on the critical need for high school graduates who can successfully enter college majors in preparation for science, technology, engineering, and mathematics (STEM) careers (BEST, 2004; National Center for Education Statistics [NCES], 2004; National Academies Committee on Science, Engineering, and Public Policy, 2006).

Research reveals growing disparities between members of underrepresented groups and members of the majority population in jobs requiring highly technical skills (BEST, 2004; Jackson, 2004). Although women, African Americans, Hispanics, American Indians, and persons with disabilities make up two-thirds of the United States workforce, they account for only one-quarter of the science and engineering workforce. *Standing Our Ground*, a report of the American Association for the Advancement of Science (AAAS) and the National Action Council of Minorities in Engineering (NACME), addresses the need to increase reform efforts aimed at helping students achieve in mathematics and science, with special emphasis on increasing the number of women, underrepresented minorities and persons with disabilities who pursue STEM undergraduate and graduate degrees (Malcom, Chubin, & Jesse, 2004).

One of the major issues confronting education is the widening of the academic achievement gap between students of color and their Caucasian peers on standardized tests, specifically African Americans in their mathematics and science performance (Oakes, Joseph, & Muir, 2004; National Science Board, 2004). The most recent *State of the State* (2002) report, which is used to assess the progress of student achievement in North Carolina, indicated an African American - Caucasian gap of 27.8 percentage points in 2001-2002. The 2007 National Assessment of Educational Progress (NAEP) performance data for mathematics indicated that at grades four and eight, Caucasian students scored higher than African American students. Although the gap narrowed slightly between 2005 and 2007 for fourth and eight graders, there still remained a Caucasian - African American mathematics score gap of 23 and 31 points, respectively. A similar score gap pattern has also held true in science. While there was a narrowing of the gap between fourth and eighth grade Caucasian students and their African American peers, the gap between Caucasians and African American twelfth-graders widened from 2000 to 2005 (NCES, 2005).

The underachievement and underparticipation of students in mathematics and science will negatively impact our nation and labor force (Jackson, 2004), including the future career status, social mobility and economic well-being of the proportion of students for whom the gap continues to widen (Parsons, Travis, & Simpson, 2005). Beginning in the early grades, there is evidence to support that tracking contributes to the underparticipation of racial and ethnic minorities in mathematics and science (Oakes, Joseph, & Muir, 2004). Such tracking occurs when students' academic performance in mathematics and science become the critical filters and pipeline linkages for enrollment in advanced mathematics and science courses and future science, technology, engineering, and mathematics (STEM) college majors and careers. Once students enter high school, their decision to enroll in advanced mathematics and science courses is hindered due to earlier academic choices that often preclude any opportunity to attend a four-year institution of higher education (Oakes, Joseph, & Muir, 2004). Research revealed that information about mathematics and science courses, the benefit of taking such courses in high school and college and knowledge of future career options in science and engineering are often inaccessible to racial and ethnic minority students (Oakes, Joseph, & Muir, 2004; Singh, Granville, & Dika, 2002). Jackson (2004) believes that students' pre-collegiate mathematics and science experiences must be addressed in order to prevent an impending crisis of a shortage of students of color who have the scientific foundation needed for postsecondary education and future upward mobility.

Data have shown that the number and type of advanced courses taken in mathematics and science are powerful indicators of preparation for undergraduate majors, as well as indicators of scientific and mathematical literacy (NCES, 2000). According to the NCES (2000), students who take advanced mathematics and science courses in high school are more likely to major in mathematics- and science-based fields in college. Achievement on large-scale assessments such as the National Assessment of Educational Progress (NAEP) scores also is linked to students' increased participation in advanced level mathematics and science courses (NCES, 2007). Although the number and type of high-level courses taken in mathematics and science are powerful indicators for college majors and career choices, African American students regrettably do not participate in high-level mathematics and science courses in large numbers (BEST, 2004; NCES, 2007; Oakes, 1990).

Jeannie Oakes (1990) posited that African American students are just as interested (or often more interested) in mathematics and science as their Caucasian peers in elementary and middle school, but are most often tracked in remedial programs of study and courses that emphasize low-level thinking and skills. In the early grades, many racial and ethnic minority students are filtered out of algebra, which is considered the "gatekeeper" course for entrance into advanced mathematics and science courses (Oakes, 1990) and higher performance on standardized testing (Powell, 1990). The pattern is perpetuated in high schools, where many African Americans are placed into low-level, non-college preparatory, and/or vocational courses and out of the pipeline for enrollment in advanced mathematics and science courses as well as future science, technology, engineering, and mathematics college majors and careers. Russell (2005) reported,

> Unfortunately, elitism, racism, and capitalism have prevailed and thwart detracking efforts aimed at providing all students with equal resources, high expectations, highly qualified teachers, and an enriched curriculum. Tracking African American students from low income or impoverished backgrounds only further exacerbates the achievement gaps between African American students, and white middle/upper class students. (p.172)

Research shows that a myriad of intervention programs exists to rectify the patterns of underrepresentation of women and racial and ethnic minorities in high-level mathematics and science courses and science- and mathematics-based careers (BEST, 2004; Oakes, 1990). Several scientific studies revealed that the vast majority of STEM intervention and academic outreach programs lacked rigorous research to support outcomes, specifically for their effectiveness in promoting interest and participation in mathematics and science among racial and ethnic minorities and women (BEST, 2004; Jackson, 2004; Jayaratne, Thomas, & Trautman, 2003; Oakes, 1990). As Oakes (1990) stated, "To date, however, most intervention programs added little information about the causes of underparticipation and provided little specific guidance for the development of effective interventions" (p. 66).

A synthesis of the research reveals that social capital provides positive education-related development, outcomes, and benefits for students (Bourdieu, 1986; Bourdieu and Wacquant, 1992; Coleman, 1988, 1990; Croninger and Lee, 2001; Dika and Singh, 2002; Halpern, 2005; Horvat, Weininger, & Lareau, 2003; Loury, 1987; Putnam, 1995, 2000; Rosenfeld and Richman, 2003; Stanton-Salazar, 2001; Wang, Haertel, & Walberg, 1994). Thus, the concept of social capital is used prominently in academe, particularly in the field of education (Horvat, Weininger, & Lareau, 2003). However, a closer examination of the literature revealed that few researchers examined the development of social capital among racial and ethnic minority students in academic settings outside of school, such as pre-collegiate academic outreach and intervention programs. More significantly, fewer empirical studies have addressed the development of social capital among African American youth who participate in programs that focus on increasing performance and participation in academic disciplines such as mathematics and science. To address the limitations of previous research on students' development of social capital in an out-of-school setting, there is a need for scholarship that investigates the experiences of African American students who participate in academic outreach science, technology, engineering, and mathematics (STEM) pre-college programs.

A scarcity of racial and ethnic minority high school students' voices on the development of social capital in academic outreach programs with discipline-specific foci (i.e., science, technology, engineering, and mathematics) raises serious concerns about the development of social capital for students of color in general and African American students in particular. In the same vein, Walker and McCoy (1997) reported,

> African American students' perceptions of their mathematics performance and influence of teachers, families, and peers on the development of that perception may be important factors that have been overlooked in our quest to determine the reasons for disappointing performance in mathematics. (p. 71)

In order to decrease the disparities that may prevent African American students from pursuing STEM or STEM-based high school courses, college majors, and careers in large numbers, I explored the perceptions of African American high school seniors who participate in a STEM Pre-College Program to ascertain how institutional agents and interpersonal networks contribute to the development of social capital. The participants in the study were eight African American high school students who took part in a science, technology, engineering, and mathematics (STEM) Pre-College Program. My goal was to discover answers to questions that can guide educators in understanding how students themselves perceive the development of social capital while participating in a STEM Pre-College Program. How do STEM Pre-College Program students perceive institutional agents and institutional support? How do they describe interpersonal networks? How do they perceive social capital in STEM? How do they perceive the relationship between interpersonal networks, social capital and STEM choices? Answers to these questions can help educators understand how students perceive the development of social capital while participating in a STEM Pre-College Program. It is important that practitioners, policy makers, and parents listen to the voices of African American high school students who are participating in an academic outreach program and selecting advanced mathematics and science courses. Only then are such stakeholders likely to find ways to help students close the achievement gap by drawing additional African American high school students into mathematics and science courses that are required for success in STEM college/university majors and careers.

Purpose of the Study

Using an instrumental case study (Stake, 1995 & 2005) this study investigated how institutional agents and interpersonal networks contribute to the development of social capital for African American high school students participating in a science, technology, engineering, and mathematics (STEM) Pre-College Program.

Research Questions

The research questions that guided the study were:

1. How do STEM Pre-College Program students perceive institutional agents and interpersonal networks?

   a. How do they describe institutional agents and institutional support?

   b. How do they describe the support provided by institutional agents?

c. How do they describe interpersonal networks?

2. How do STEM Pre-College Program students perceive social capital development in STEM?

3. How do STEM Pre-College Program students perceive the relationship between interpersonal networks, social capital and its impact on STEM choices?

Conceptual Framework

In a review of social capital literature conducted by Dika and Singh (2002), the researchers report that the concept of social capital spawned interest among many educational researchers and policy makers since its conceptualization by Pierre Bourdieu and James Coleman in the 1980s, specifically for its approach to improving one's life outcomes. Furthermore, a synthesis of the literature revealed that a number of contemporary researchers have credited the two theorists with the continual resurgence of researchers' interest in social capital. This is especially true in the field of education because of its contribution to maximizing adolescent's educational development and academic outcomes (Bourdieu & Wacquant, 1992; Croninger & Lee, 2001; Dika and Singh, 2002; Halpern, 2005; Horvat, Weininger, & Lareau, 2003; Loury, 1987; Putnam, 1995, 2000; Rosenfeld & Richman, 2003; Stanton-Salazar, 1997, 2001; Wang, Haertel, & Walberg, 1994).

Social capital, as employed in this study, is based on Ricardo D. Stanton-Salazar's (2001) critical network-analytic view of social integration and significant others. The author's critical network-analytic view of society "sees individuals as deeply embedded in social webs that, in turn, are interwoven within other webs, with these webs further interwoven within other webs, with these further interwoven within even larger webs or networks" (p.16). From this perspective, he believed that one's engagement in multiple interpersonal networks and relationships with significant individuals (institutional agents) can lead to racial and ethnic minority's social integration and success in mainstream institutional settings.

Stanton-Salazar (2001) further stated,

> *Social capital* is a set of properties existing within socially patterned associations among people that, when activated, enable them to accomplish their goals or to empower themselves in some meaningful way. Such association can occur in various ways: between two individuals (e.g., teacher and student), between individuals in a group (e.g., parents in a neighborhood), and between groups within a community (e.g., parents, school personnel, police). (p. 265)

Stanton-Salazar (1997, 2001) posited that inequalities within mainstream institutional settings made access to social capital problematic for students of color. However, he maintained that relationships with significant adults (institutional agents) can provide empowering resources and opportunities (social capital) that can promote and enhance student's educational goals and outcomes needed for traversing mainstream educational settings. In a study of urbanized Latino youth, Stanton-Salazar and Spina (2003), for example, reported that a supportive non-family adult agent, who becomes a member of an adolescent's social network, impacts the development of that individual, particularly in-school settings where students' social capital may be undervalued. They explained,

> For many youth, older siblings, extended family members, peers, neighbors, and key adults in the community all play a very important role in helping to determine their overall well-being and future life chances. For youth from working-class ethnic minority communities, these agents often play a decisive role in guiding them away from risk factors and into productive adulthood. Apart from the contributions that these individual agents, the reality of today is that public and private institutions, such as the school, community organizations, commercial centers, religious institutions, the media, social services agencies, employment sites, and the police and judicial systems, also participate and share in the adolescent socialization process. (p. 232)

Consequently, the author defined institutional agents as “those individuals who have the capacity and commitment to transmit directly, or negotiate the transmission of, institutional resources and opportunities” (Stanton-Salazar 1997, p. 5). Stanton-Salazar and Spina (2003) in a later study emphasized,

> Foremost is the recognition that for adolescents to successfully meet developmental challenges in today’s world, they require resourceful relationships and activities socially organized within a network of significant others and institutional agents distributed throughout the extended family, school, neighborhood and community. (p. 231)

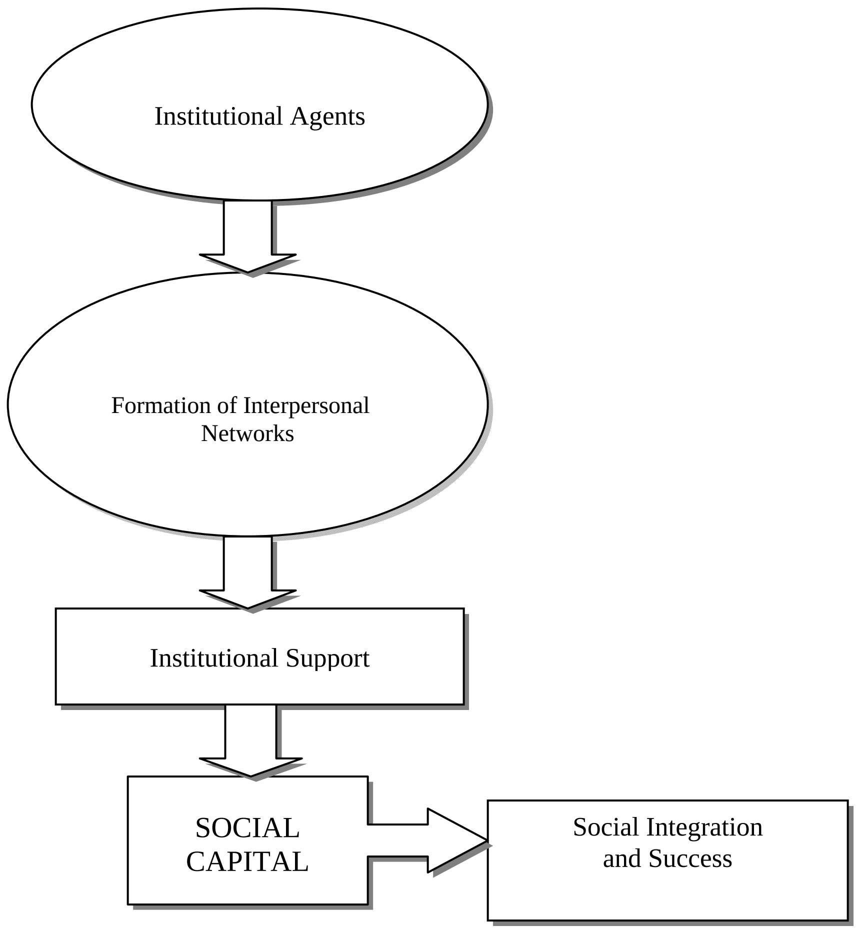
My conceptual framework was guided by Stanton-Salazar’s (1997, 2001) concept of social network analysis that encompassed the institutional support that he believed is inherent in interpersonal networks and transmitted through the structure of relationships with key institutional agents. Stanton-Salazar (1997, 2001) articulated six key forms of institutional support that he believed play a critical role in the social integration and success of racial and ethnic minority students. They are as follows:

> Provision of various funds of knowledge (i.e., institutional sanctioned discourse, academic task-specific knowledge, organizational/bureaucratic knowledge, network development, technical, knowledge of labor and educational markets, and problem-solving); 2) bridging, or the process of acting as a human bridge to gatekeepers, to social networks and to opportunities for exploring various "mainstream" institutions (e.g., university campuses); 3) advocacy and related forms of personalized intervention; 4) role modeling; 5) provision for emotional and moral support; and 6) provision of regular, personalized, and soundly based evaluative feedback, advice, and guidance. (p. 11)

The notion is that African American students' development of social capital can be garnered from institutional support inherent in students' interpersonal networks with key institutional agents in an out-of-school academic enrichment setting, which can serve as a conduit for buffering students from existing in-school social inequalities that consistently perpetuate their STEM underachievement and underparticipation. Therefore, my study investigated the development of social capital among African American students who participate in an out-of-school STEM Pre-College Program.

The conceptual framework for this study is grounded in Stanton-Salazar's research on social capital and interpersonal networks where the formation of students' interpersonal networks, with support from significant others (institutional agents), are linked to the development of social capital, social integration and STEM success. In this conceptualization, STEM success is defined as the enrollment in high school mathematics and science courses annually, with one or more of the courses being college preparatory, honors and/or advanced placement in preparation for pursing a college degree and career in a STEM-related discipline (Figure I).

Figure 1. Conceptual framework diagram



Significance of the Study

Our nation must begin to prepare, attract and retain a larger share of our citizens in the technical workforce who can support our nation's economy, security and quality of life. Oakes (1990) states, "If the nation continues to rely on decreasing numbers of Whites and Asian males for scientific talent, the quantity and quality of the workforce will be substantially lower than it would be if all groups were included" (p. vi).

The small percentage of American students who pursue science and engineering careers, especially racial and ethnic minorities; the decline in foreign-born students in the U.S. seeking graduate degrees in this country (Oliver, 2005); the decline in foreign-born STEM employees in the U.S. because of the global competition for well-trained professionals in the workforce (Coble & Allen, 2005); and the number of STEM professionals approaching retirement age (Malcom, George, & Matyas, 2005) could impact the future of America's social, educational, and technological standing in the world. Yet, racial and ethnic minorities continue to face far more formidable challenges in their access to colleges and universities in the United States, which translates into fewer individuals being trained for a highly scientific and technical workforce.

In order to meet the escalating demand for the future scientific and technical workforce, it is imperative that a body of research examines ways to increase the number of students graduating from high school with sufficient mathematics and science preparation to pursue STEM- or STEM-related college majors. Therefore, a study focused on the development of social capital can help advance our understanding and interpretation of the meanings that students of color attach to their experiences when they participate in a STEM Pre-College Program and select advanced mathematics and science courses in preparation for STEM college majors and careers.

Finn, Gerber and Wang (2002) asserted, "educators recognize that mathematics and science courses in high school are important stepping-stones to success in college and employment. They hold that students who take rigorous high school mathematics courses are better able to complete college-level mathematics courses" (p. 336).

However, educators continue to grapple with the question of why too few students, specifically African American students are selecting advanced mathematics and science high school courses needed for future academic and economic success. The current body of literature shows the value of social capital in an array of academic settings, primarily school time venues. Most studies did not extensively addressed the development of social capital among African American students, specifically while participating in a STEM Pre-College Program conducted in an out-of-school setting (i.e., after-school, weekend and summer).

Findings from this study can help parents, policy makers and practitioners identify strategies that address the mathematics and science achievement gap, as well as African American students' selection of advanced mathematics and science courses required for scientific literacy, college majors and STEM and STEM-related careers. This study can provide rich detailed data, which can contribute to a more comprehensive understanding of how institutional agents and interpersonal networks contribute to STEM choices by African American high school seniors who participate in a STEM Pre-College Program.

Limitations of the Study

The study was limited to eight African American STEM Pre-College Program participants. The eight students participating in the study do not reflect the background characteristics of all African American students. Thus, my study may not be generalizable to other students in other settings and the findings may be subject to other interpretations.

Maxwell (2005) maintains that qualitative researchers must be cognizant of two validity threats that can surface in their research: (a) biases and (b) reactivity. Therefore, I acknowledged the validity threats that I personally bring to my case study. I am very much aware of the biases and reactivity to what was voiced by participants and viewed by me in the course of this study. Consequently, I made a conscious effort to identify and address my subjectivities throughout my study; particularly in the selection of participants, data collection, and data analysis, as suggested by the author.

Definition of Terms

The terms used in this study are defined as follows:

<u>Social Capital</u> is defined as the social interactions that make use of the resources embedded within multiple webs of social relationships with significant others (institutional agents) that are needed for educational attainment. (Noguera, 2003; Stanton-Salazar, 1997; Valenzuela, 1999).

<u>Interpersonal Network (Social Network)</u> is defined as the formation of social ties and webs from relationships with significant others, which also can be called social support systems (Noguera, 2003; Stanton-Salazar, 2001).

<u>Social Integration</u> is defined as a student's level of personal engagement and inclusion in an institutional setting, which can lead to a sense of belonging or connection to various aspects of an institution (Stanton-Salazar, 2001).

<u>Institutional Agents</u> are defined as those individuals who have the capacity and commitment to negotiate resources and opportunities, as well as provide institutional support (Stanton-Salazar, 2001).

Institutional Support is defined as a form of assistance that functions to help empower students to become effective participants within mainstream institutional settings and society (Stanton-Salazar, 1997).

Science, Technology, Engineering, and Mathematics (STEM) Pre-College Programs (PCP) are out-of-school educational initiatives aimed at broadening students' science, technology, engineering, and mathematics interest; improving their achievement; advising their course selections; and/or influencing their science- and mathematics-related careers choices (Oakes, 1990).

Underrepresented Minority (URM) is defined as racial and ethnic minorities such as African American, Alaskan Native, American Indian, Hispanic American and Native Pacific Islanders who historically have been inadequately or insufficiently represented in the fields of science, technology, engineering, and mathematics. (NCES, 2007)

Advanced Placement (AP) Courses are defined as credit bearing high school courses that allow the bypassing of introductory college level courses (Sadler and Tai, 2007).

Advanced-level Mathematics Courses include honors or advanced placement courses in any algebra, geometry, statistics, probability, pre-calculus and calculus (NCES, 2007).

Advanced-level Science Courses include honors or advanced placement courses in biology, any chemistry, and any physics (NCES, 2007).

CHAPTER II

REVIEW OF LITERATURE

The following review of the literature is organized into four major strands. The first strand looks at African Americans and social capital. The second examines social capital and academic outcomes for students. The third deals with the underrepresentation of African Americans in science, technology, engineering, and mathematics. The fourth and final strand presents research related to science, technology, engineering, and mathematics (STEM) pre-collegiate programs.

African Americans and Social Capital

African American people endured the atrocities of slavery, criticism, and stereotypical images for many years. Yet, they are continually portrayed in society as a powerless and disorganized group of people filled with hopelessness, doom, and the lack of problem-solving skills and ambition (Frazier, 1939; Gelbach, 1966; Herskovits, 1941; Kardiner & Oversey, 1959; Moynihan, 1965; Rainwater & Yancey, 1967; Persell, 1991).

In fact, as Allen (2000) pointed out, far too many studies ignored institutional and societal context and characterized African Americans as problem-oriented individuals who come from low-income or underclass families with female-headed households and absent fathers. Allen reported,

> Both historically and today, the special circumstances that characterize black family life in the United States warrant – indeed require – that these families be examined in relation to their environments. Where this is done, one can expect clearer understandings of black family experience. (p. 314)

Despite a historical legacy of discrimination, many African American students overcome a myriad of social, economic, and educational barriers in order to pursue postsecondary education. Within the last two decades, scholarship emerged that examines students' development of social capital as it pertains to issues of social class, race, and nationality (Noguera, 2003). However, empirical studies that illuminate the social capital garnered specifically by African American students are limited, particularly research on resourceful relationships with institutional agents and network members in academic outreach settings.

The available studies show that access to social networks can be beneficial to African Americans' experiences and those of their children. For example, an important strength of African Americans is their ability to be resilient, which evolves from the social support networks between African American children and their parents, peers in schools, and communities (Wang, Haertel, & Walberg, 1994). In the same vein, Billingsley (1992) and Hill (1998) identified factors that contribute to the strength and resilience of African American families, including a strong emphasis on achievement, work, multiple family roles, kinship ties, home support, self-help, and religion. Hill (1998) believed that the ability of African American family members to facilitate demands outside the family unit lies in the cultural assets that members pass from generation to generation. More importantly, Billingsley (1992) reported that the strengths of African Americans are more powerful than their weaknesses, which enable African Americans families to persevere, especially during challenging times.

Stanton-Salazar (1997) explored the development of social capital among racial and ethnic minorities, particularly Mexican/Latino adolescents. He posited that social networks and ties are useful for connecting students with key institutional agents who can augment educational outcomes. He believed that developing networks, including negotiating and seeking help from significant others, could be beneficial for overcoming certain obstacles. Stanton-Salazar (1997) reported that in contrast to the dominant culture, racial and ethnic minority students are likely to encounter a number of constraints that prohibit or hinder them from seeking school-based sources of institutional support. For example, Stanton-Salazar (1997) described dominant group members' access to resourceful relationships and activities as "social freeways to privilege and power" (p. 4). He further stated, "a major vehicle that allows for the use of such freeways is an educational experience that is strategic, empowering, and network-enhancing" (p. 4). He concluded that racial and ethnic minority children, however, are limited in their access to these social freeways and the accompanying vehicles that permit such privilege and power.

Stanton-Salazar (1997, 2001), along with others, attributed the differentiation of power in society to ideologies related to class, race, ethnicity, and gender that play a major part in obstructing access to economic opportunities and social advantages (Horvat, Weininger, & Lareau 2003; Noguera, 2003; Valenzuela, 1999). Stanton-Salazar (1997, 2001) argued that individuals may acquire resources from a host of institutional agents (i.e., significant others) such as families, teachers, counselors, social workers, clergy, community leaders, college-going community youth, and school peers that can facilitate apposite social development and educational outcomes, particularly invaluable resources for students.

In addition, social networks comprise many overlapping ties among members that provide various types of support to individuals. However, researchers have concluded that racial and ethnic minorities' access to social capital can be problematic, specifically in schools and other institutional settings primarily because of social inequalities such as stereotyping, as well as the failure to acknowledge and/or recognize the value of minority students' culture (Stanton-Salazar, 1997; Valenzuela, 1999; Yan, 1999).

Using data from a *National Survey of Families and Households*, Kim and McKenry (1998), however, pointed out that social networks and social support may occupy an important role in the well-being and social mobility of racial and ethnic minorities. In a comparison of three racial and ethnic minority cultural groups (i.e., African Americans, Asian Americans, and Hispanics) and Caucasians, they found that variations in historical experiences tend to impact the creation of social networks, particularly the building of networks that can facilitate upward mobility and advancement. In contrast to other groups in the study, the authors reported that African American's propensity to participate in church and church-related social events and political activities accrued social capital embedded within the social support systems of these institutions. The researchers also reported that African Americans derived most of their social support from family and extend family members, non-familial kin, friends, neighbors, and co-workers. In addition, they "were more likely to rely on parents and children for support as compared to Caucasians" (p. 313). Kim and McKenry (1998) surmised that social networks and social support occupy an important role in our society, however, the social network systems of racial and ethnic minorities were found to be relatively different from the dominant groups that studied.

Researchers such as Lareau and Horvat (1999) and Horvat, Weininger, and Lareau (2003) explored the concept of intergenerational closure and the development of social capital, particularly as related to issues of how race and class have exacerbated school-based social inequalities. Horvat and Lareau (1999) used Bourdieu's social reproduction theory as a theoretical orientation to explore social inclusion and exclusion in family-school relationships, particularly African American parents' involvement in their children's education. Their study used a case study methodology to investigate the role of race in African American parents' compliances to requests from educators. They concluded that the affluent Caucasian parent's viewed social capital from a more positive perspective that of African American parents in an array of school-based settings.

Lareau and Horvat (1999) argued,

> In particular, educators are relentless in their demands that parents display positive, supportive approaches to education. The historical legacy of racial discrimination, however, makes it far more difficult for black parents than white parents to comply with such demands. Although social class seems to influence how black and white parents negotiate their relationships with schools, for blacks race plays and important role, independent of class, in framing the terms of their relationships. (p. 38)

John Ogbu (2003) argued that African American students' oppression and marginalization in classrooms rendered them non-participants in many aspects of society. Ogbu conducted an ethnographic study of 110 classrooms in the affluent Shaker Heights, Ohio school district. He investigated how academic achievement and school experiences affect the identity of oppressed African American students who are outside what he called "the opportunity structure." Ogbu advocated for the development of a community action framework that could assist African American families and the African American community in their educational efforts. He stated his belief that community-based non-profit and for-profit organizations, which run parallel to regular school, could help eliminate the achievement gap between African American and Caucasian students. The author encouraged community-based initiatives that would provide after-school and weekend intervention programs, activities, and opportunities for students. He reported that the achievement of African American students could be improved with the establishment of community-based academic programs that had a multicultural focus that included parents, role model speakers, and a public recognition program for students. Ogbu further argued that schools can address the African American - Caucasian achievement gap by persuading teachers to become caring individuals with high expectations for their students, and a willingness to create institutional settings that are conducive to helping parents become advocates for their children's education.

Since Coleman's (1988) conceptualization of social capital and its empirical investigations of social networks and relations, Noguera (2003) argued that social capital is of interest to numerous scholars because of its potential to strengthen social mobility, socialization, and social reproduction developments in the field. He underscored that point in the following statement:

> With its emphasis on the benefits derived from participation in social networks and relations of reciprocity, the focus on social capital encouraged researchers to examine relations between parents and teachers and students and teachers and among students themselves. (p. 181)

The literature clearly reflects the strength and resiliency of the African Americans. Horvat, Weininger, and Lareau (2003) maintained that material and immaterial resources accessible to individuals and families because of social ties also enable them to gain resources that can produce significant educational advantages for their children. Additionally, Croninger and Lee (2001) and Horvat et al. (2003) reported that individuals and families can garner educational advantages for adolescents through the resources of social capital. Several researchers suggest that the social capital African American children and their families bring to the classroom is conceptualized differently; thus, it is devalued by some educators and their educational practices. This devaluation can take away the resources that impact adolescent development and learning outcomes (Noguera, 2003; Ogbu, 2003, Smith-Maddox, 1999; Stanton-Salazar, 1997; Valenzuela, 1999).

In addition, much scholarly work on racial and ethnic minorities' development of social capital is largely devoted to studies of intergenerational closure, which focuses on relationships between parents and students (Noguera, 2003). The concept of social capital, as espoused by Bourdieu (1986) and Coleman (1985, 1988, 1990), provided the theoretical orientation for many of the social capital studies. A review of the literature reflects a pattern of studies using a social capital theoretical orientation to explore intergenerational closure and its impact on regular school time settings, particularly for racial and ethnic minorities. Clearly, these scholars unveiled evidence that social support, ties, and networks are beneficial for the development of social capital, while at the same time showing that access to social capital and institutional support can be problematic for students of color. As a result, school success and opportunities for racial and ethnic minority children are often undermined.

Although several studies include research on ethnic minorities' development of social capital, the literature is lacking in research that has investigated African American students' perceptions of the development of social capital from relationships with institutional agents outside of regular school time. Missing especially in this regard, are studies that examine pre-collegiate outreach initiatives in science, technology, engineering and mathematics (STEM) designed to broaden interest among racial and ethnic minority students in STEM and STEM-related high school courses, college majors and careers.

Social Capital and Academic Outcomes

Research findings provide substantive support for positive academic outcomes for students who possess and activate social capital (Coleman, 1988, 1990, 1995; Coleman & Hoffer, 1987; Croninger & Lee, 2001; Dika & Singh, 2002; Goddard, 2003; Horvat, Weininger, & Lareau, 2003; Lopez, Ehly, & Garcia-Vazquez, 2002; Malecki & Demaray, 2003; McNeal, 1998; Rosenfeld & Richman, 1999, 2003; Smith-Maddox, 1999; Stanton-Salazar, 2001; and Yan,1999)

Coleman and Hoffer (1987) in their early research, along with their study of Roman Catholic and other private schools articulated the value of capital in education. They argued that social support networks developed among individuals and groups in the church, community, and school increased students' mathematics and verbal performance, particularly where home social capital may be sparse. Coleman (1988) believed that the small networks of relationships and patterns of connection among individuals and groups can benefit students.

McNeal (1998) found that students' participation in extracurricular activities engendered different forms of social and cultural capital for parents and students of high socioeconomic status (SES). For instance, participation in extracurricular activities can offer a venue for maintaining status and prestige and students and parents who hold membership in higher social classes will enjoy more power. In turn, the exclusion of low-income and racial and ethnic minority students from extracurricular activities limits their access to social networks and alternate pipelines that could increase academic achievement.

The literature reflects that Coleman's earlier research on social capital and its impact on academic success continued to generate immense interest among many researchers (Lopez, Ehly, & Garcia-Vazquez, 2002). Thus, particularly in the last two decades, empirical studies began appearing to show the impact of social capital on student and adolescent development (Kahne & Bailey, 1999; Rosenfeld & Richman, 1999, 2003); academic performance and achievement (Goddard, 2003); and school attendance (Croninger and Lee, 2001; Lopez, et al., 2002) among racial and ethnic minorities.

Researchers such as Stanton-Salazar (1997), whose work focused on the concept of social capital among racial and ethnic minorities, posited that social ties are useful for connecting students with key institutional agents who can augment educational outcomes. "Institutional agents can be formally defined as those individuals who have the capacity and commitment to transmit directly, or negotiate the transmission of, institutional resources and opportunities" (p. 5). Stanton-Salazar reported that individuals can acquire resources from institutional agents such as families, teachers, counselors, social service workers, clergy, community leaders, college-going community youth, and school peers. These agents can provide invaluable resources and information about school, tutorial programs, mentoring, career awareness and advising, and college admission. He further argued that social networks comprise many overlapping ties among its members, which can supply a range of support for individuals. More importantly, these relationships can provide access to resources and privileges for individuals that can equate to forms economic and political power.

A study that looked at social networks and resources of low-income African American eighth graders also found that social networks can be beneficial to adolescents, especially with regards to acquiring information related to specific educational programs, courses, and careers (Smith-Maddox, 1999). Using longitudinal data, Smith-Maddox sought educational aspiration predictors of African American eighth grade students. She reported that the social networks within extra curricular activities and family, regardless of social class, are factors for predicting African American students' educational aspirations.

In a study of social interactions and relationships of highly successful African American students who completed high school and enrolled in postsecondary education, Yan (1999) sought to identify characteristics of social capital. He believed that social capital could be described as the building of relationships and social networks among parents and their children. Using Coleman's theoretical orientation and parent and student data from the National Educational Longitudinal Study (NELS:88), Yan compared successful African American students to both their successful Caucasian peers and their non-successful African American peers by exploring interactions among parents, family, teens, and school.

Yan's (1999) findings indicated that "the families of successful African American students demonstrate equal or higher levels of parental involvement than do those of successful European American students, despite the former comparatively disadvantaged home environment" (p.19). He suggested that parent-teen interactions among students of disadvantaged African American families should cover topics directly related to school subjects, experiences and activities, as well as postsecondary education plans such as scoring and grading, college placement testing, selecting courses, and applying to college. Yan poignantly concluded "that educators need to increase their awareness and acknowledgement of cultural differences in parental involvement in order to better challenge their own and others' stereotypical ideas and attitudes toward minority parents" (p. 20).

Two qualitative analyses examined the role of social capital in youth programs at the middle school (Kahne & Bailey, 1999) and high school (Rosenfeld & Richman 1999, 2003) levels. Using interviews and student academic performance data, Kahne and Bailey (1999) conducted a two-year study of the role of social capital in youth development. The study targeted the "I Have a Dream" Program, which provided financial, academic, and social support to sixth grade students who attended the public schools of Chicago. Using James Coleman's theory of social capital, the researchers examined social capital in terms of social trust, communication patterns, and behavioral norms of individuals to ascertain how these components promoted the pursuit of particular goals. The findings revealed that social networks, trust and norms, as well as effective sanctions indeed promoted youth development.

According to Kahne and Bailey (1999),

> It appears that many students in urban schools will benefit substantially from programs and structures that facilitate strong, trusting relationships between an identifiable and relatively small group of students and either one or a small number of trained and committed adults. (p. 340)

Using a qualitative approach to study at-risk African American and not at-risk African American and Hispanic students, Rosenfeld and Richman (1999) also investigated the relationship between types of social support and important academic outcomes, particularly for high school students. Using free and reduced lunch as the measure of socioeconomic status, at-risk students of the North Carolina and Florida Communities in School (CIS) Programs were participants in the study. The CIS Program provides support and aid for at-risk students such as tutoring and mentoring, as well as the coordination of student services from personnel and volunteers from agencies and organizations such as social services, schools and businesses.

The major findings indicated that at-risk and not-at-risk students attained social support from their parents, as well as their friends. In terms of gender, the findings show that male students experiencing poor parent relationships were more likely to suffer from a lack of social supportive relationships. In contrast, males who experienced social supportive relationships with their parents tended to seek needed assistance from other male counterparts. Overall the findings indicated that receiving social support accrues positive student outcomes, especially if the outcomes matched the specific needs of the individual. The researchers also reported a definite linkage between social support and educational outcomes, with social support shown to be a means of heightening academic performance (Rosenfeld & Richman 1999, 2003).

Croninger and Lee (2001) studied social capital to determine the benefits of teacher support and guidance to "at-risk" tenth and twelfth grade students. The purpose of the study was to examine whether teacher-based forms of social capital reduced the dropout rate among at-risk students. Data from the National Education Longitudinal Study (NELS: 88) was used to research the following question, "Do teachers provide students with valuable forms of social capital?" The researchers conducted a study of 11,000 public and private school students from approximately 1,000 schools for a period of two years, beginning in 1990. They suggested that social institutions such as families, religious associations, community groups, and educational organizations are valuable to young people. More importantly, they concluded that teachers are a significant source of social capital for students. However, they reported that the decline of many social institutions that traditionally provided support and/or guidance, which is significant for adolescent development, could be at the core of the school dropout rate among many Mexican-American students who are on a trajectory for failure.

Croninger and Lee (2001) further argued that teachers provide disadvantaged students with emotional support, encouragement, and assistance that can help with academic and personal predicaments, particularly decreases in the dropout rate. These researchers reported that adolescents could also benefit from the support that comes from other school personnel (school administrators, teacher assistants, coaches, and clerical and custodial staff). Lastly, peers were found to be invaluable sources of support for other peers through the formation of social ties and the many advantages that flow from the development of social capital (e.g., completion of high school).

Lopez et al. (2002) examined acculturation, as well as perceptions of social support and academic achievement in Mexican and Mexican American ninth-grade students to ascertain if these features impacted school success. The study investigated the high dropout rate among high school Mexican American high school students and included 60 ninth grade Mexican American students in a southwestern school district population of approximately 50,000. The researchers' conceptualization of social support included these components (a) a support network – availability of people who can provide help to others, (b) received support – actual help and support from members of the social networks, and (c) perceived support – a personal assessment of supportive relationships, as well as the type of supportive action. The findings suggested a significant connection between acculturation, social support, and academic achievement in Mexican Americans students.

Goddard's (2003) study of social capital and its influence on fourth-grade students' achievement in an urban school district reported that social capital can generate desirable outcomes; thus it also can be beneficial to disadvantaged students. The purpose of the study was to examine social capital and students' performance on mathematics and writing tests. Fourth-grade students from a Midwestern state participated in the study. Using a qualitative research method, the researcher collected data from 2,429 students and 444 teachers via surveys from 45 randomly selected schools. In an examination of social capital, the measure included teachers' reports of networks that connected parents and community members and its impact on facilitating students' learning, building of trusting student/parent relationships, and establishing norms that accelerate student learning. The author's findings suggested some gains in mathematics and writing assessments as a result of social capital. However, Goddard (2003) purported that the topic warrants further research, specifically the examination of the formation of social capital among high poverty, minority-serving public schools.

Malecki and Demaray (2003) investigated the specific types (emotional, informational, appraisal, and instrumental) and sources (parents, teachers, classmates, and close friends) of support that students perceived as important for social, behavioral and academic outcomes. These researchers suggested that students could be protected from certain outcomes and barriers if they perceived that they had encouragement and assistance from others within a supportive network. Using a quantitative methodology to investigate sources and types of social support for 263, fifth- through eighth-graders, the researchers measured the sources of students' support networks from parents, teachers, classmates, and close friends. One of the findings indicated that gender was not a significant factor in early adolescents' perceptions of levels and types of support from their parents and teachers. The findings for adolescents show that parents provided emotional and informational support, teachers provided informational support, and classmates and friends provided emotional and instrumental support. Overall, students' emotional and informational scores rank highest for teachers, whereas emotional and instrumental support scores rank highest for classmates and close friends.

A synthesis of social capital research and its impact on academic outcomes provides the best evidence that a positive link exists between types and sources of social capital and educational outcomes for students. For example, much research suggests that sources of social capital that contribute to students' educational outcomes include the home, school, and peers. There is also evidence to suggest that institutional agents provide educational advantages.

Underrepresentation of African Americans in Science, Technology, Engineering, and Mathematics (STEM)

Research on persons of color provides insight into the dismal nature of inequalities that historically and presently exist in educational institutions. Lee (2002) provided data for three decades, from the 1970s to the 1990s, which demonstrated a decline in trends toward educational equity. During the 1990s, the greatest setback occurred when the achievement gap widened for African American - Caucasian and

Hispanic – Caucasian populations in reading and mathematics. Lee's analysis of racial and ethnic achievement gap patterns have demonstrated growing disparities in SAT achievement, high school completion and dropout rates, and advanced course placement for the same two groups. Linda Darling-Hammond (2007) also addressed the achievement gap issue between Caucasian and non-Asian minority students and has reported,

> While we bemoan the dramatically unequal educational outcomes announced each year in reports focused on the achievement gap, as a nation we often behave as though we are unaware of - or insensitive to - the equally substantial inequalities in access to educational opportunity that occur from preschool through elementary and secondary education, into college and beyond. (p. 318)

In terms of achievement and performance, research shows that the number and type of advanced courses taken in mathematics and science are powerful indicators of preparation for undergraduate majors and course taking, as well as scientific literacy (NCES, 2000; National Science Board, 2004). According to NCES (2000), students who took advanced mathematics and science courses in high school are more likely to major in mathematics- and science-based fields. Although the number and type of advanced-level courses taken in mathematics and science are powerful indicators for college majors and career choices, many African American, Hispanic, and American Indian students are not participating in these courses in large numbers (BEST, 2004; NCES, 2007; Oakes, 1990).

In light of the growth of Advanced Placement (AP) testing nationally, survey data collected from eight high schools from a mid-size school district of approximately

58,000 students and a 30% minority student population, revealed a relatively low percentage of minority students pursuing AP courses in the school district of the study. The findings indicated only 2% minority students, with the exception of Asian and Pacific Islanders, are enrolled in the AP courses in contrast to 71% Caucasian Non-Hispanic students (Ndura, Robinson, & Ochs, 2003). The authors concluded,

> Society as a whole will benefit from higher enrollments of minority students in AP classes and in all other rigorous courses. One area of particularly significant importance to the US is the small percentage, excluding Asians, of minority students who pursue Science, Technology, Engineering, and Mathematics (STEM) careers. Our modern, technological society is especially dependent on human power in STEM to remain competitive in the global market. Tapping this human resource and preparing minorities to enter STEM careers would be beneficial to both the individuals involved and society as a whole. (p. 33)

For example, only 25% of African American high school graduates took higher-level mathematics courses in high school (i.e., pre-calculus, calculus, or trigonometry) in comparison to 49.2% of Caucasian graduates. For advanced placement calculus only 2.6% of African Americans enrolled in this course in comparison to 8.4% of Caucasian high school graduates. Twenty percent of African American high school graduates took biology, chemistry, and physics in contrast to 25.7% of Caucasian students. For advanced placement and honors physics, 2.2% of African American high school graduates have taken these courses in contrast to 4% of Caucasian students. Overall, African America high school graduates nationally continue to participate in far fewer higher-level mathematics and science courses than their Caucasian peers (NCES, 2002).

According to the recently released National Assessment of Educational Progress (NAEP) mathematics performance data for 2007, the average scores of African American eighth graders have reported a 23 point increase since 1990, from 237 to 260. More significantly, the 2007 NAEP results show a Caucasian-African American performance gap in eighth-grade mathematics continues to exist with scores for African American students 31 points lower than the scores of their Caucasian counterparts. A similar pattern holds true for science performance data with African American students' average achievement scores ranging from 39 to 52 points below those of Caucasian students for the ages of 9, 13 and 17 years (National Science Board, 2004). According to the most recent *National Assessment of Educational Progress* (NAEP) science achievement gap data for racial and ethnic groups in grade 12, gaps continued to persist between Caucasian students and their African American and Hispanic counterparts between the years of 2000 and 2005 (NCES, 2006).

Furthermore, 2003 graduate data from the National Science Foundation illustrated a four percent gain in science and engineering enrollment, which is higher than previous years (Oliver, 2005). Prior to this report, the graduate school enrollment data had revealed a decline in science and engineering that started in 1993. Currently, an examination of degrees in science and engineering revealed that African Americans represent only 7.2% of the bachelor's degrees, a mere 3.1% of the master's degrees, and 3.6% of the doctoral degrees in those fields (BEST, 2004).

Malcom, Chubin, and Jesse (2004) warned that the number of members of the current United States workforce in the age range of 40-49 years, 50-59 years, and 60+ years are approaching retirement at the rate of 29%, 21% and 7%, respectively, is also reason for alarm. According to the National Science Foundation, the competitiveness of the global market for foreign-born scientists is reflecting the decline in science and engineering graduate enrollment data (Oliver, 2005) and the domestic workforce (Coble & Allen, 2005). In 2003, for a second consecutive year, first-time, full-time U.S. graduate enrollment showed a decline of 8% among foreign-born students with temporary visas in the fields of agricultural science; computer science; earth, atmospheric, and oceans sciences; and in engineering (Oliver, 2005). In the past, foreign nationals could replace the shortage of well-prepared science and mathematics students in the United States. In fact, one-half of all engineering and mathematics doctorates, and almost one-half of all computer doctorates in the United States were foreign nationals in 2002. However, the recent competitiveness of the global economy for highly qualified STEM students and professionals could impact the number of foreign nationals who remain and work in the United States (Coble & Allen, 2005).

Oakes (1990) stated, “if the nation continues to rely on decreasing numbers of White and Asian males for scientific talent, the quantity and quality of the workforce will be substantially lower than it would be if all groups were included” (p. vi.). Consequently, the small percentage of American students who pursue mathematics and science careers (especially racial and ethnic minorities), the decline in foreign-born students in the U.S. seeking graduate degrees in this country, the potential decrease in foreign nationals in the workforce because of the global competition for well-trained STEM professionals, and the number of STEM professionals approaching retirement age could impact the future of America’s social, educational, and technological standing in the world. Yet, racial and ethnic minorities continue to face far more formidable challenges in their access to colleges and universities in the United States. This translates into fewer individuals being trained for a highly scientific and technical workforce.

Adelman's (1997) examination of who finished bachelor's degrees and why indicated that the "best prepared" high school students are the most likely to matriculate to a four-year college. One of the key indicators for being the "best prepared" is the academic intensity and rigor of the high school curriculum. In addition, students who participated in college preparatory programs show higher rates of college participation (Perna, 2000). Redd (2003) posited that higher income Caucasian students who attend the better high schools also have greater access to college preparatory items such as test preparation and college admission materials. Conversely, far too many schools that enroll a large number of African Americans students show small numbers on college-preparatory tracks and advanced courses, and who go to college (Martinez & Martinez, 2003).

Orfield (1998) theorized that many societal issues contribute to inequity in our society. He pointed out that because a college education is directly related to future careers and income, it can be the primary pathway through which inequities between groups can be reduced or erased so that there can be advancement toward equality. The absence of educational equality for racial and ethnic minorities, especially in the case of women's and racial and ethnic minorities' pursuit of science, continued to remain quite prevalent in our society (Jayaratne, Thomas, & Trautmann, 2003).

Studies show too few African American students are enrolled in advanced mathematics and science courses because of educational inequities. Summers and

Hrabowski (2006) argued that African American students' low enrollment in advanced mathematics and science courses may be attributed to educational- and cultural-related isolation, low expectations, a dearth of peer support, and discrimination. The ensuing consequences of this exclusion of African American students from mathematics- and science-based disciplines are serious for both society as a whole and for the individual students denied opportunities to achieve the power and prestige essential for upward mobility. Research validated that social injustices prevent many African American students from entering the pipeline for advanced mathematics and science course enrollment, as well as future STEM and STEM-related fields. These are compelling reasons to investigate interpersonal networks and institutional support in the development of social capital in a STEM Pre-College Program.

Clearly, too few African American students are being prepared to graduate from high school with sufficient preparation to pursue STEM college majors and careers. More importantly, the achievement gap continued to widen, leaving many racial and ethnic minority students void of the required skills to be competitive in a global society.

Science, Technology, Engineering, and Mathematics (STEM) Pre-College Programs

In a study titled, "*Who Will Do Science?*" Berryman (1983) theorized that students need access to science and mathematics experiences both in-school and out-of-school in order to enter the pipeline necessary for scientific literacy. Similarly, Oakes (1990) also reported that students need exposure and access to out-of-school scientific opportunities in order to enhance mathematics and science learning. Malcom (1984) and Malcom, Chubin, and Jesse (2004) suggested fourteen out-of-school intervention program strategies that appear to be very effective in encouraging females and minority students to pursue scientific careers:

- Concentration on academic enrichment activities
- Application of science and mathematics
- Integrative teaching, hands-on activities, and technology
- Participation in the program for multiple years
- Well-qualified program director
- Recruitment of participants
- Collaboration between university, school, and/or industry
- Reliable long-term funding base
- Opportunities for in- and out-of school time learning experiences
- Parent and community-based involvement
- Successful role models
- Peer support systems
- Institutionalization of program components into regular school time
- Competent and consistent teachers and staff.

Racial and ethnic minorities (excluding many of Asian decent) and females traditionally participate in scientific careers in smaller numbers than Caucasian males. Consequently, many interventions and academic outreach programs target underserved groups to improve their participation in science and mathematics (Oakes, 1990). Several researchers articulate that the vast majority of these programs lack rigorous research and evaluations, specifically for their effectiveness in encouraging interest in mathematics and science among minorities and females (BEST, 2004; Jayaratne et al., 2003; Oakes, 1990). Oakes (1990) surmised that programs for minorities and females generally have operated on the premise that the expanding enrichment experiences, changing instruction, and exposing students to career awareness information and speakers who can serve as role models will be sufficient for elevating academic performance and participation in mathematics and science.

The mid-1970s saw the outgrowth of many mathematics and science intervention and academic outreach programs for racial and ethnic minority students, specifically geared toward improving academic achievement, such as raising grade point averages, increasing enrollment in advanced-level courses/classes, and promoting participation in science-based activities (Gay, 2000). To illustrate, Gay cited several successful mathematics and science programs for K-12 students of color such as Teaching Excellence for Minority Student Achievement in the Science (TEMSAS), Equity 2000, American Indian Science and Engineering Society (AISES) Comprehensive Enrichment Program, Qualitative Understanding and Amplifying Student Achievement and Reasoning (QUASAR), and the Detroit Area Pre-College Engineering Program (DAPCEP).

Gay (2000) indicated that many early intervention programs for elementary and middle school students, as well as academic outreach efforts for high school students, list components such as opportunities and exposure to mathematics and science experiences and activities, self-esteem building strategies, career awareness, science- and mathematics-related role model speakers and leaders, integrative strategies for learning, and problem-solving and critical thinking activities. In addition, measures of program effectiveness generally included results from standardized tests, frequency of enrollment in advanced courses and participation levels, and self-report data on science and mathematics interest and motivation.

Gay (2000) emphasized a belief that the incorporation of particular features into early intervention programs could promote greater mathematics and science interest and achievement among racial and ethnic minorities. Among such suggested features are: including a multicultural and culturally-relevant curriculum; differentiating instruction to speak to varying learning styles; and making available program leaders, teachers, and staff who are caring and culturally sensitive and who have high expectations for learners.

Research findings, such as those cited earlier in this chapter, show that social capital can also play a vital role in buffering negative academic outcomes. However, the benefits of social support networks for African Americans are imperceptible in much of the current STEM social capital research. In fact, only a small number of studies focused on the role of social capital for African American students who participate in STEM pre-collegiate programs. For example, *The Meyerhoff Program*, a merit-based scholarship initiative for high-achieving African American college freshmen who wish to pursue STEM majors and careers found that social support networks helped to establish peer networks, which ease the experiences of isolation among many high-achieving African American students in majority and minority communities and schools (Fries-Britt, 1998). Further, a study of the social networks and resources of African American eighth graders found that social networks actually helped African American adolescents obtain valuable school-related information about specific programs/activities, courses, and careers (Smith-Maddox, 1999).

McLure and McLure (2000) examined the link between high school students' science course-taking patterns and their out-of-class achievements. These researchers provided examples of outside-of-class accomplishments reported by students and included activities, honors, and awards such as the following: wrote a paper on a scientific topic; received the highest possible grade given in school; performed an independent scientific experiment; participated in a National Science Foundation summer program for high school students; won a prize or award for scientific work or study; placed first, second, or third in a school science contest; placed first, second, or third in a regional or state science contest; participated in a scientific contest. The study analyzed data for 997,069 students who took the ACT test in the graduating class of 1998. Comparisons were made among groups and subgroups based on gender, race/ethnicity, and family income. The findings indicated that the greater the number of high school science courses taken and the more out-of-class accomplishments and achievements reported the higher students' ACT scores.

Jayaratne's et al., (2003) study of intervention programs that focused on keeping girls in the science pipeline indicated that numerous mathematics and science programs helped to eliminate the disparities in science, mathematics, and engineering. These authors argued that research on science intervention programs, however, is anecdotal; thus, such studies failed to show effective intervention program components for maintaining students' interest and pursuit of science. The researchers suggested more in-depth and longitudinal research methods should be conducted to help alleviate the void in the literature.

In general, a review of the literature conveys that many African American students do not have equal access to educational opportunities in school, particularly mathematics and science courses. Researchers expound on their belief that early intervention and academic outreach programs can promote students' mathematics and science achievement. Yet, only a limited number of studies are available to support this claim, which leaves a void in the body of literature on the role of interpersonal networks and institutional support in the development of social capital in a STEM academic enrichment and intervention programs.

Summary

Many empirical studies illustrate the value of social capital to adolescent development, specifically as it relates to academic performance and achievement in school-based settings. However, most studies do not extensively address the development of social capital for African American students who participate in out-of-school STEM programs. According to Smith-Maddox (1999) and Kim and McKenry (1998), the same collective resources that enable productive educational outcomes of other populations can benefit underrepresented students in general and African Americans in particular.

A myriad of empirical research findings on the benefits of social capital to adolescent development demonstrate that social relationships or a network of relationships can produce valuable resources and positive educational opportunities for students. Interestingly, this is not always the case for racial and ethnic minority students within institutional settings. Valenzuela (1999) so aptly coined the phrase "social de-capitalization" to describe the experiences of American classrooms and schools that fail to acknowledge or are insensitive to U.S. racial and ethnic minorities' social capital. Noguera (2003) similarly reported that schools can serve as a source of negative social capital for racial and ethnic minorities if the connections between school and community are filled with apprehension and distrust.

Based on the sparse research presently available, there is a need to explore the perceptions of African American students who participate in STEM pre-collegiate programs. The absence of research on STEM Pre-College Programs in general and on African American social capital development in particular demonstrates the need for such a study, particularly as it relates to the historical underrepresentation and underparticipation of African Americans in STEM, as well as the African American - Caucasian achievement gaps in science and mathematics.

CHAPTER III

METHODOLOGY

This study investigated the development of social capital for African American high school students participating in a science, technology, engineering, and mathematics (STEM) Pre-College Program. The study examined how eight high school seniors, having participated in a STEM Pre-College Program for a minimum of four years, were led to make STEM choices. This chapter describes the design of the study; context of the study; roles of the researcher; selection of participants; data collection and analysis procedures; and validity and trustworthiness issues.

Case Study Design

My study employed a qualitative research paradigm. According to Creswell (1998),

> Qualitative research is an inquiry process of understanding based on distinct methodological traditions of inquiry that explore a social or human problem. The researcher builds a complex, holistic picture, analyzes words, reports detailed views of informants, and conducts the study in a natural setting. (p. 15)

The selection of a qualitative research approach provided an appropriate venue to conduct an in-depth study of a group of African American students in a single entity and natural setting, a STEM Pre-College Program. Using data collection procedures, I gathered detailed information on the participants' perceptions of the development of social capital, particularly with regard to relationships between STEM students and institutional agents that may contribute to the development of social capital, social integration, and STEM success. The use of a qualitative research paradigm permitted my involvement in sustained intensive interaction with the eight STEM Pre-College Program participants. According to Creswell (2003), such interaction between the researcher and participants allows participants' perceptions and experiences to emerge, thereby providing insight into the researcher's questions.

I selected an instrumental case study design (Stake, 1995 & 2005) for my study. Stake (2005) uses "the term instrumental case study if a particular case is examined mainly to provide insight into an issue or to redraw a generalization" (p. 445). Stake (2005) further maintains that an instrumental case study allows a case to be looked at in-depth, its contexts analyzed, and ordinary activities detailed. He emphasizes that unlike an intrinsic case study methodology where *the case itself* is of interest, an instrumental case study is guided by an external interest. In short, the purpose of an instrumental case study is to provide a greater understanding of some particular issue within or about the case study or on which the case study can shed light. Thus, the instrumental case study design allowed me to pursue my particular interest in garnering an in-depth understanding of how African American high school seniors perceive the formation of interpersonal networks with institutional agents who can provide resources and opportunities (social capital) that can promote STEM integration and success. I therefore selected this design because of its appropriateness to uncovering information about ways institutional agents and interpersonal networks may contribute to the development of social capital--particularly for those students who have participated in a STEM

Pre-College Program and subsequently select high school advanced mathematics and science courses.

Lastly, Creswell (1995) assumes that an instrumental case study is a bounded system. Eight African American high school seniors bound by their participation in a STEM Pre-College Program comprised the bounded system in this study.

Context of the Study

This study involved eight African American high school seniors who are enrolled in a STEM Pre-College Program that has sites located on nine public campuses dispersed throughout a southeastern state. According to the program's historical records, the three sites for this study were established when the state legislature appropriated funding in 1986. The program was authorized under a mandate by the state legislature. Its mission was to increase the pool of underrepresented students who would graduate from high school with sufficient preparation to pursue science- and mathematics-based majors and careers in science, technology, engineering, and mathematics and teaching.

Throughout its 22-year history, the STEM Pre-College Program has been committed to providing high quality, year-round, multi-year academic enrichment programs that support students from historically underserved/underrepresented groups in science and mathematics so they can matriculate successfully at the university level. The program recruits students with average to above average academic performance and moves them to become high achieving students in mathematics and science. This highly successful program boasts a 97% rate of college enrollment for its graduates with over

82% pursuing mathematics- and science-based majors and 64% indicating plans to attend graduate school.

The 2007-2008 STEM Pre-College Program data show that approximately 2,621 students participate in the program. Within that number are 1,477 middle school students and 1,144 high school students. Enrollment data by ethnicity indicate that 79% of the combined middle and high school students are African American, 11% Caucasian, 2% Hispanic, 3% Asian, 3% multi-racial, and 2% designated as other. Sixty-one percent of the students are females and 39 % are males.

STEM students are recruited as rising sixth graders and encouraged to remain in the program until graduation from high school. Following is a description of the major high school components:

- *Saturday Academy and Summer Academic Enrichment Programs* are conducted on each of the nine participating university campuses. Students take part in a series of mathematics and science enrichment activities, classes (e.g., Communications, Career Awareness, Science, Mathematics, Technology, SAT Preparation, Research, etc.), fieldtrips, sessions with role model speakers, and science laboratory experiences conducted on Saturdays throughout the academic year, beginning in September and ending in May. The daily summer classes are conducted in a similar fashion to the Saturday Academy. However, they are specifically designed to prepare students for their school-based mathematics and science courses in the upcoming fall semester. Students are exposed to approximately 80 summer contact hours.

- *Leadership Development Activities* are designed to engage students in the development of leadership skills. The activities expose high school students to numerous activities focused on leadership-building. Also included are STEM professional leaders who provide motivational sessions for students.
- *Parent Organizations* are established at local campus sites. Parents are asked to participate in workshops and meetings on topics such as school academic requirements, standardized testing, college application process, scholarships, and so forth. Members of the parent organization also serve as volunteers and assist program staff in planning.
- *Mathematics and Science After-School Clubs* are created to serve the same function as those traditionally served by other high school clubs and/or honor societies. The advisor to the club is a mathematics or science teacher who is assigned by the principal in conjunction with the STEM Pre-College Program coordinator. The after-school clubs are established at STEM Pre-College Program participating schools for the purpose of: (a) allowing the advisor to stay in touch with the students to keep abreast of their academic progress, as well as problems and concerns that students may encounter; (b) providing a regular after-school time for students to be involved in activities, workshops, tutoring and mentoring; getting feedback from students; and keeping them apprised of important dates such as PSAT, SAT, college applications and scholarship deadlines; (c) building a sense of community; and (d) developing leaderships skills by electing club officers and assigning them responsibilities for each part of the meeting.

- *A Summer Research Program* is planned so that students are totally immersed in the planning and execution of a summer research internship experience with a practicing research scientist or mathematician. Students work in research laboratories during the summer months and engage in follow-up activities held in the fall semester.
- *Mathematics and Science Competition Day* is an annual event hosted by one of the nine universities that house a STEM Pre-College Program on their campus. Approximately 700 students participate annually in an array of science, engineering, and mathematics challenges and events. In teams of two to four, students take part in one or more competitive events such as mathematics and science written tests and hands-on activities. Students who participate in testing take a fifty-minute quiz in the same mathematics or science subject area in which they are enrolled during the academic year. Other students participate as teams in the hands-on activities such as bottle rockets, parachute egg drop, tower/bridge building, poster art, writing, engineering design, quiz bowl, oratorical contests and other events. The day concludes with an awards ceremony where medals and trophies are presented to the winning teams and to the overall first, second, and third place STEM Pre-College Program sites.

Through university and school partnerships, advisory teams that are established at each school site consist of a school administrator, school counselor, mathematics teacher and/or science teacher. Based on the recommendations of advisory teams, in conjunction with the Program's site coordinators, students are considered for admission to the on-campus program, including but not limited to, the following criteria:

- Evidence of interest and aptitude for rigorous mathematics and science courses
- Lack of preparation to pursue high school level mathematics- or science-based courses
- Grades of "C" average or better
- Completeness and timeliness of application
- Socio-economically disadvantaged backgrounds
- Evidence of leadership ability
- From single-parent households
- Substantial family and/or financial responsibilities
- From schools with high dropout rates.

Students enrolled in the program come primarily from an array of public schools, Charter and private school students also participate in the program, although in smaller numbers. As reported in the 2006-2007 annual report of the STEM Pre-College Program, 50 school districts have middle and / or high school participants in the STEM Pre-College Program. Upon admission to the program, participants are expected to enroll in mathematics and science courses each academic year until graduation from high school, specifically college preparatory mathematics and science courses in high school. Although sixth and seventh grade students who are recruited for the STEM Pre-College Program are of average to above average ability, data indicate that 97 percent of all high school seniors had enrolled in one or more advanced mathematics and science course at each grade level.

Roles of the Researcher

Stake (1995) believes that the researcher must assume certain positions and responsibilities for conducting an instrumental case study. My roles in this study encompassed those of advocate, teacher, researcher, and biographer.

In the roles of advocate and teacher, I used my 25 years of professional experiences and personal interest in teaching and directing out-of-school STEM-related academic enrichment and community-based programs to extrapolate and interpret the voices of students of color, which are limited in historical and contemporary research. Since there is limited research on African American students' perceptions of institutional agents and interpersonal networks in the development of capital in general and in advanced mathematics and science course selection in particular, I used my role as an advocate in this study to ensure that the voices of the participants were heard.

In the role of researcher, I was cognizant that the leadership provided to the STEM Pre-College Program sites might bring my personal biases to the study. First, there was a possibility that I might not be unknown to some of the students who had been purposefully selected as participants in the study. I have the responsibility of monitoring and leading the statewide STEM Pre-College Program; however, the central coordinating office is not located at any of the three campuses that participated in this study. Also, I do not have any direct contact or authority in making decisions about students who are admitted or terminated from the program sites. This authority is the responsibility of the

STEM Pre-College Program coordinators on each of the campuses. Secondly, determining the program's effectiveness in preparing high school students for STEM college majors and careers is first and foremost one of my majors responsibilities as the director of the statewide program. Although the intended purpose of this study was not a program evaluation, the tendency to delve into evaluative issues was another bias that I recognized in my study. Consequently, I relied heavily on triangulation, member-checking, peer examinations, and debriefing to validate the accuracy and trustworthiness of my accounts and findings in the study.

In order to accurately convey the life of participants in my study, I assumed the role of a biographer and drew upon the skill of writing when interpreting data for understanding and meaning as proposed by Stake (1995). I have an ethical obligation to clearly portray the complex ideas that emerged from multiple data sources. Thus, I immersed myself into writing concise representations that fairly and accurately illuminate issues and tell the stories offered by participants.

Participants

Creswell (2005) maintains that purposeful "qualitative" sampling (e.g., homogeneous sampling) is useful for selecting "information rich" sites to investigate. Out of a total of nine university-based STEM Pre-College Program sites situated on public university campuses in a southeastern state, three were purposefully selected for the study. The 2007-2008 academic year registration data indicated that approximately 2,621 sixth through twelfth grades students were enrolled at the nine campus sites. Of the total enrollment, 251 high school seniors participated at six of the nine university-based

STEM Pre-College Program sites. The total high school senior enrollment for the three university-based sites included in this study is 85: MaryArthur University = 28, Marionville University = 34, and Chestertown University = 23 (for the purpose of anonymity, pseudonyms are used for the universities included in this study)

The site's large high school senior enrollment yielded a sizable pool of African American students from an array of school demographics (e.g., location, size, race and ethnicity, socio-economic status, and advanced mathematics and science course offerings) and family structures. The three sites also admit students from urban, suburban, and rural schools, which ensured a geographic balance among participants (Table 1). Lastly, the three selected sites had experienced minimum turnover of the STEM Pre-College Program coordinators who provided local oversight to the university-based initiatives.

Table 1

Demographics of Sites

UNIVERSITY[a]	**LOCATION IN REGION**	**SIZE**	**RACE/ ETHNICITY**	**SOCIAL CLASS STATUS**	**GEOGRAPHIC STATUS OF HOME SCHOOLS**
MaryArthur	South	208	166 African Am. 3 Asian / Pacific Islander 7 Bi-racial 5 Caucasian 12 Hispanic 5 Native / American Indian 7 No Response 3 Other	Low to Middle	Urban, Suburban, and Rural

UNIVERSITY[a]	LOCATION IN REGION	SIZE	RACE/ ETHNICITY	SOCIAL CLASS STATUS	GEOGRAPHIC STATUS OF HOME SCHOOLS
Marionville	East	429	305 African Am. 20 Asian / Pacific Islander 17 Bi-racial 48 Caucasian 9 Hispanic 4 Native / American Indian 6 No Response 20 Other	Low to Middle	Urban, Suburban, and Rural
Chestertown	Central	811	482 African Am. 24 Asian / Pacific Islander 23 Bi-racial 254 Caucasian 25 Hispanic 1 Native / American Indian 2 Other	Low to Middle	Urban, Suburban, and Rural

[a]pseudonym

Using the following selection criteria, 20 participants were purposefully selected from the 2006-2007 STEM Pre-College Program registration database: (a) reported ethnicity as African American, (b) were currently enrolled in the STEM Pre-College Program, (c)had participated in the STEM Pre-College Program for a minimum of four years, (d) were enrolled in mathematics and science high school courses each year, and (e) were currently enrolled in advanced mathematics and science high school courses. The selection criteria yielded a total of 85 students for which I assigned a number. After the assignment of a number to each individual who met the selection criteria, I used a random numbers table to select 20 high school seniors for the study. The demographics of the 20 students are listed in Table 2.

Table 2

Demographics of Students

Student	**Gender**	**Site**
1	Female	MaryArthur University
2	Female	MaryArthur University
3	Female	MaryArthur University
4	Female	MaryArthur University
5	Female	MaryArthur University
6	Female	MaryArthur University
7	Female	MaryArthur University
8	Male	MaryArthur University
9	Male	MaryArthur University
10	Male	MaryArthur University
11	Male	MaryArthur University
12	Male	MaryArthur University
13	Male	MaryArthur University
14	Female	Marionville University
15	Female	Marionville University
16	Male	Marionville University
17	Male	Marionville University
18	Male	Chestertown University
19	Male	Chestertown University
20	Male	Chestertown University

The purposeful selection process yielded nine female and eleven male prospective participants. Individual telephone calls (see Appendix A for the telephone call script) were made to the 20 prospective STEM Pre-College Program participants, as well as to their parents/legal guardians in order to obtain their verbal consent for participation. The next step involved scheduling a meeting with the prospective participants and their parent/legal guardian in order to obtain written permission for participation in the study. Since the participants were under 18 years of age, the STEM Pre-College Program coordinator was asked to witness the oral and written presentations made by the researcher and to the affixing of student and parent signatures on the consent form as established by the Institutional Review Board (see Appendix B, Appendix C, and Appendix D for the oral presentation and consent forms).

Of the 20 contacted, 11 students and their parents initially agreed to participate in my study, which included four females and seven males. In the midst of the actual data collection process, three of the female participants withdrew from the study, leaving one female and seven male participants. Two of the females withdrew from the study because their work schedules would not permit full participation in the study. The third female failed to show for the scheduled interview times. Since gender was not a variable in the study, I decided to continue with the eight students. Table 3 lists the participants with their gender for the STEM program sites.

Table 3

List of Participants

Participant [a]	**Gender**	**STEM Pre-College Program Campus Site**
Eric	Male	MaryArthur University
Janay	Female	MaryArthur University
William	Male	Marionville University
John	Male	Marionville University
Joe	Male	Marionville University
Nigel	Male	Chestertown University
George	Male	Chestertown University
Tom	Male	Chestertown University

[a]pseudonyms

Data Collection Procedures

According to Maxwell (2005), the purpose of qualitative research is to find “data rich in detail and embedded in context” (p. 149). Creswell (2005) argues that case study is appropriate for empirical inquiry and the gaining of an in-depth understanding of a case or bounded system by collecting extensive data through multiple forms of primary sources (e.g., interviews, documents, artifacts, and observations).

In addition, triangulation as defined by Creswell (2005) is “the process of corroborating evidence from different individuals (e.g., a principal and a student), types of data (e.g., observational field notes and interviews), or methods of data collection (e.g., documents and interviews) in descriptions and themes in qualitative research” (p. 600). I used multiple sources of data in this study (face-to-face interviews, focus group interviews, and observations) to ensure the trustworthiness and accuracy of the data obtained from African American students who served as key participants.

A detailed description of my data collection protocols was submitted to the Institutional Review Board (IRB) for approval prior to conducting any research. Upon approval, I adhered to ethical research practices and ensured that participants were not deceived about the study's purpose and procedures, and confidentiality and anonymity were guaranteed in all phases of my research.

For purposes of preliminary access to participants, they were contacted by telephone and asked to participate in the research. This initial access allowed me to describe my research and the role of the researcher with the project. Furthermore, this initial contact helped to build rapport with the research participants who were included in the study. As mentioned above, the three sources of data for this study were (a) semi-structured interviews; (b) observations; and (c) focus group interviews.

Semi-structured Interviews

The first data source was semi-structured interviews, which according to Yin (2003) and Creswell (2005) are commonly used in case study research to gain detailed personal information from participants. Yin further states, "… case study interviews require you to operate on two levels at the same time: satisfying the needs of your line of inquiry while simultaneously putting forth 'friendly' and 'non-threatening' questions in your open-ended interviews" (p. 90) (see Appendix E for Interview Protocol). I conducted two interviews with each of the eight STEM Pre-College Program high school participants for a total of sixteen hours using pre-determined, open-ended questions; their responses were audio-taped for purposes of accuracy in transcribing the recordings for analysis. The interview questions were used as a guide. However, for points of clarification or to acquire a greater understanding, I would ask additional questions. I interviewed participants in their natural settings (for example, homes, a local public library, a park, or a STEM Pre-College Program site), and anonymity and confidentiality were assured throughout the entire study, as well as beyond (Creswell, 2005). In order to ensure anonymity, each participant was asked to provide a pseudonym that was used throughout the entire study.

Observations

The second data source was observations. Yin (2003) explains:

> By making a field visit to the case study "site" you are creating the opportunity for direct observations. Assuming that the phenomena of interest have not been purely historical, some relevant behaviors or environmental conditions will be available for observation. Such observations serve as yet another source of evidence in a case study. (p. 92)

I assumed the role of a non-participant observer and made three 4-hour observations and field visits to the participants' STEM Pre-College Program Saturday Academy mathematics and science classes (see Appendix F for Observation Protocol). Creswell (2005) writes, "a non-participant observer is an 'outsider' who sits on the periphery or some advantageous place to see the phenomenon under study (i.e., the back of the classroom)" (p. 212). Field notes, as defined by Creswell (2005), are "text (words) recorded by the researcher during an observation in a qualitative study" (p. 213). For my study, I made advanced appointments with the STEM Pre-College Program coordinators to conduct site visits at the various campus sites prior to the actual visits. As suggested, I used the observation protocol for purposes of documenting field notes such as information about the participants, the physical setting of the activities and events, types of activities and events, and my personal reactions to things that I observed during each site visit (Creswell, 2005). The observations served a two-fold purpose: (a) information from observations of mathematics and science classes was used to triangulate data from the interviews, and (b) questions not discussed in semi-structured interviews were generated for use with focus groups.

Focus Group Interviews

The third and final data source was focus group interviews. Focus group interviews as defined by Creswell (2005) “are the processes of collecting data through interviews with a group of people (typically 4-6). The researcher asks a small number of general questions and elicits responses from all individuals in the group” (p. 215). For this study, three focus group interviews were conducted with the participants from each site; two groups of three participants (Marionville and Chestertown) and one group of two participants (MaryArthur). Each focus group interview lasted from 45 minutes to one hour. The first focus group interview took place in the home of a participant in the study, which was in close proximity to the other two participants. The remaining participants reside in different towns and cities and the travel distances between them limited the coming together for face-to-face focus group interviews. Since travel was problematic for some of the participants, teleconferencing arrangements provided access to the participants. The availability of a teleconference call allowed all participants’ voices to be heard by everyone in the group. The use of a speaker telephone also permitted me to digitally record the interviews. The focus group protocol was developed after transcribing and coding data collected during my semi-structured interviews and observations with participants, which allowed the formation of focus group questions based on prompts that emphasized emergent patterns from the analysis of the prior data (Appendix G for Focus Group Interview Protocol). Table 4 aligns the research questions with data sources.

Table 4

Crosswalk Aligning Research Questions with Data Sources

Research Questions	**Conceptual Framework**	**Data Collection Procedure**		
		Student Semi-Structured Interviews	*Student/ Agent(s) Observations*	*Student Focus Interviews*
1. How do STEM Pre-College Program (PCP) students perceive institutional agents and interpersonal networks? a. How do they describe institutional agents and institutional support? b. How do they describe the support provided by institutional agents? c. How do they describe interpersonal networks?	X	X		X
2. How do STEM PCP students perceive social capital development in STEM?	X	X		X
3. How do STEM PCP students perceive the relationship between interpersonal networks, social capital and its impact on STEM choices?	X	X	X	X

Data Analysis Procedures

As suggested by Creswell (2005), "data analysis is an ongoing process involving continual reflection about the data, asking analytic questions, and writing memos throughout the study" (p.190). First, individual interview transcripts and observation field notes were immediately reviewed in order to capture what was seen and heard during each of the semi-structured interviews, focus group interviews, and direct observations. Secondly, I sorted and organized each type and source of information collected from participants in order to begin the coding process. In regards to the coding process, Creswell (2003) states, "it involves taking text data or pictures, segmenting sentences (or paragraphs) or images into categories, and labeling those categories with a term, often a term based in the actual language of the participant (called an *in vivo* term)" (p. 192).

Thirdly, I thoroughly reread and reviewed the text data in order to capture and reflect on the overall meanings. I used the margins of my transcriptions and notes to record my thoughts, as well as underlining key words or phrases about what was being said by each of the participants around a category such as *supporting, pushing, caring, encouraging, guiding; and talking to us*. I created a list of codes (categories), which were abbreviated, alphabetized and used in reviewing the text data again, while also capturing new codes (categories), patterns, and relationships that I saw emerging from data. I reread the data and continued with the process of coding to help generate the broader themes, as well as emerging indicators associated with each theme (see Appendix H for a detailed description of how Theme Two, "Institutional support through dialogue and discourse," emerged from the data analysis).

Lastly, I wrote the most meaningful data into a short summary in order to identify the common patterns that ran through the interviews and direct observations (Maxwell, 2005). I took the themes and a summary of the transcripts back to the participants for purposes of member checking, which also verified the accuracy of my findings (Creswell, 2003). Three themes emerged from the data analysis: (a) institutional agents as extended family, (b) institutional support through dialogue and discourse, and (c) empowerment. The relationship between the emergent themes and indicators is exhibited in Table 5.

Table 5

Emerging Themes and Indicators

Themes	**Indicators**
"I told her she better not drop AP or I was going to tell her momma": Institutional agents as extended family	-Peers -Coordinators and Staff -Career/Role model Speakers
"I just feel that being able to talk, they always let you know that there's a hand to pick you up": Institutional support through dialogue and discourse	-Advocacy -Nurturance -Encouragement -Conversation
"It's not about trying to be who somebody wants you to be; it allows you to be who you need to be, who you want to be": Empowerment	-Strategies for Success -STEM Options -STEM Information -STEM Self-efficacy -STEM Engagement

Trustworthiness of the Study

In keeping with a well-developed research design, I acknowledged my biases, which is critical for validity and trustworthiness in research approaches (Creswell, 2005). I addressed "trustworthiness" through the research design where accuracy of the information is verified.

I used purposeful sampling in the selection of participants and sites, triangulation of multiple data sources, member checking to obtain feedback from participants, and the identification of strategies for how participants were involved in all phases of the research.

As recommended by Creswell (2005), the descriptions and themes garnered from the study were validated through various forms of evidence from different people, data types, and methods of collection. Therefore, the triangulation of data and feedback received from participants (e.g., member checking), as well as the inclusion of how participants were involved in all phases of the research helped to verify the accuracy of this study. For instance, I prepared written summaries of my interview and observation findings, as well as the three emerging themes, and in subsequent interviews asked participants if my interpretations and inferences were appropriately represented. Lastly, as Creswell (2005) suggests, I have provided thick, detailed description, and my interpretations are grounded in relevant literature.

Summary

An instrumental case study was used to investigate African American high school senior students' perceptions of the development of social capital in a STEM Pre-College Program. Data were gathered via (a) sixteen semi-structured individual interviews, (b) nine observations, and (c) three focus group interviews.

Eight students who met the following criteria participated in the study: (a) reported their ethnicity as African American, (b) were currently enrolled in the STEM Pre-College Program, (c) participated in the STEM Pre-College Program for a minimum of four years, (d) had enrolled in mathematics and science high school courses each year, and (e) were currently enrolled in advanced mathematics and science high school courses. Each participant took part in two semi-structured individual interviews, a direct observation, and a focus group interview. Three themes emerged from an analysis of data collected from participants in this study: (a) institutional agents as extended family, (b) institutional support through dialogue and discourse, and (c) empowerment.

CHAPTER IV

RESULTS

This chapter presents the findings of my instrumental case study. Eight African American high school seniors who attend the STEM Pre-College Program at three different universities in a southeastern region of the United States participated in the study. Three overarching themes emerged through the analysis of interview and observation data: (a) institutional agents as extended family (b) institutional support through dialogue and discourse, and (c) empowerment. The profiles of the eight African American students and the findings of my study follow.

Profiles of Students

- Eric is a 17-year-old African American male. Although a quiet young man, he talked candidly about his career plans to become a neurosurgeon and enthusiastically shared that Dr. Benjamin Carson was his role model. He is an honor high school senior who resides with his grandmother. When given an opportunity, his grandmother fondly shared the original documents detailing Eric's academic accomplishments from first grade to the present. She was most proud of his acceptance to the North Carolina Governor's School during the summer of 2007. Eric enrolled in the STEM Pre-College Program in sixth grade and has been an active participant for a total of six years. He has complete college admission applications to the University of North Carolina at Chapel Hill

Morehouse College, Xavier University of Louisiana, Hampton University, Wake Forest University and the University of North Carolina at Charlotte. His goal is to pursue a major in biology or biochemistry (pre-med) in preparation for medical school. Eric has enrolled in the following high school courses in preparation for a STEM career, including: Advanced Placement Biology, Honors Chemistry and Advanced Placement Physics, Honors Algebra II, Honors Geometry, Honors Pre-Calculus, and Honors Calculus.

- Janay is an articulate 17-year-old African American female whose future plans include becoming a chemist. She lives in a neighboring town to the university campus that serves as host site to one of the nine STEM Pre-College Programs. She has to travel 90-minutes (round trip) in order to attend the early morning start up time for STEM Saturday Academy and Summer Scholars sessions. Janay also works at a fast food restaurant. She is an honor student and has taken high school mathematics and science courses in Algebra I, Geometry, Algebra II, Advanced Functions and Modeling, and Honors Pre-Calculus, Earth and Environmental Science, Biology, and Advanced Placement Chemistry. She has submitted college applications to the University of North Carolina at Greensboro, North Carolina State University, and the University of North Carolina at Chapel Hill.
- George is a very confident 17-year-old African American male honor student who eagerly speaks about his level of comfort in doing mathematics and science, particularly calculus and physics. In addition to his numerous academic achievements, he is an outstanding high school athlete. George has applied to the

University of Miami, Rutgers University, Hampton University, and Princeton University and plans to major in biology. His high school courses have included advanced-level mathematics and science courses such as Honors Biology, Honors Chemistry, Honors Physics, Advanced Placement Environmental Science, Integrated Mathematics, Advanced Placement Calculus, and Advanced Placement Statistics. His goal is to earn a Ph.D. in biology.

- Nigel is a creative 17-year-old African American male who has a passion for the performing arts. One of his major extra-curricular activities is dancing. He is an active participant on a dance team and spends an inordinate amount of time practicing for performances. He also is employed at an ice cream shop where he delights in preparing creative ice cream dishes and, in turn, patrons delight in his engaging customer service. Nigel is a high school senior who enrolled in the following high school mathematics and science courses: Honors Biology, Honors Earth Science, Honors Chemistry, Honors Algebra I, Honors Geometry, Honors Algebra II, Honors Pre-Calculus in preparation for a college degree in Biology. He has applied to Guilford College and the University of Miami. This academic year concludes his sixth year of being in the STEM Pre-College Program.
- Tom is a 17-year-old African American male high school senior who plays football for his varsity high school team while also acknowledging his interest in mathematics and science. Tom looks forward to pursuing a college major in accounting at Winston-Salem State University or North Carolina Agricultural and Technical State University. His high school courses in mathematics and science

have been Integrated I, II, III, and IV; Advanced Functions and Modeling, Honors Biology, Honors Chemistry, and Honors Earth Science. He has been in the STEM Pre-College Program since sixth grade.

- William is a 17-year-old energetic African American male who stated, “I do not enjoy seeing people down. Life is too short; we need to have a smile on our faces” (Observation, October 13, 2007). He expressed an interest in becoming a role model for other students and is an active participate in the STEM Pre-College Program After-school Club. William plays high school sports and Amateur Athletic Union (AAU) basketball. He also serves as a lifeguard for the city’s recreational swimming program. He has submitted college applications to Morehouse College, Wingate University, Chowan University, Hampton University, Florida A&M University, and Xavier University of Louisiana with plans to pursue a degree in Business Management. William has been in the STEM Pre-College Program for a total of six years.
- John is a 17-year-old self-assured African American male high school senior who has been with the STEM Pre-College Program for the past seven years. He is interested in technology and wants to pursue a career that involves working with computers and computer software. John described himself as a “determined, confident and successful African American male” (Observation, October 13, 2007). He is an honor student whose high school science and mathematics courses included - Algebra I, Geometry, Algebra II, Advanced Functions and Modeling, Earth Science, Honors Biology, Honors Chemistry, and Honors

Physics. John has applied to North Carolina Agricultural and Technical State University, Georgia Institute of Technology, Howard University, Hampton University, and the New Jersey Institute of Technology.

- Joe is an articulate 17-year-old African American male. His interest in science was enhanced after last summer's participation in a summer research internship. The summer program matched high ability/high potential students with practicing research scientists for a six-week summer research experience in a university research-based laboratory. Joe was placed in a chemistry laboratory where he conducted research on textiles. He also presented his summer research experience at several research symposia during the summer and fall. He delights in sharing how this very competitive experience has motivated him to take a closer look at the field of chemistry. Joe is a high school senior and was elected president of this STEM Pre-College Program After-school Club for the 2007 -2008 academic year. He has enrolled in Algebra I, Geometry, Honors Algebra II, Advanced Functions and Modeling, Honors Earth Science, Honors Biology, Honors Chemistry and Advance Anatomy and Physiology during his four years of high school. He has submitted college applications to the University of North Carolina at Greensboro, North Carolina Central University, the University of North Carolina at Charlotte, and North Carolina State University. He plans to pursue a college major in communications.

Theme One: "I told her she better not drop AP or I was going to tell her momma": Institutional Agents as Extended Family

As a body, the participants collectively described their interpersonal networks as interactions and relationships with institutional agents (i.e., important people). They identified the same key categories of people as institutional agents in the STEM Pre-College Program, namely, (a) peers, (b) coordinators and staff, and (d) career/role model speakers.

Participants provided numerous examples of their patterns of interactions among institutional agents within STEM Pre-College Program components. The interactions within participants' interpersonal networks were articulated as being close and friendly relationships, thus the social ties and webs within the social patterns of interactions were described as being similar to those found among their extended family. Examples included the Saturday and summer enrichment activities, after-school mathematics and science club, and mathematics and science competition day.

Peers

Participants readily described the interpersonal ties and relationships that developed with their peers who had similar academic, college, and career aspirations. The dimensions of peer relationships included familial-type ties or fictive kin, support for STEM goals, and comfortability with STEM discussions.

The participants explained their close connections with STEM Pre-College Program peers from their same high school. Participants provided details about the characteristics of the peers within their interpersonal networks, including descriptions of familial-type relationships among STEM Pre-College Program participants who share an affinity for science and mathematics schoolwork and success. These comments by William and Nigel are illustrative.

> Well, personally the relationships at the school that I attend for Pre-College (STEM Pre-College Program) is a brother and sister relationship. Everybody is close. You know there is no …. I'm going to be over here with my friends and I'm not going to talk to others. I think that is one thing about attending Hewlett High School (pseudonym for a STEM Pre-College Program participating school with an After-school Mathematics and Science Club site). Everybody knows everybody, and everybody is close to everybody. And, you know there never is a hesitation where can I go talk with him. And no pre-judgment. I think that is the main thing that at Hewlett-- there is the connection. Influences. I think one of the biggest influences is just, probably just seeing kids willing to work, and just seeing them wanting to succeed. You know, not too much of, you know, I'm just in this club (STEM Pre-College Program After-school Club) to be in this club, to take up space. Everyone wants to work. Everyone is trying to pursue what they want to do in their own course, but in the long run we're all there to try and help everybody out and pick everyone up at all times. There is never a doubt in anyone's mind that we're not going to help you out. I think that is the biggest thing that any other school doesn't have and Hewlett does, and that is that everyone is close in a brother and sister relationship. Regardless of male and female, relationships are close. (William-Marionville, Interview, August 3, 2007)

> I have known Z. ever since the ninth grade so I think I have known Z. for maybe four or four and one-half years now. We meet at the STEM Pre-College Program and we went to the same high school, as we always hung around each other, and we refer to each other as brother and sister. We just decided that I was going to take an Honors class and she was going to take an Honors class; and she was going to drop an AP and I told her she better not drop an AP or I was going to tell her momma. So that's what we did back and forth. (Nigel-Chestertown, Interview, September 19, 2007)

Participants also pointed out how their interpersonal networks encompassed more than their relationships with STEM Pre-College Program peers whom they saw regularly; these networks also included relationships with individuals at other campus sites. The peer interactions were characterized as being friendly interpersonal ties where discussions were easily pursued around topics such as science, mathematics, and college matriculation. Joe, Nigel, and Eric were among those making this point:

> I think we (STEM Pre-College Program peers) have a good relationship. They're (peer relationships) usually pretty open. We know we're all headed towards college so we're in that mindset. It's like when we're at meetings (STEM Pre-College Program After-school Club) at our school. We know why we're there and we kind of set ourselves apart from other kids who aren't as serious about going to college or pursuing goals in math and science and other things like that, so we have a kind of strong relationship in that sense. (Joe-Marionville, Interview, August 7, 2007)

> Kind of meant that you could make friends (STEM Pre-College Program) wherever you go no matter where you are and not just because you live in different counties in the state. You can have friends all over the place, even if you only met each other for a summer (STEM Pre-College Program Summer Session). You can ask each other what they're doing in school and how we're doing. It was kind of a friendly environment. And we would always remember this time we went to the Math and Science Competition Day (annual statewide competition for all STEM Pre-College Program sites) and we did this and this and this. Kind of, because some people ask me what school I'm going to, what I'm going to major in. We try to go to the same school (college) or try to major in the same thing, try to see each other, to meet up somewhere, you know in college. That's probably about it, see each other in college. (Nigel-Chestertown, Interview, August 27, 2007)

> I made a lot of connections with people like students from other schools and they can help out with things that you are going through like math problems or science. (Eric-MaryArthur, Interview, June 12, 2007)

From a different perspective, Janay elaborated on the differences among STEM Pre-College Program peers and non-participating friends who attended her same high school. She reported that peers in the STEM Pre-College Program components share similar interests and abilities and enjoyed social gatherings outside of the formal and informal learning settings:

> And if you're talking about friends and that kind of different interaction, before you can go to school with different friends at your regular school, and you just find a whole new class of people (STEM Pre-College Program) who may be like

> you, who want to learn and may have the same potential that you have, and it's easier to interact with them than maybe with some people at your school**.** (Janay-MaryArthur, Interview, July 16, 2007)

> STEM Pre-College Program and the interacting that allows me to be around different people, different people from my school so they have become my friends and we all get along when we go to the Saturday Academy. We don't fight and when we hang out with each other, and when we go into the city of Norrisville (pseudonym), I have friends there and we can hang out together. It is good to know there are other smart people, that we can be smart and also have fun. (Janay-MaryArthur, Focus Group Interview, December 19, 2007)

Coordinators and Staff

Secondly, in addition to close relationships with peers, participants described their close relationships with institutional agents such as the STEM Pre-College Program coordinators and staff. Their interactions and connections focused on three dimensions of the relationships with these adult agents including: fictive kin, personal friendship, and academics.

Participants spoke of non-related coordinators and staff as their family members or fictive kin. They depicted this sense of extended family relationships in this manner:

> I still keep in contact with the teachers and some of the coordinators. One particular teacher, Mr. O., I feel like he is an uncle that I never had. He teaches science and he looks out for me. You know, he asks about my normal life outside of being in the Program, and he remembers that, so every time we are together he asks about me and he just watches over me. (Tom-Chestertown, Interview, July 6, 2007)

> I remember Mr. T. and Mr. R. who worked in the Program and we talked a lot because I would be there after all the people had gone and we would talk. Well, they were just like my brothers. (George-Chestertown, Interview, August 4, 2007)

> The relationships at the school (STEM Pre-College Program After-school Mathematics and Science Club) that I attend for Pre-College is a brother and sister relationship. Everyone is close….Teachers (Program staff who serve as Club advisors), they just let you know that to never be intimidated by someone

> that's older than you, or that has you in their class, because everyone has a right to speak their minds at all times. (William-Marionville, Interview, August 3, 2007)

Along with the fictive-kin dimension, the participants mentioned another dimension in their interaction with the coordinators and staff—the friendship or personal relationship dimension. Personal relationships are defined as long-term, friendly interactions among participants and the coordinators and staff where interest in the personal lives of participants outside the STEM Pre-College Program setting is common. George was especially affected by this personal relationship:

> We (participants and the STEM Pre-College Program staff) would go out to eat and just random bits of advice that they would give, not just about science and math but like life in general. Well, their (Pre-College Program staff) classes are always interesting, and like after class is over sometimes they have conversations about life and stuff. This makes you fell like they wanted to get to know you. Well, all the teachers (STEM Pre-College Program staff) in the Program (STEM Pre-College Program) make you feel like you're special to them. (George-Chestertown, Interview, August 4, 2007)

> Maybe a personal relationship with the STEM Pre-College Program people (STEM Pre-College Program coordinators and staff) because you see the same teachers for years and you get to know them better than your teachers (in-school) that you have for one year and then you never see them again. (George-Chestertown, Focus Group Interview, December 8, 2007)

> Mr. R. always asks how our football team is doing. Well, he always seems to want to know what's going on in our lives. (George-Chestertown, Focus Group Interview, December 8, 2007)

Observation data confirm the participants' personal relationships with Program staff. For example, George and Tom talk about their high school football team and the previous night's game as they move to their second class of the Saturday Academy. George mentions that he is hungry and has no money for lunch or gasoline. He had driven his car to the Saturday Academy on empty. The teacher (Program staff – Mr. R.)

joins the conversation and begins to share how he would do the exact same thing as a teenager. However, gas was only $.29 a gallon then. He still would bring his parents' car home on empty each time that he used it. George and the class all laugh and appear to enjoy the story. The teacher calls the class to order for science. (George and Tom-Chestertown, Observation, October, 27, 2007)

Participants also talked about the personal relationship they enjoyed with the STEM Program coordinators and staff:

> They (STEM Pre-College Program coordinators and staff) always have friendly interactions with students and they are always positive interactions with the teachers, and mainly Ms. D. (STEM Pre-College Program coordinator) because I have known her for a long time, like I'd get to see her in the mornings because she would pick me up and take me home. (Nigel-Chestertown, Interview, August 4, 2007)
>
> Everyone (important people) from the teachers to the coordinators, I have made some of my best and closest friends in the Program, and I still keep in contact with the teachers and some of the coordinators. (Tom-Chestertown, Interview, July 6, 2007)
>
> He's (Program coordinator) always been there to help me, especially on the Saturday Academy. I can still communicate with Mr. B. just about a conversation or if I just need a little bit of help. (William-Marionville, Interview, August 3, 2007)
>
> Freshman year I took Algebra I with Ms. W. Ms. W., who was also our teacher advisor (STEM Pre-College Program advisor staff), I would actually go to her during my lunch periods and she would just help me, just tutor me, just give me extra help to prepare for tests and stuff like that. (Joe-Marionville Interview, August 7, 2007)
>
> My sophomore year, Mr. S. (Program staff), that's the math teacher (STEM Pre-College Program staff), it was real hard in Geometry because my teacher (in-school), she was new, and he (Mr. S.) went over every step with us at the Saturday Academy. We became close and he helped me with things I did not understand. (Janay-MaryArthur, Interview, July 16, 2007)

Not only were the fictive kin and personal relationships valued by the participants; they also appreciated a third category, namely, academic relationships. Academic relationships are defined as the formation of interpersonal networks among participants and coordinators and staff where interactions focus on academic-related topics. Participants described how their close relationships, as well as opportunities for frequent interactions with coordinators and staff, equipped them with essential academic support and general knowledge of world issues:

> As far as high school, the directors (STEM Pre-College Program staff) of the Clubs at school and Mr. B. (STEM Pre-College Program coordinator), you have a pretty good relationship with them if you need them you know they're there for you, so you can use them as an advantage. They're really useful in helping you out. They want to give you information so you have pretty strong relationships in that aspect. We're able to learn more about the different majors and career choices that we have available to us. (Joe-Marionville, Interview, August 7, 2007)
>
> Yeah, the teachers (STEM Pre-College Program staff) they've had a big impact on my life, some of them are some of my closest friends. I hope that I have gained knowledge and I will be able to take it on into the world. (Tom-Chestertown, Focus Group Interview, December 8, 2007)
>
> Mr. B. (STEM Pre-College Program coordinator) is always there for us, letting us, he's always letting us know that whenever we need something to never hesitate to give him a call or e-mail him. (William-Marionville, Interview, August 3, 2007)

Career/Role Model Speakers

Although participants repeatedly cited their peers, as well as Program staff and coordinators as significant others in the STEM Pre-College Program, they also designated career/role model speakers as important people in their lives. The speakers were STEM professionals outside the STEM Pre-College Program who were invited to make presentations at the Saturday Academy or at after-school or summer sessions. The presentations focused on the speaker's academic preparation, career experiences, and success in the STEM workforce, particularly their experiences as racial and ethnic minorities underrepresented in their professions. Participants perceived three types of relationships with career/role model speakers: personal, academic, and professional. They described interactions where the institutional agent motivated and/or enabled their career aspirations.

A personal relationship is defined as a one-on-one interaction with a career/role model speaker. For example, Eric listed a career speaker in the field of computer science as significant and described how a personal relationship with this speaker motivated him to consider a STEM career. He shares how he garnered a personal benefit (i.e., college recommendation letters) from the relationship:

> The computer program that they (STEM Pre-College Program) have helps, and they also have speakers (STEM Pre-College Program career/role model speakers) come in, and they are career-oriented speakers that speak about their careers. And a computer science person came in and told us a lot about computers, and I found something that I was really interested in. Also, when the speakers come, you make relationships with the speakers and the speakers help out with some things. A lot of the speakers are really, really helpful and I've gotten some recommendations from speakers, and I have gone some other places and heard them speak. (Eric-MaryArthur, Interview, June 12, 2007)

Joe expressed how he was personally motivated by career/role model speakers to strive for excellence in preparation for a STEM career where racial and ethnic minorities are traditionally underserved, and John likewise spoke of benefiting from the career preparation guidance provided by a career/role model speaker.

> Mr. B. (STEM Pre-College Program coordinator) might have guest speakers come in that are majoring in certain particular math and science fields so this really helps. We know about the normal stuff (careers) you hear about all the time, but like I said, stuff like Textile Engineering, no one really knows about that kind of stuff so they (career/role model speakers) serve that purpose. I guess on a personal level it motivates me to do better and do what maybe a majority of the minorities

> may not do. Just to make a difference in something that is needed for us to be in those special fields. (Joe-Marionville, Focus Group, December 13, 2007)

> Well, one of the career/role model speakers, … he's majored in Technology in his career and …, and he told me what decisions, I mean what courses I should take. (John-Marionville, Interview, July 3, 2007)

In addition to valuing the personal relationship dimension of interaction with career/role model speakers, students perceived an academic dimension. An academic relationship is defined as the interactions and connections among participants and career/role model speakers who motivate and/or enable participants' career aspirations by focusing on the need for racial and ethnic minority students to consider highly scientific and technical careers, as well as an understanding of pre-collegiate and postsecondary education requirements for entering globally competitive disciplines. Participants described how academic relationships with career/role model members motivated them to consider STEM careers and opportunities:

> It's through the Saturday Academy where we had our guest speakers and people talking about scholarships and colleges in general. They let us know that basically you need to be more competitive in the world, and you have to take those high level classes to be successful, and there is definitely a need for more minorities in the math and science field so that's how they get us to go those classes. (Joe-Marionville, Focus Group Interview, December 13, 2007)

> I know being a high school student sometimes you don't know what you really want to do. You know the field that you sort of want to go into, but you're not sure specifically what you want to do and when they (Program staff and career /role model speakers) speak on each specific field, you know, you can find exactly what you want to do. (Eric-MaryArthur, Focus Group Interview, December 19, 2007)

> I agree what he (Focus Group participant) said and also it just makes you more aware of the type of fields that are out there, like I think we had a guest speaker who talked a while ago about textiles. And, you know it is always good to hear about that type of stuff. (Joe-Marionville, Focus Group Interview, December 13, 2007)

> It makes you more cognizant of fields that are available and are out there. (John-Marionville, Focus Group Interview, December 13, 2007)

> It just exposes you to careers; it broadens your horizons to what's out there. (George-Chestertown, Interview, December 8, 2007)

Not only were personal and academic relationships with career/role model speakers valued; the participants were also cognizant of a third dimension—the professional element in such relationships. A professional relationship is defined as participants' interactions and connections with career/role model speakers who offer an opportunity for a STEM real-world involvement in a particular profession or career path. For instance, Joe expressed how his interactions with a career/role model speaker enabled his participation in a summer research experience in a highly scientific and technical discipline:

> My summer project I worked at Marionville University (pseudonym), and I worked in textile engineering with the Textile Engineering Department and where our main focus was trying to see if we could create core seed fibers using two polymers. I've always tended to focus on math and science-related stuff so I think that had a big part in it. I saw the internship so I kind of followed along with that because I knew it was a good opportunity and it was math-and science-related. Basically, a lot of them (STEM Pre-College Program career/role model speakers) make us aware of stuff that we didn't know about, what their field actually does, what the need for minorities to be in that field, and I guess that what the field is really about. So that's what the speakers serve as representatives of what they do in their jobs and letting people know because a lot of the time we don't really know about all of this other stuff. (Joe-Marionville, Interview, October 2, 2007)

Eric shared how career/role model speakers provided contact information for professionals with whom he could connect at prospective colleges:

> They've (STEM Pre-College Program career/role model speakers) helped me find, helped me with colleges that they went to, and gave me a lot of connections (Eric-MaryArthur, Interview, June 12, 2007).

Theme Two: "I just feel that being able to talk, they always let you know that there's a hand to pick you up": Institutional Support through Dialogue and Discourse

Participants depicted several examples of institutional support they perceived as being garnered from institutional agents via interpersonal networks. The context of the STEM Pre-College Program was described as affording the participants an array of opportunities for STEM dialogue and discourse with institutional agents. The various forms of institutional support provided by these institutional agents were perceived by participants as impacting their academic, personal, and professional selections, particularly STEM and STEM-related choices.

Institutional support provided assistance to the participants, which empowered them to become effective participants within mainstream institutional settings and society. Participants commented on being pushed, guided, and supported by institutional agents (i.e., Program coordinators and staff, career/role models speakers, and peers) within their interpersonal networks. The participants described the STEM Pre-College Program's setting as a context for this institutional support. They agreed that institutional support had enhanced the selection of advanced-level mathematics and science high school courses, which they expressed as essential for college and STEM career success. Participants' accounts included evidence of institutional support such as advocacy, nurturance, encouragement, and conversations. The participants associated academic, personal, and professional value with their engagement in frequent and consistent dialogue and discourse with caring and encouraging institutional agents who were willing to talk with them, as well as advocate on their behalf in mainstream institutional settings.

They believed this type of institutional support had impacted their selection of advanced-level mathematics and science high school courses in preparation for STEM and STEM-related college majors and careers.

Advocacy

Advocacy is defined as promoting and guiding participants toward engagement in advanced-level high school courses in preparation for college matriculation. For instance, participants shared how peers served as advocates within interpersonal networks, particularly their desire to rally around other students contemplating STEM- and STEM-related choices:

> Students from last year-- they always gave us input about what courses to take and what majors you were interested in and what courses you needed to go into that major. I think that was one of the biggest things a person gives input about, a specific math class or science class that they had taken that they might have thought was best for them, and you get that information before taking a course (William-Marionville, Interview, November 14, 2007).

> In our classes (STEM Pre-College Program Saturday Academy), everyone I ask, what classes are you in, what classes are you taking, and they (STEM Pre-College Program peers) just try to push us towards taking other classes that they're taking, so we try to push people in the right direction of what classes they should be taking. Like AP classes. (Janay-MaryArthur, Interview, October 2, 2007)

> I know R. (STEM Pre-College Program After-School Club president) always encourages people to take Honors and AP classes. That's what we've always talked about at those meetings, talked about pushing ourselves. They basically helped in just giving us more reasons why a person should take Honors and AP classes. (Joe-Marionville, Interview, October 2, 2007)

> Z., I called her my little sister because we used to go to the same high school, and I was taking an Honors class and you could like, even though you were in Honors classes, you could have dropped down into the standard class if you were thinking you couldn't handle it, but she was in the STEM Pre-College Program too so we decided to take that (Honors). We were going to have all our classes either honors or AP (advanced placement). And the first day he (in-school teacher) said.

> "You're a senior," and he was like, "I hope you guys didn't sign up for Honors Pre-Calculus thinking it was an easy class." He was like, "Because it's not, and if you think you're going to struggle, then you better drop this class now and go into a standard Pre-Calculus class now." And the first day it was hard and I thought about dropping, but I decided not to because my friend (Program peer) told me not to drop the class. (Nigel-Chestertown, Interview, August 4, 2007)

Similarly, Program coordinators and staff within interpersonal networks were perceived as advocates. The supportive nature of these adult agents promoted participants' enrollment in advanced-level mathematics and science courses such as honors and advanced placement (AP). Participants shed light on the value of being guided by a network of Program coordinators and staff—a point emphasized by Joe, Nigel, and Janay:

> It's just that by having the STEM Pre-College Program you can actually-- what's the word I use--you can go and see these people (STEM Pre-College Program coordinators and staff) who you know why they're there. They want us, you know they're trying; they're pushing college and math and science, and the overall stuff. I'm not saying that we don't have teachers (in-school) that are actually doing that, but by having the Pre-College Program, it's basically you can see these people for that. By being in the Pre-College Program, I've learned to take honors science classes, honors math classes. (Joe-Marionville, Interview, October 2, 2007)

> Yes, because there was one year when I did really bad. I don't know what year it was, but I was doing STEM Pre-College Program. It was 8th grade, 9th grade science. I do believe it was in middle school, but I was doing really bad in science. I don't know what science it was but I was really doing bad in science. I did really good at the Program and they were just really supportive at the STEM Pre-College Program so I decided to stay in all of my honors classes, to just keep on trying. (Nigel-Chestertown, Interview, August 4, 2007)

> It helped me want to be aware of them (Program coordinators and staff) like if I have a problem I don't feel bad coming to a professor (Program coordinator or staff) and asking for help. It actually makes you want to maintain your good grades, and so I think that is what helps you. It's just knowing that you have someone else who is outside of school who wants to help you and keep you at a

> level to go to college. I think that's where it has helped you at. I think it's very good support. (Janay-MaryArthur, Interview, July 16, 2007)

Nurturance

Participants elaborated on the care and assistance (or nurturance) perceived from Program coordinators and staff. They talked about accessibility to coordinators and staff outside regular school classes--elaborating on the availability of institutional support (assistance) from caring relationships with Program coordinators and staff. Some singled out specific individuals who were perceived as being especially helpful:

> Mr. B. (STEM Pre-College Program coordinator), obviously, from the Saturday Academy, he sets up the math and science courses that helps us get that extra studying in order for us to ask questions about what we're doing and stuff like that. Well, it's pretty straightforward basically. You just ask I know at the Saturday Academy they want to know what you're doing, and we're just able to ask questions on anything we need help with. Mr. C. (STEM Pre-College Program mathematic teachers) is certainly open to helping everybody and we just let him know what we're studying at the time and what we really need help on. (Joe-Marionville, Interview, October 2, 2007; Observation, October 13, 2007)

> It is good to be pushed and I really like being pushed because it's like having a counselor who can help you, as well as let your mother know what is out there. I like the idea that they push me because that lets me know that they care about me in the Pre-College Program (Janay-MaryArthur, Focus Group Interview, December 19, 2007)

> Mr. B. (STEM Pre-College Program coordinator) took the time out of his busy schedule to comment on and give me a bit of extra help on some of the math because last year the teacher (in-school regular teacher) I had was,--I'm not going to say he was the worst teacher-- but he had an accent, and his way of teaching was a lot different and hard to adapt. Mr. B. (STEM Pre-College Program coordinator) came and actually took time out of his day to provide an extra bit of tutoring. He expanded my knowledge on math and some of the techniques my teacher didn't touch on so that was a big help, a real big help. He came to my school. He let everyone know if anybody had any problem just to let him know. He came up to the school, and at the Saturday Academy he was also available if we needed any help to bring our schoolwork and he was there to help us. (William-Marionville, Interview, November 14, 2007)

Observations at the sites confirmed nurturance provided by Program staff and coordinators, as evidenced by these notes:

> Mr. H. (STEM Pre-College Program assistant coordinator) stands at the entrance of the building where the Saturday Academy session is held. He greets each STEM Pre-College Program student who enters the building. William stops to share information about a basketball camp and a leadership program he attended in the summer. Mr. H. shakes his hand and congratulates him by stating, "That's wonderful! I look forward to talking with you later about it, William" William walks proudly into the building, chatting with his peers. (William-Marionville, Observation, October 13, 2007).
>
> Participants chat during their movement from class to class. Teachers stand in the hallway and greet students individually and ask about their feelings. One teacher (STEM Pre-College Program staff) asks each student as they enter the classroom -- including Eric and Janay – "On a scale of 1-10, how was your week?" (Janay and Eric – MaryArthur, Observation, December 8, 2007)

Encouragement

Encouragement is defined as the affirmation considered necessary for selecting and persisting in STEM advanced-level courses in preparation for college and careers. Participants gave details about the encouragement they received from institutional agents in selecting advanced-level mathematics and science courses during each high school year:

> Mr. O. (STEM Pre-College Program Program staff) taught science. He taught the science courses for two years in a row, and I had Biology that year and I got a 97. I was encouraged to take science the next year; he (Mr. O) was like, "What course are you taking next year? I do not like Chemistry. He said I should take Chemistry, and I didn't want to take Honors Chemistry because I heard it was hard. He kind of convinced me to take Honors Chemistry because he said it shouldn't be hard because "you got such good grades in Biology and Earth Science." (Nigel-Chestertown, Interview, September 19, 2007)
>
> Like AP classes, we (STEM Pre-College Program peers) encourage them to take as many AP classes they can because colleges look at that, and even if we take one it still looks good for us, so we all try to encourage each other to take some

> type of college credit class. We all try to make sure we're still on the same track, the same track that will get us accepted to college. We're doing things that the colleges are going to want, and we're not falling behind. We pretty much make sure that we're all on track so that we all can further our education. In our classes, everyone I ask, what classes are you in, what classes are you taking, and then they (STEM Pre-College Program peers) just try to push us towards taking other classes that they're taking, so we try to push people in the right direction of what classes they should be taking. (Janay-MaryArthur, Interview, October 2, 2007)

> Everyone really was supportive. The teachers (STEM Pre-College Program staff) were always really supportive and everything. They were always asking what math you were planning on taking and what science are you planning on taking and what college are you planning on going to. They were always very supportive whether you got the right answer or the wrong answer. It was kind of just encouraging. I guess for me I would probably have to say it probably just made me stay in all of my honors classes, like all of my science and math and all of my honors classes. I could have just gone back, but I stayed with honors. (Nigel-Chestertown, Interview, August 4, 2007)

> I have been in the program for five or six years, Uh, just an encouraging environment. They don't try to hinder you. You just have support from everyone around (STEM Pre-College Program coordinators and staff, career/role model speakers, and peers). There's not really any negative influences around you. If you have a dream, they just help you with it. They never tell you it's too big or you can't do that. OK, it's just like what do you need to help you. My dream is to be a neurosurgeon. Uh, well, a lot of people have told me that I can't do it, but like when I come here (STEM Pre-College Program) they (Program coordinator and staff, career/role model speakers, and peers) believe in me, they all tell me, you know, you can do it. You just have to try hard and study, and get good grades. (Eric-MaryArthur, Interview, June 12, 2007)

An observation of Janay provides another illustration of the impact of encouragement given by Program staff and coordinators:

> In a chemistry laboratory at the STEM Pre-College Program Saturday Academy, students group themselves into groups of four students each. Participants Eric and Janay go into different groups (Janay an all female group and Eric an all male group). The students work on the laboratory experiment assigned, which takes place in a university Chemistry laboratory. The instructions are given by the teacher (STEM Pre-College Program staff) that students must observe, identify, and write balanced equations for precipitation reactions in the assignment. The

> teacher informs students not to balance the equations if that objective had not been covered in their regular school classes. The teacher walks around the room to observe the groups while they complete their assignment. She recognizes that Janay, who is enrolled in an AP Chemistry, knows how to balance equations. She announces this to the other students in the classroom. At the end of the laboratory experience, Janay is asked to go to the blackboard to write the chemicals in the equations for the compounds made by the group during the laboratory activity. Janay writes the chemicals and balances the equations. One male student announces loudly and approvingly to the entire class that Janay can do the entire assignment. He states, "She (Janay) killing it, man!" The entire class cheers her on, and the teacher responds, "Very good!!" (Janay-MaryArthur, Observation, November 18, 2007)

Conversation

Participants described the opportunity to interact and engage in dialogue and STEM discourse with Program coordinators and staff, career/role model speakers, and peers as reasons for participating in the STEM Pre-College Program. Dialogue support was articulated as an interaction and exchange of voices among students and institutional agents, which students articulated as institutional support. They believed the STEM Pre-College Program located on a college campus provided access to coordinators, staff, and peers willing to engage in conversations on an array of topics, which participants voiced as unavailable at their regular schools. Participants' examples illustrated the availability of friendly Program coordinators, staff, and peers with whom they engage in STEM discourse, including common STEM verbiage (e.g., high school course, college, major, career, and life issues) among these network members:

> They (STEM Pre-College Program coordinators) sit down and talk to us and help us out with different things, and they have different teachers (STEM Pre-College Program staff) now who talk to us about life issues--not even just the school issues, life issues-- because we can't get it right with school if we're not good with our life. So I think they really support us in what we're doing and what we're trying to do. (Janay-MaryArthur, Interview, July 16, 2007)

To me specifically because one of our counselors/advisors (STEM Pre-College Program staff) last year, actually one of my math teachers (STEM Pre-College Program staff), it was already kind of like home sweet home for me just being able to talk to her. Whenever I needed something, just being able to go talk to her, how it impacted me, I mean, I just feel the impact that being able to talk, they always let you know that there's a hand to pick you up. You never feel down. There's always someone there to help you regardless of, if they don't have time, they're always going to find someone to help you out. I think that is the main thing. I think that is why I joined Pre-College this year. (William-Marionville, Interview, August 3, 2007)

The conversations that impact STEM decisions are those with my friends (STEM Pre-College Program peers). Everyone is talking about applying to college and thinking about reasons you like a particular college, the major that you probably want to go in, and knowing that someone from the Pre-College may be there, at the same college that you may be going to, and knowing that you'll have a friend there, that's the kind of conversations that are going on with my friends and me. (Janay-MaryArthur, Focus Group Interview, December 19, 2007)

We (STEM Pre-College Program peers) talk about what courses we're going to take the next year and what we think will help us with the best chance of getting into college, And some of the reasons that I got more people to join the STEM Pre-College Program was so they would have something to put on their college transcripts. So, that's what we usually talk about is how the Program helps us get into the colleges we want. (George-Chestertown, Interview, October 4, 2007)

Being at a university you get to talk about majors and what majors the colleges offer. You get to talk about what schools are good for certain majors, and what colleges to look at for particular majors. (Janay-MaryArthur, Focus Group Interview, December 19, 2007)

The friendly conversations (STEM Pre-College Program coordinators and staff and peers) that you have help your decision-making. It just creates a warm environment that helps you learn. (George-Chestertown, Focus Group Interview, December 8, 2007)

The friendly conversations, they do kind of help you. You could be talking to another student (peer) about what college they are planning on attending and you might hear something good that you like and it might change your mind about the college choices that you have. (Tom-Chestertown, Focus Group Interview, December 8, 2007)

Theme Three: "It's not about trying to be who somebody wants you to be, it allows you to be who you need to be, who you want to be": Empowerment

The participants who took part in this study held an overall belief that institutional agents, whom they described as fictive kin, were central to their current and future STEM decision-making. The participants' formation of multiple interpersonal networks and ties with institutional agents promoted the transmission and accumulation of STEM- and STEM-related information, resources, and opportunities, thereby the development of social capital.

Participants elaborated on this social capital, which had been built up through the information, resources, and opportunities they had experienced within their web of relationships with all institutional agents (Program coordinators and staff, and career/role model speakers, and peers). What was offered to them through these relationships and experiences had empowered them to participate in honors and advanced placement courses. They pointed to their social interactions and dialogue with institutional agents who served in the capacity of extended family as essential for social integration and success. Thus, the following indicators emerged for this theme of empowerment: (a) strategies for success, (b) STEM options, (c) STEM information, (d) STEM self-efficacy, and (e) STEM engagement (advanced-level mathematics and science courses).

Strategies for Success

Participants described strategies for success as techniques and tips used to improve performance in school-based mathematics and science coursework. They specifically talked about strategies that STEM Pre-College Program coordinators and staff as well as peers provided, which they employed to facilitate in-school mathematics and science classroom learning. For instance, participants shared how Program coordinators emphasize key strategies such as double-checking mathematical problems looking for simple mistakes, using simple mathematical tricks for understanding complicated problems, and providing additional explanations and practice with challenging mathematics and science regular school homework:

> Yeah, they (STEM Pre-College Program staff and coordinator) also told you what I needed to work on, just like little things they saw that was stuck in their mind that was something that I can make a mistake over and over, not just one time, and that was one thing that I know that stuck out in my mind that they gave me like key points, just little things that I might be doing and what I needed to double check my work for simple mistakes that I usually make. (William-Marionville, Interview, November 14, 2007)

> I had extra practice with math, more than probably other people would. I would use extra little tricks to think through problems so I felt better. I felt I could be successful in some of these harder math classes. (George-Chestertown, Interview, August 4, 2007)

> I like interaction with teachers (STEM Pre-College Program staff). While they help you on what you need to know at school, things like you really didn't get to know at school or understand and they explain it to you. (Eric-MaryArthur, Interview, June 12, 2007)

> It's a little slower pace than school so it lets you practice--practice your skills a second time. Like in math if you are just learning to do the area of a circle and in school you just did not get it, the STEM Pre-College (Program staff) will help you learn, not learn again, like, reinforce so it sticks in your mind. (George-Chestertown, Focus Group Interview, December 8, 2007)

> Well in my past I've always been able to have—make—[it] come easy for me, no matter what the math was, like it might be harder in the beginning but I've always pulled through, so I guess that's why, and I guess you could say that getting extra practice on the Saturdays and coming to the STEM Pre-College Program played a big role in that. Well, because you learn math at school and then you come on Saturdays and get it reiterated and sometimes in a different way (George-Chestertown, Interview, October 4, 2007; Observation, October 27, 2007)

Peers empowered other peers within the STEM Pre-College Program via the implementation of strategies such as using flashcards to help memorize scientific facts, comparing different solutions for the same problem, and collaborating with others in order to share experiences and knowledge. Participants articulated these strategies in this manner:

> One student (STEM Pre-College Program peer) was having trouble with science, was having trouble with memorizing the formulas, and I helped him memorize. We did flashcards. (John-Marionville, Interview, October 8, 2007).

> If we don't understand it, we try to see different viewpoints up on the board in Chemistry. One person will put their view of how they did the problem and another person will put their view of how they did it, and it's good sometimes for people to see two different perspectives of how to work out a problem, and it kind of helps to see that you can work it out one way and others can work it another way. (Janay-MaryArthur, Interview, October 2, 2007)

> Well, I get a lot of help in math from A., one of my (STEM Pre-College Program peers), when I was struggling. A lot of times during math class if I don't understand, a friend will help me out with a problem. I usually help people with science, and it's the other way around in math. In science class, especially when we're doing labs and things like that, if they need help with labs like what to record and the right measurements. (Eric-MaryArthur, Interview, September 19, 2007)

STEM Options

Participants felt that the Program coordinators and staff, career/role model speakers, and their peers made them aware of the wide variety of STEM course options, options in majors, and career options that were at their disposal. They maintained that STEM Pre-College Program Saturday and summer sessions supplied appropriate STEM options for consideration (such as honors and advanced placement high school courses) and STEM college majors and careers related to their interests and career goals. Participants expressed praise for Program coordinators and staff efforts at making them aware of the variety of available STEM options from which to select a potential major or career, thereby participants perceived an awareness of STEM choices as essential for considering STEM college majors and careers as viable options:

> They (STEM Pre-College Program teachers and program coordinators) definitely made me more aware about science and math. It might sound kind of funny that I might not be exactly sure if I want to pursue something in math and science, but I'm not exactly saying that I don't want to. I'm just trying to figure it out now. So it's shown me the different options that I can take, the different goals and things to make it. I guess the different majors I could pursue for college. Basically they give us direction. They, Mr. B., he does a really good job in trying to present us with activities to help us pursue goals in math and science and just try to go to college period, which is really good because you don't always have those type of people. (Joe-Marionville, Interview, August 7, 2007)

> I also talked with Mr. B. (STEM Pre-College Program coordinator) about my career and Mr. Y. (STEM Pre-College Program staff), and they also helped me and guided me toward a career. They helped me to make the right choices and they told me what it is about. (John-Marionville, Interview, July 3, 2007)

> I'm more social than I was, and it's (STEM Pre-College Program) let me have more choices. I really can relate to others, have more feelings about what people are feeling, and it lets you be more respectable, and it changes who you are I think, because it gives you an out view of how people are, how different views of different people personalities and their perceptions of you, so it allows your choices to vary, like it's not just one thing, it varies. Yeah, it changes who you are because you could have came into the program just thinking that, you know, that there is nobody like you-- nobody who knew how you were. And you met somebody who had the same potential, the same choices that you want. You want to go to college. You want to do something with your life. You want to be able to go back to your school that you go to and talk to your teachers (in-school) and be, like, look what I've made. You know it allows you to see different views of people who are like you. Your choices vary because, like, you have choices like you can go to college and you can succeed and you can go to community college and you can succeed. It's about who that person is and who you want to be. That is why your choices vary, because it's not about trying to be who somebody wants you to be. It allows you to be who you need to be, who you want to be. It gives you an idea of who you want to be, and I think that's how your choices vary. (Janay-MaryArthur, Interview, July 16, 2007)

Additionally, some of the participants believed numerous science- and mathematics-related options presented by Program coordinators and staff, career/role model speakers, and peers opened their eyes to greater STEM possibilities. Participants articulated how an awareness of STEM options provided by the above referenced institutional agents impacted their mathematics and science choices:

> They are better choices because I wanted to go into the law field, but since taking the Program (STEM Pre-College Program) from sixth grade it's made me more interested in engineering and math, so it's probably better off because I like it more. Better choices like what courses to take during high school because where I would take probably standard choices of classes, I would take an AP class or an Honors class. (Tom-Chestertown, Interview, July 6, 2007)

> You know we (STEM Pre-College Program peers) would suggest to each other the options if you were going to do this then you should take a certain class so you could better yourself in that field when you get into college. You know we (peers) would suggest to each other the options if you were going to do this then you should take a certain class so you could better yourself in that field when you get into college. Well, mostly it all started out when went into the classroom in the Pre-College Program and we started working on a problem that the teacher (STEM Pre-College Program staff) would have for us and someone wouldn't know how to do it because they hadn't taken that certain math yet and someone would always be there to help you out. A conversation would just get started with who should take this type of math so they would be able to know what they should do in this situation or that situation. (Tom- Chestertown, Interview, October 4, 2007)

> Some of the activities like the Saturday Academy where we have guest speakers (STEM Pre-College Program career/role model speakers) come in and talk about different careers and stuff like that, and it basically makes us aware of the opportunities there are in the math and science fields. (Joe-Marionville, Focus Group Interview, December 13, 2007)

STEM Information

The participants voiced the value of receiving STEM information from Program coordinators and staff, career/role model speakers, and peers. They believed these institutional agents acted as purveyors of a variety of information related to topics such as mathematics and science high school courses, STEM college majors, and STEM careers. Participants elaborated on an array of STEM information made available from institutional agents which they articulated as institutional support necessary for their STEM decision-making:

> Of course, they (STEM Pre-College Program staff) present the basics like English, science, math, and also they present like different careers, and just talk about things to do and things to look for. You get so much information and you try to take it in to make the decision for yourself. (William-Marionville, Focus Group Interview, December 13, 2007)
>
> They (STEM Pre-College Program staff and coordinator and career/role model speakers) told me about the program (colleges, STEM majors and careers) that I am interested in. They told me about it, what certain activity, what certain career it is, and what it is about, and how I can be successful in it. They also told me what schools (colleges/universities) they, what schools to, what school that, that offer that certain program, career. (John-Marionville, Interview, July 3, 2007)
>
> I don't know--being a high school student sometimes you don't know what you really want to do. You know the field that you sort of want to go into, but you're not sure specifically what you want to do; and when they (STEM Pre-College Program coordinator and staff and career/role model speakers) go over each specific field, you know, you can find exactly what you want to do. (Eric-MaryArthur, Focus Group Interview, December 19, 2007)
>
> Well, it's my senior year, and first I want to talk with the advisor (STEM Pre-College Program staff) for what math and what science I should take in order to get into college or into the profession that I want. They would give me a list of suggestions, and then I would go to my teachers (in-school) that I had from last year and ask them if they thought I would be able to meet the levels and needs of the classes my advisor had provided for me (Tom-Chestertown, Interview, July 6, 2007)

In terms of the specific sources and types of information provided participants, they listed STEM Pre-College Program coordinators and staff as key institutional agents who disseminated the vast majority of information needed for STEM decision-making, such as high school mathematics and science courses, study sessions, extra-curricular activities, college majors, scholarships and financial aid, careers, and so forth.:

> The support would probably be a couple of teachers who are advisors at the STEM Pre-College Program. And also, at some of our meetings after-school, we always have some of our advisors over at STEM Pre-College come and help us. As far as giving us information about college and extra curricular activities, or study halls, they help give you information so you can just go to a study hall if you need any help. There is always someone. There is never a meeting where, you know, we're not doing anything. There is always someone there telling you; you need to do this or that, a better fit for your grades and to just help you succeed better in high school. (William-Marionville, Interview, August 3, 2007)

> Schools, scholarship information. I think I receive an e-mail from her (STEM Pre-College Program coordinator) every day. I have a lot of information from her about scholarships. Grants and applications, and deadlines, pretty much everything you can think of she's (STEM Pre-College Program coordinator) going to tell you about it. (Nigel-Chestertown, Focus Group Interview, December 8, 2008)

> They support us in all that we do, if we are not doing well in math or science, they kind of make sure we are, and if there are any other programs that they know can help to understand, they tell you about it. (Janay-MaryArthur, Interview, July 16, 2007)

> Usually at the first meeting (STEM Pre-College Program Saturday session) that we have, they usually explain most of the classes, the classes you should be taking for whatever career path you are planning to do. (Eric-MaryArthur, Focus Group Interview, December 19, 2007)

STEM Self-efficacy

Participants portrayed STEM self-efficacy as their level of comfort and confidence for engaging in advanced-level mathematics and science courses, such as honors and advanced placement courses and STEM college majors and careers. The participants agreed that Program resources and opportunities made available by coordinators, staff, career/role model speakers, and peers within their supportive interpersonal networks had influenced their STEM self-efficacy. In two separate interviews, George described his gain in self-confidence, which had moved him toward selecting more difficult and challenging advanced-level high school courses. Also, in describing their STEM self-efficacy, other participants expressed confidence in their ability to successfully engage in advanced mathematics and science courses. They attributed this to the readily accessible institutional support found among their interpersonal networks with STEM institutional agents (Program coordinators, staff, career/role model speakers and peers):

> It (STEM Pre-College Program coordinator and staff, career/role model speakers, and peers) gave me, like, more confidence in math and science and made me more apt to take the harder classes. Well, it's important. It showed me different angles of science and math that I'd probably not be exposed to later so I'd be-- I'd feel-- more comfortable taking higher levels of science and math, learning more about science and math. (George-Chestertown, Interview, August 4, 2007)

> Well, I wasn't sure if I wanted to take AP Calculus in the AB or BC form, and BC is the harder course, and I decided to take the BC just because I was confident in my math skills so I decided to just take the harder course. I felt, I just felt that I could do it and so I was confident that I could do the work and, if I needed extra help I had people (STEM Pre-College Program coordinator, staff, and peers) who could back me up. And that's just basically how I made that decision. (George-Chestertown, Interview, October 4, 2007)

> I guess I'm pretty comfortable; one, because I know, like, what you (Focus group participant) stated earlier that we can actually go somewhere and get help (STEM Pre-College Program coordinator, staff, and peers) with the math and science courses we're taking, especially the Saturday Academy. That's one place you can just take homework and get help on that, so I feel pretty confident with the courses that I take, and even though they might be challenging I'm usually up for it. (Joe-Marionville Focus Group Interview, December 13, 2007)

From a slightly different premise, participants also explained the protective webs inherent in relationships with various STEM institutional agents, which supplied the impetus for STEM self-efficacy:

> Uh, this relationship (STEM Pre-College Program career/role model speaker) influence on my science or math, or technology choices made me want to pursue a career in the science technology field and I guess, you know, give me the confidence to pursue my dreams no matter how big. (Eric-MaryArthur, Interview, June 12, 2007)

> Friends. You look at friends (STEM Pre-College Program peers), and a friend might have taken that class; and you felt as though if they could do it, then I could do it to. That would make me boost my ego and self-confidence (Tom-Chestertown, Focus Group Interview, December 8, 2007).

> I guess our self-confidence is due to the Saturday Academy courses and the Summer Scholars Program where we're able to take these courses and get extra help (Program coordinator and staff) with it, and we tend to feel better about what we're doing (Joe-Marionville Focus Group Interview, December 13, 2007)

> Pretty much everything I've learned in the Pre-College Program I probably took a course in or I planned to take a course in high school. Like if I had taken a course in and felt comfortable with it, my friends (STEM Pre-College Program peers) would probably feel comfortable in it too, so I would suggest it to them that they might want to look into it that it would be a good class to take for them to learn things. (Tom-Chestertown, Interview, October 4, 2007)

One of the Saturday Academy sessions involved student's self-introductions prior to the beginning of their mathematics class. The teacher (Program staff) asked students to introduce themselves by name and the most important thing about themselves in mathematics. John's response was "determined, confident, and successful." (John-Marionville Observation, November 3, 2007)

STEM Engagement

Social integration, as described by participants, includes: (a) believing STEM is a viable option, and (b) having the self-confidence to effectively and successfully engage in mainstream science and mathematics settings, experiences, and activities that promote the attainment of their STEM interests and goals. For the participants, their sense of self-efficacy led to successful engagement in advanced mathematics and science courses.

They detailed reasons for their social integration and success in high-level mathematics and science courses, which included participation in a STEM Pre-College Program:

> By being in the Pre-College Program, I've learned to take honors science classes, honors math classes. This year I took Honors Algebra II, and I actually had one of the hardest teachers, Mr. X. So, you know last year I actually did kind of back out of honors and took the easy way out and go normal Geometry because I thought it was going to be too hard. But then, my grade didn't actually suffer but I feel like I didn't learn as much as I could have. So I kind of keep in mind that yeah it'll be harder, but I need to push myself, so I stayed in Honors Algebra II this year, and I actually did real good. I heard the EOC scores were really bad around the county, and I was actually really close to making a four, so you know stuff like that. The Pre-College Program definitely made me stay focused on math and science. (Joe-Marionville, Interview, October 2, 2007)

> Every year I've taken a math and science. I know this year I could have had the chance to kind of slack off and not taken science, but I still decided to take Anatomy and Physiology. I'm actually really liking it, and as far as taking Honors credit classes, I've always taken Honors for my science classes. And, I took Honors for Algebra II my junior year school, not the sophomore year, but I realized after awhile, you know it's better to push yourself. STEM Pre-College Program lets us know that it's always better to go for the Honors and AP classes in high school. (William-Marionville Interview, August 3, 2007)

> That's obviously something important about the STEM Pre-College Program; you want to stay in math and science courses, and I know that's one of the reasons why I did take a science course my senior year. (Joe-Marionville, Interview October 2, 2007).

> They are better choices because I wanted to go into the law field, but since taking the Program (STEM Pre-College Program) from sixth grade, it's made me more interested in engineering and math, so it's probably better off because I like it more like that. Better choices, like, what courses to take during high school because where I would take probably standard choices of classes, I would take an AP class or an Honors class. (Tom-Chestertown, Interview, July 6, 2007)

> Well, for years since we've been pushed to take high level classes--all that reinforcement--when you get to big level classes, it just comes natural, and you're not intimidated by those hard classes. (George-Chestertown, Focus Group Interview, December 8, 2007)

> The way I've grown up, looking at other people who aren't really going where they could be going, looking and realizing that I'm wanting this (courses in

> preparation for a Chemistry major and career). (Janay-MaryArthur, Interview, July 16, 2007)

> You just have to get used to the level of work that is required, and I feel confident also to step up to the plate and achieve the level of work that's required by an advanced course (Eric-MaryArthur, Focus Group Interview, December 19, 2007)

The following observation report likewise affirms participants' successful engagement in STEM advanced courses:

> An awards and recognition breakfast was held to recognize the STEM Pre-College Program students who excel academically (honor roll status) for the first semester at their regular schools. The event was held on the university campus. The parents and students gathered early for the Saturday, 8:30 a.m. ceremony. The participants and their parents, as well as the STEM Pre-College Program coordinator, staff, and peers participated in the event. During the program, Janay and Eric were presented certificates of achievement for their honor roll status during the fall semester by the STEM Pre-College Program coordinator and staff. The participants, dressed in their best attire, very proudly walked to the front of the room to receive their awards as their peers, parents, coordinators, and staff applauded and cheered. (Janay and Eric, Observation, December 1, 2007).

Summary

In exploring how eight African American high school seniors described the development of social capital while participating in a STEM Pre-College Program, the three themes that emerged were (a) institutional agents as extended family, (b) institutional support through dialogue and discourse, and (c) empowerment.

In this study, the eight participants identified STEM Pre-College Program coordinators and staff, peers, and career/role model speakers as institutional agents who assumed the role of extended family. The participants believed the context of the STEM Pre-College Program provided a venue for social interactions and relationships with institutional agents, thus the formation of interpersonal networks. The development of multiple social ties and webs provided invaluable institutional support, which was viewed by participants as critical for STEM decision-making.

Participants suggested that the formation of interpersonal networks with caring individuals who provided institutional support in the form of advocacy, nurturance, encouragement through opportunities for discourse and dialogue had empowered them to pursue advanced high school mathematics and science courses in preparation for STEM college majors and careers.

Participants acknowledged institutional agents as contributing to their development of social capital. The institutional agents were recognized by students as the purveyors of information, resources, and opportunities, such as mathematics and science learning strategies, STEM options, and STEM information, which promoted a sense of STEM self-efficacy and engagement in advanced-level mathematics and science courses.

Participants described institutional agents as facilitators of their STEM self-efficacy. Thus, they had been empowered to make STEM decisions such as the selection of honors and advanced placement high school mathematics and science courses in preparation for college matriculation. They believed they could successfully engage in STEM courses and careers because of the institutional support provided within their interpersonal networks. Participants felt they had developed social capital via the institutional support inherent in their social interactions and relationships with institutional agents, which was considered to essential for social integration and success.

CHAPTER V

CONCLUSION

This study focused on eight African American high school students' perceptions of interpersonal networks and institutional agents in the development of social capital in a science, technology, engineering, and mathematics (STEM) Pre-College Program. In this chapter, the findings related to the research questions are discussed. The chapter concludes with implications for practitioners, parents and policy makers and presents suggestions for future research.

Research Questions Addressed

Research Question 1: How do STEM Pre-College Program students perceive institutional agents and interpersonal networks?

The first research question in this study addressed the participants' perceptions of institutional agents and interpersonal networks, including their descriptions of (a) institutional agents and institutional support, (b) support provided by institutional agents, and (c) interpersonal networks.

Since this study investigated the perceptions of African American high school seniors, it was important to gain an awareness of African American families from a historical perspective in order to create a clearer understanding of their children's contemporary experiences. Clearly, African American families' cultural experiences have included a history of racism, economic oppression, and political disenfranchisement that must be taken into account in a study of African American adolescents. As a result of African American experiences, the literature illustrates that an important feature of their culture is the capacity to persevere during challenging times, a cultural characteristic and strength that has been passed down for generation to generation (Billingsley, 1992; Hill, 1998; Wang, Haertel, & Walberg, 1994). Also, the capacity to give and receive support in the community is considered a key feature of the African American culture (Hrabowski, Maton, Green, & Greif, 2002) [e.g., Tom's remarks about receiving information from STEM Pre-College Program students who had taken honors and/or advanced placement courses and, in turn, he shared information about mathematics and science courses successfully completed with other Program peers].

Kim and McKenry (1998) maintained that embedded within the African American cultural experiences are a myriad of occasions for social interaction among family, fictive kin, extended family, and neighbors that is strongly valued in the African American community. The eight African American high school students in this study had participated in a multi-year, year-round STEM Pre-College Program for a total of six years (6th through 12th grades); therefore, they had come to value opportunities for frequent and consistent social interaction with individuals within the STEM Pre-College Program. Consequently, institutional agents were viewed as individuals with whom they had close social ties and connections such as STEM Pre-College Program peers, coordinators and staff, and career/role model speakers. The students' long-term associations with institutional agents who remained consistent over multiple years resulted in extended family relationships, thus non-familial institutional agents were given fictive kin titles such as uncle, mom, brother and sister. This corroborates research on the resiliency and strength of the African American family, which is impacted by opportunities for social interaction among neighbors, fictive kin and extended family (Billingsley, 1992 & Hill, 1998). Therefore, the eight African American high school seniors' perceptions of institutional agents and interpersonal networks were shaped by their historical familial experiences.

When addressing how students perceived institutional agents, students characterized extended and sustained social interaction with young Program staff and peers as brother and sister relationships, and older, more mature female and male Program coordinators and staff members as mom or uncle. They identified with individuals who were sensitive to and had an understanding of their cultural practices and experiences. Such friendships and social interactions were important for students (Janay's remarks about the value of having friends within the STEM Pre-College Program with whom she could socialize, particularly peers with similar goals and aspirations).

Nigel, a male student in the study, noted familial ties with a female peer who participated in the STEM Pre-College Program and attended his same high school. Their close social ties caused school faculty and staff to believe they were brother and sister. Although Nigel and his female friend were encouraged by their in-school teacher to drop an Honors Pre-Calculus course because of its anticipated rigor, Nigel believed the sister-brother relationship with his friend, which had been developed within the STEM Pre-

College Program, had empowered them to take on the challenge in spite of the teacher's attempt to have some students exit the course.

In this study, multiple social ties and webs, as well as frequent social interaction among students and institutional agents provided invaluable forms of institutional support, particularly the strength and ability to persevere in mainstream institutional settings such as honors and advanced placement courses (e.g., Joe's remarks about the STEM Pre-College Program as the reason for his selection of a science course in his senior year). The students viewed the formation of interpersonal networks with institutional agents as contributing to their selection of and successful engagement in advanced-level mathematics and science high school courses.

McNeal (1998) posited that students' participation in extracurricular activities offer a level of status and privilege, which is found to be common among families of high social economic status. In contrast, many racial and ethnic minority students have limited access to many of the extracurricular activities that promote the formation of interpersonal networks and the accompanying status associated with participating in out-of-school events. Gay (2000), however, maintained that extracurricular academic enrichment and outreach intervention programs can heighten mathematics and science achievement among racial and ethnic minorities, particularly when students are exposed to teachers and staff who are caring, culturally sensitive, and have high expectations for participants in the program.

The STEM Pre-College Program, a STEM extracurricular academic enrichment activity, provided a venue for raising students' self-efficacy, including a level of status and privilege that society has come to associate with engagement in honors and advanced placement courses in preparation for STEM college majors and careers (William's remarks about returning to school and sharing what he had learned in the STEM Pre-College Program and not being intimidated by people at his school and in-school classes). The academic, personal, and professional support provided by institutional agents such as mentoring and tutoring, as well as dialogical support helped to ensure success when selecting rigorous and challenging mathematics and science courses. The STEM Pre-College Program After-school Mathematics and Science Club, one of an array of STEM Pre-College Program components, provided a vehicle for building nurturing and encouraging interpersonal networks between students and institutional agents [e.g., STEM Pre-College Program peers, coordinators and staff, and career/role model speakers (individuals invited to speak at club meetings)]. Students' participation in the STEM Pre-College Program allowed the creation of multiple webs of relationships among individuals in which students had come to recognize as extended family.

The students perceived that social interactions and relationships with institutional agents permitted the formation of interpersonal networks within the context of STEM Pre-College Program components. The comprehensive list of multiple-year, year-round STEM Pre-College Program science, technology, engineering, and mathematics enrichment activities that occurred during students' out-of-school time (e.g., weekends, summers and after-school) included:

- tutoring;
- mentoring;

- study sessions;
- mathematics, science, English, career awareness, technology, and SAT preparation courses;
- field trips;
- college tours;
- mathematics and science competitions;
- hands-on, inquiry-based activities;
- laboratory experiences;
- awards and recognition ceremonies;
- after-school club;
- leadership development; and
- summer research experiences.

In the book entitled *Social Capital*, John Field (2003) stated, “By making connections with one another, and keeping them going over time, people are able to work together to achieve things that they either could not achieve by themselves, or could only achieve with great difficulty” (p. 1). Acknowledged by students as one of the strengths of the STEM Pre-College Program was its programmatic design. The year-round, multi-year components permitted students to engage in enriching experiences and interact with caring and committed institutional agents over a sustained period of six years. On-going familial-type relationships with individuals who functioned as extended family provided institutional support in the form of nurturance, encouragement, advocacy, and discourse that was critical for STEM decision-making.

The participants viewed institutional support at the core of interpersonal relationships with STEM institutional agents. The development of relationships with institutional agents within an academic enrichment setting such as a STEM Pre-College Program supported students' enrollment in high-level mathematics and science classes. According to Ogbu (2003), community-based after-school and weekend activities with a multicultural focus that include caring teachers, parents, role model speakers and a public recognition of students could assist the African American community in their educational efforts to close the achievement gap among Caucasian and African American students.

It was posited by Malecki and Demaray (2003) that support from institutional agents can protect students from certain negative outcomes and barriers, particularly when the encouragement and assistance comes from individuals within supportive interpersonal networks. The Program's institutional agents initiated and provided opportunities for on-going conversation and support that focused on STEM topics (e.g., Eric remarks about a friendship that developed with a career/role model speaker who visited the Program) such as, but not limited to, high school advanced-level courses, college, and career choices. And, just as importantly, other topics of interest that occurred between students (e.g., male students who played school sports and male institutional agents). Often time, dialogue between institutional agents such as Program coordinators / staff and individual participants permitted institutional agents to make mathematics and science relevant and applicable to students and their everyday experiences (e.g., George and Tom played on a high school football team and cited examples of sports discourse with Program staff who used mathematical concepts to explain the game of football). The ability to be openly engaged and immersed in conversation with significant adult agents in the STEM Pre-College Program, a practice voiced by students as being relatively uncommon in regular school because of the shortage of teachers' time for engaging in student-teacher dialogue, was perceived as valuable for making STEM choices. The students in this study viewed the limited availability of classroom teachers coupled with feelings of isolation because of the low enrollment of other students of color in their classes as reasons for saving school-related mathematics and science questions and issues for the Saturday morning classes, the after-school study session, or lunch period where caring institutional agents were readily accessible for providing one-on-one assistance and institutional support (e.g., this also was evidenced in the data collected during observations of Saturday Academy sessions where mathematics teachers encouraged students to bring their regular school class assignments, homework, and textbooks to the Saturday session in order to receive assistance with regular schoolwork).

According to Stanton-Salazar (2001) students of color need caring individuals who can advocate for them, as well as assist them in the navigation of mainstream institutions in order to acquire information about programs, career-decision making, college admission, role modeling, and emotional and moral support. Participants' access to a group of consistent and caring out-of-school institutional agents helped to build supportive interpersonal ties and relationships with institutional agents (e.g., Janay – "I like the idea that they push me that lets me know that they care about me"), which increased students' development of social capital essential for making STEM choices.

Clearly, support from significant others such as peers and other adults was instrumental for immersing students in a wealth of resources and opportunities (social capital) that fostered high school advanced-level mathematics and science course selection, college matriculation, and career choices (e.g. Eric's remark about his interaction with a career/role model speaker that extended beyond the visit to the Saturday Program). The availability of caring relationships in an environment supported by encouragement and advocacy was perceived as paramount for African American students' social integration and STEM success.

Most noted among the participants were the connections and the supportive relationships found at the institutional/group (meso-level), which Stanton-Salazar (2001) called cliques. At the group level, cliques served as social freeways for privileged individuals to move more quickly and efficiently within mainstream institutional settings, which the author argued was problematic for students of color. However, regular and consistent dialogue with institutional agents over multiple years built close relationships and ties with significant fictive kin. The formation of interpersonal networks with institutional agents in the STEM Pre-College Program independently and collectively empowered African American students to make important STEM choices such as selecting advanced-level mathematics and science courses and STEM careers (George's remarks about having a choice in the selection of an AP calculus course and selecting to enroll in the more difficult course.)

The institutional agents in the STEM Pre-College Program were diverse in terms of race, ethnicity and gender. For example, two of the Program coordinators in which students identified as institutional agents are African American males and one an African American female. There was greater diversity among Program staff, including: African American, Mexican American, Caucasian, African, Native American, Indian (native of India) as well both genders. In terms of gender and racial patterns of institutional agents, none emerged in the study. The race, ethnicity, or the gender was not a factor in students' identification of institutional agents. Although the eight students in the study were African Americans, they identified a diverse group of individual as institutional agents. More important than race, ethnicity, and gender were institutional agents who (a) exhibited characteristics of nurturance, advocacy, and encouragement; (b) provided opportunities for social interaction and dialogue with students; and (c) shared an appreciation of the students' cultural experiences. These characteristics and traits contributed to the development of interpersonal networks with institutional agents who provided institutional support to the eight African American high school students who participated in a STEM Pre-College Program and made STEM- and STEM-related choices.

Research Question 2: How do STEM Pre-College Program students perceive social capital development in STEM?

The second question explored participants' perceptions of the development of social capital in STEM. Maldonado, Rhoads, and Buenavista (2005) defined social capital as "the assets and benefits derived from the relationships" (p. 605). In this study, participants individually and collectively referred to social capital as resources such as information (instrumental assistance) generated from their relationships with institutional agents within their interpersonal networks. They described their patterns of social interactions between identified STEM institutional agents as promoting the transmission of STEM resources and opportunities (social capital) needed for STEM decision-making. They considered the relationships between various institutional agents to be essential for the accumulation of academic resources (social capital) required for making decisions that impacted advanced-level high school course selection, college matriculation, and career success. They further perceived social capital as being embedded within their supportive interpersonal networks. They concurred that the formation of interpersonal networks among STEM institutional agents played a vital role in their access to and accumulation of institutional resources (social capital) required for STEM decision-making.

Participants indicated that nestled in multiple networks were institutional agents who were purveyors of institutional support in the form of advocacy, encouragement, nurturance, and discourse. Thus, they believed their interpersonal networks of institutional agents served as conduits for the transmission of empowering STEM resources and opportunities, thus the development of social capital. Consequently, institutional agents within participants' interpersonal networks were seen as empowering individuals who encouraged participants to consider advanced-level mathematics and science courses. They specifically acknowledged the frequent conversations and interactions with Program staff, coordinators, career/role model speakers, and peers that centered on an array of topics and issues, specifically disparities in advanced-level high school course-taking and STEM college majors and careers, including the underrepresentation of people of color and females in STEM. Therefore, this was addressed by participants as a reason for challenging the status quo by laying the groundwork at the high school level for later STEM pursuits.

Stanton-Salazar (2001) claimed that a social network (interpersonal network) is a "social support system, that web of relations that keeps us economically afloat as well as resilient and healthy, and that ultimately sustains our humanity" (p. 6). He also maintained that interpersonal networks allowed for resource-sharing. In this study, the formation of interpersonal networks was based on STEM academic enrichment opportunities that promoted students' social interactions with supportive agents such as Program peers, coordinators, staff, and career/role model speakers who provided STEM information, options, and strategies for success, thus, the development of social capital.

Participants acknowledged that STEM institutional agents were important providers of resources such as mathematics and science instructional strategies and techniques that increased the understanding of difficult and challenging mathematical and scientific concepts. Participants described these strategies as beneficial because of the transferability to mathematics and science regular classrooms, which helped to reinforce classroom learning. Participants addressed the value of having in- and outside regular school time support and resources, which promoted their understanding of complex materials and instruction. For instance, participants shared the value of having out-of-school time instruction for purposes of reiterating, as well as resolving ambiguous concepts taught in regular classroom mathematics and/or science classrooms. Therefore, participants credited institutional agents as important for transmitting a myriad of tangible institutional resources.

Lareau's (2003) book entitled, *Unequal Childhoods: Class, Race, and Family Life*, used a quote from C. Wright Mills, which states – "The life of an individual cannot be adequately understood without references to the institutions within which his biography is enacted" (p. 14). She asserted that individuals are embedded with social structures that are used in carrying out their lives, which she defined as regular patterns of interactions found among social organizations. Therefore, the patterns of interactions and associations among institutional agents within the STEM Pre-College Program played a role in African American students' development of social capital. Institutional agents are defined as those individuals who have the capacity and commitment to negotiate resources and opportunities, as well as provide institutional support (Stanton-Salazar, 2001). Therefore, students require a supportive network of institutional agents who can provide the social capital needed for social integration and success in advanced-level mathematics and science classes.

Program peers also play an important role in the development of social capital by providing their peers information about courses, college, careers and strategies for success (Tom's remark about helping his peers to select science and mathematics courses that he had experienced success in taking). The out-of-school STEM Pre-College Program venues such as the Saturday Academy, After-school Club, and other Program-related activities events such as field trips, college tours, and competitions allow opportunities for students to develop resourceful relationships with caring institutional agents who can promote the development of social capital. In addition, the hosting of the Program on a college campus, as well as the college tours planned by Program coordinators and staff had increased students' interest in and exposure to college, particularly the alleviation of fear that some first-generation college students associate with going to college.

Students participating in the STEM Pre-College Program represent populations disproportionately underrepresented or underserved in highly technical careers. Many of them come from socio-economically disadvantaged backgrounds, single-parent households, and families with substantial financial responsibilities. For most, they will be first generation college-going students. Consequently, the cited school-based inequalities coupled with disadvantaged home contexts had rendered many of the participants in this study unaware of the different mathematics and science options available to them at their high school and beyond. Thus, they posited that communication among institutional agents within interpersonal networks focused on viable STEM options and information critical for their continuous STEM engagement. Participants felt they garnered appropriate course enrollment information essential for making future science and mathematics choices. Information also included the sequence of mathematics and science courses leading to their enrollment in high school honors and advanced placement courses. They admitted that social capital embedded within relationships with institutional agents was helpful in accessing resources such as an awareness of mathematics and science learning and exposure to specific information about the many different non-traditional opportunities available in scientific fields. They believed that many of these opportunities would not be considered without intervention on the part of STEM institutional agents in the form of information sharing.

STEM Pre-College Program coordinators and staff contributed to students' development of social capital via the in-school (e.g., lunch, before school, After-school Mathematics and Science Club) and out-of-school (e.g., Saturday and summer sessions) activities and experiences offered to students over multiple years. The accessibility of institutional agents and interpersonal networks for conversation/discourse and mentoring also contributed to the transmission of information, resources, and opportunities.

In addition to delivering high school-related information, participants indicated that STEM institutional agents disseminated a vast array of resources pertaining to colleges, such as colleges and universities offering STEM- and STEM-related majors, as well as the admissions' procedures for entering postsecondary institutions. Participants stressed the importance of students and their families receiving information about the college application and scholarship processes and deadlines. Participants also saw value in the Program staff's planning of college tours that permitted on-campus college exposure for students prior to college admission, as well as career/role model speakers who talked about their college and career experiences. In addition, they viewed the opportunity to participate in an academic enrichment pre-collegiate program situated on a college campus helpful in considering college as a viable option. Lastly, institutional agents and their relationships and connections with participants enabled an array of exchanges around STEM and STEM-related resources and opportunities necessary for social integration and academic success.

Stanton-Salazar and Spina (2003) claim adolescents' success in our society requires the formation of resourceful relationships and activities socially organized within an interpersonal network of significant others. The eight African American students in this study had developed long-term close fictive kin relationships with Program coordinators and staff, peers and some of the career/role model speakers (e.g., Eric's mentoring from a career speaker) over their six consecutive years of participation in the Program. Career/role model speakers also played a role in the development of social capital. They provided career-related information and opportunities unfamiliar to some of the students in the study. The invited speakers from outside the STEM Pre-College Program made students aware of cutting-edge, scientific and technical opportunities in STEM fields, as well as the preparation needed to enter the profession and life. They not only provided career-related information, but opportunities for students to participate in internships and summer experiences (e.g., Joe's invitation by a career speaker to conduct a six-week, paid summer research experience in his university textile laboratory) and other benefits (e.g., Eric's letter of recommendation for college from a career speaker).

Rosenfeld and Richman (1999, 2003) reported that social supportive relationships accrue positive student outcomes for at-risk African American students. The seven African American male students consistently referenced fictive kin and dialogical support from institutional agents within their interpersonal networks as opportunities for gaining information and learning about STEM opportunities and resources. A social support network of caring and encouraging individuals that provides opportunities for friendly conversations in a non-threatening environment, where discourse is related to topics of interest such as sports, as well as academic information and challenges (e.g., course selection, college majors, career interests, grades, etc.), was important for the African American males in the study. Therefore, it was perceived as contributing to African American males' development of social capital in the STEM Pre-College Program; thus all seven of the male students in this study had selected advanced-level mathematics and science courses (Honors and AP) and had applied, as well as was accepted, to multiple colleges in preparation for STEM careers.

Malecki and Demaray's (2003) examination of the types of early adolescent social support found that females perceive more support and types of support from their classmates and friends. [e.g., Janay's involvement in the Program had afforded her an opportunity to socialize (hang out) with female peers who had similar academic and career interest and potential in- and outside the parameters of STEM Pre-College Program. Her interpersonal networks had allowed her to engage with peers from her school who participated in the STEM Pre-College Program. Consequently, her ability to dialogue and interact with institutional agents about life and school issues reduced school-related conflicts (e.g., fighting)]. Opportunities for interaction with institutional agents within an informal academic enrichment setting provided students possible alternatives to negative socialization.

The eight African American high school seniors in the study considered the relationships between various institutional agents to be essential for the accumulation of academic resources (social capital) required for making decisions that impacted and empowered their advanced-level high school mathematics and science course selection, college matriculation, and career success. They further perceived social capital as being embedded within their supportive interpersonal networks. Students in the study concurred that the formation of interpersonal networks among STEM institutional agents played a vital role in their access to and accumulation of social capital required for STEM decision-making and social integration.

Research Question 3: How do STEM Pre-College Program students perceive the relationship between interpersonal networks, social capital and its impact on STEM choices?

The third and final question explored participants' perceptions of the relationship between interpersonal networks, social capital and its impact on STEM choices. Participants perceived that close, friendly, and fictive kin relationships among interpersonal network members afforded an opportunity for the transmission of STEM information, resources and opportunities as the development of social capital.

Social integration according to Stanton-Salazar (2001) "views student variations in academic learning, intellectual development, and persistence to degree completion as dependent on a student's level of personal engagement or social integration into the social and intellectual fabric of the school" (p. 13). When addressing how participants perceived the relationships between interpersonal networks, social capital and its impact on STEM choices, the African American students in this study identified key individuals and articulated the interconnectedness and interrelatedness of the individuals within fictive kin supportive networks and the opportunities for dialogical support. This had enabled the transmission of information, resources and opportunities essential for making STEM choices and decisions.

Wehlage, Rutter, Smith, Lesko, and Fernandez (1989) investigated the integrative processes in schools serving low-income students. The research focused on school memberships and involved an examination of students' connections to the social and intellectual fabric of the school. They concluded that students are connected to the social and intellectual fabric of their school through the bonds they develop with school personnel. The author posited that students must develop a "we-ness" for social integration.   The context of the STEM Pre-College Program provided a venue for developing relationships and social capital, thereby generating a "we-ness" attitude among students and institutional agents. Fictive kin and dialogical support resulted in students experiencing a higher level of empowerment, which impacted their STEM choices. The programmatic design of the STEM Pre-College Program, particularly Saturday and summer hands-on mathematics, science, technology, and English classes; science laboratory experiences and activities; after-school mathematics and science clubs; competition day; career awareness classes; educational field trips and college tours encouraged and permitted bonding between STEM Pre-College Program peers, STEM coordinators and staff, and career/role model and students, thereby contributing to the development of social capital among students for engaging in STEM opportunities.

Specifically, the out-of-school time, as well as the in-school STEM Pre-College Program After-school Mathematics and Science Club that met regularly, permitted access to a group of caring familial-type institutional agents. The ability to frequently connect, dialogue, and socialize in supportive relationships within an encouraging environment served as a mechanism for developing social capital and empowering students toward STEM choices and decision-making.

According to social integrationists, “students must connect in some fundamental way with various aspects of the social life of an institution” (Maldonado, Rhoads, & Buenavista, 2005, p. 605). This connection is more challenging for working-class and low-income families. Lareau (2003) maintained that discussions between parents and children are very prevalent in the lives of middle-class households, a process called “concerted cultivation” of children. Thus, these children take on a sense of entitlement, which plays a prominent role in institutional settings, primarily because students are able to question and address adults on the same level as if they were equal. Additionally, middle-class children tended to engage in more organized and planned activities that promote cognitive and social skills, which parents believed will provide children a distinct advantage in life.

Clearly, the eight students in this study had connected with the social and the intellectual fabric of their school because of their involvement in a STEM Pre-College Program for multiple years; therefore, they felt entitled to, as well as empowered by discussions with institutional agents that impacted STEM engagement. The eight students had developed close, familial-type interpersonal networks with STEM Pre-College Program peers, coordinator and staff, and career/role model speakers who permitted dialogical discourse about academics in a non-threatening, social environment (e.g., George’s remark about friendly conversations in a warm environment that helps you learn). Yet, the eight African American high school students' formation of interpersonal networks with institutional agents and the dialogical support inherent within fictive kin relationships facilitated the development of social capital critical for STEM decision-making (e.g., William's remark about getting an abundance of information that he uses to make decisions). Social capital is essential for navigating and negotiating the social and intellectual fabric of schools, thus the successful engagement of students in high school advanced-level mathematics and science courses. The participants in the study included seven African American males and one African American female who articulated the value of institutional agents and the resources embedded within resourceful relationships that facilitated STEM self-efficacy (e.g., Tom's remark that relationships with institutional agents give you the confidence to pursue your dreams no matter how big).

The opportunities for dialogical support in the form of advocacy, nurturance, caring, conversation/discourse within interpersonal networks contributed to the development of social capital from resources, information, and opportunities embedded within social relationships impacted African American students' STEM self-efficacy (e.g., George's remarks about pursuing a more challenging AP calculus course rather than an easier calculus course). Consequently, institutional agents facilitated students' STEM choices, social integration and success in this study.

STEM institutional agents and the resources contributed to African American students' interest, efficacy, and engagement in (a) advanced-level high school mathematics and science course-taking, (b) future STEM and STEM-related college majors, and (c) STEM and STEM-related career choices. Thus, STEM institutional agents' nurturance and advocacy becomes central to STEM decision-making. Being guided and pushed by institutional agents had empowered male and female students to engage in mainstream institutional settings such as honors and other advanced-level high school mathematics and science courses throughout high school.

Participants concurred that a support system comprised of institutional agents willing to provide dialogical support and advocacy was beneficial for long-term STEM integration and success (e.g., Joe's remarks, the staff's collection of report cards each grading period in order to verify students' enrollment in advanced-level mathematics and science school courses, as well as to ascertain their level of success in the courses) Institutional support that steered participants toward mathematics and science was articulated as being sparse in regular school settings, which participants attributed to insufficient time on the part of the classroom teacher. In contrast to students' perceptions of the STEM Pre-College Program and its institutional agents, in-school teachers were viewed as having large classes, limited time, and out-of-date pedagogical skills and practices necessary for nurturing and encouraging students' mathematics and science interest and choices. The STEM Pre-College Program experiences supplemented regular school mathematics and science instruction. Thus, students benefited because of the relevancy and transferability of informal (out-of-school) STEM Pre-College Program learning to formal (in-school) classroom experiences, which also contributed to students STEM social integration.

According to Hall (2003), self-efficacy is experienced when people “(a) develop the skills to achieve, (b) believe that they can succeed, and (c) receive affirmation from significant others not only that they have skills but also that they are expected to succeed” (p. 81). In this study, STEM self-efficacy was impacted by students’ multiple webs of committed and caring institutional agents who held high expectations for students and provided consistent communication; advocacy; skills and knowledge; reinforcement; and encouragement that supported social integration and success. For example, institutional agents (a) provided the capacity (skills and knowledge) for mathematics and science learning; (b) helped with schoolwork and homework outside regular class time; (c) offered academic and personal encouragement and nurturance for pursuing advanced-level regular school mathematics and science courses; (d) provided relevant and engaging science and mathematics activities and experiences outside regular school time (e.g., college tours and other field trips, competitions, internships, science labs, and Saturday and summer classes) that complemented regular school work; (e) presented options and information on courses, college, and career pathways; and (f) engaged in consistent STEM discourse. It was through the supportive and resourceful networks of institutional agents that participants viewed the development of social capital, which they expressed as being critical for increasing participation in STEM.

Implications for Parents, Policy Makers, and Educators

The study provided insight into the inequities that continue to exist in African American students’ attainment of information, resources, and opportunities essential for mathematics and science literacy. Gay (2000) attributes the underachievement of some racial and ethnic minority groups to racism and cultural hegemony in mainstream education. This also is evidenced in the literature that focused on African American students' underparticipation and underachievement in disciplines such as science and mathematics.

In fact, one of the major challenges confronting practitioners, policy makers, and parents is to find ways to prepare more underrepresented students for STEM college majors and careers. In spite of the increases in the 1990s, students from historically underrepresented racial and ethnic minority groups have exhibited no substantive rise in their pursuit of STEM college majors and careers. Consequently, data revealed an insufficient number of African American high school students selecting advanced-level mathematics and science high school courses in preparation for a highly scientific and technical workforce. This, coupled with the gaps in mathematics and science achievement scores in comparing Caucasian and African Americans, raises serious concerns about how to resolve this perplexing problem.

According to Baber (1992), "education in general and teaching in particular ought to be about facilitating the unleashing of human potential. Schooling, however, has too oftentimes become a means for controlling human potential rather than unleashing it" (p. 91). Clearly, there is a dire need for policy makers and practitioners to examine empirical scholarship to help eradicate the marginalization and biases currently preventing educators within mainstream institutions from unleashing African American students' potential in science and mathematics.

Therefore, the findings of this study suggest three principles that I believe should be reflected in mathematics and science policy considerations impacting African American students and their parents. First, there needs to be consideration of funding for sustaining multi-year, year-round academic enrichment programs that operate during out-of-school time and that are specifically designed to increase high school students' efficacious engagement in mainstream institutions such as advanced-level mathematics and science courses. Such a need for continuous and reliable long-term funding base to support out-of-school science and mathematics enrichment programs were articulated by Malcom (1984) and Malcom, Chubin, and Jesse (2004). They suggested the need for a continuous and reliable long-term funding base to support out-of-school science and mathematics enrichment programs. The findings from my study also suggest that policy makers and practitioners investigate approaches for the appropriation of funds for STEM pre-collegiate initiatives that demonstrate effectiveness in preparing students for STEM integration and STEM success.

Secondly, it is critical for African American students' STEM decision-making that students be provided with academic enrichment opportunities that allow for their frequent social interaction with nurturing and encouraging peers and adults – opportunities which participants in this study reported to be sparse in regular schools. Gay (2000) emphasizes that, "caring interpersonal relationships are characterized by patience, persistence, facilitation, validation, and empowerment" (p. 47). Therefore, her research, as well as Ogbu's (2003) are substantiated in this study, particularly the fact that caring teachers can create high levels of success for students, especially students of color, by creating a nurturing and encouraging environment with high expectations for students to excel.

Berryman (1983) and Oakes (1990) indicate the need for students' exposure and access to science and mathematics experiences both in-school and out-of-school in order to enter mathematics and science pipelines. Perhaps policy makers, practitioners, and parents will consider approaches to creating a social context for the formation of interpersonal relationships among peer and adult institutional agents who can provide relevant and consistent advocacy, nurturance, and encouragement that supplement and complement in-school mathematics and science learning.

Lastly, the results of this study indicate the need for practitioners to create avenues for the development of social capital via the facilitation of institutional support such as STEM information, resources, and opportunities from institutional agents to pre-college students and their parents that, in turn, promote skills, knowledge, and disposition toward STEM self-efficacy and engagement. Similarly, Smith-Maddox's (1999) scholarship illustrates that interpersonal networks actually help African American adolescents obtain valuable school-related information about specific programs/activities, courses, and careers.

This study demonstrated that information disseminated by caring institutional agents influenced students' STEM choices such as the sequencing of high-level mathematics and science courses, particularly middle school prerequisites for enrollment in high school honors and advanced placement mathematics and science courses. Long-term, consistent social interactions with institutional agents also provided students with processes for college admission and scholarships, information about various colleges and STEM majors, and an awareness of the various career pathways that empowered students to consider STEM careers as viable alternatives.

The underrepresentation of students of color in general and African Americans in particular among courses, majors, and careers requiring science and mathematics implies the need to build a knowledge base of innovative social capital approaches that are most likely to heighten student's mathematics and science social integration and success. Consequently, I believe the development of social capital in a science and mathematics pre-collegiate academic enrichment program clearly warrants further consideration for increasing racial and ethnic minority students' engagement in science and mathematics at the high school, postsecondary, and career levels.

Recommendations for Future Research

Using an instrumental case study design, this study investigated how institutional agents and interpersonal networks contribute to the development of social capital for African American high school students participating in a science, technology, engineering, and mathematics (STEM) Pre-College Program. The study involved eight African American high school seniors who met the criteria for participation in the study, including (a) reported ethnicity as African American, (b) were currently enrolled in the STEM Pre-College Program, (c) had participated in the STEM Pre-College Program for a minimum of four years, (d) were enrolled in mathematics and science high school courses each year, and (e) were currently enrolled in advanced mathematics and science high school courses.

The following topics are recommended for further investigation:

- A longitudinal study of attrition in multi-year, year-round STEM academic enrichment programs and its influence on social capital development. Clearly, all students who initially enroll in STEM out-of-school academic enrichment programs do not fully participate or remain for multiple years, therefore, it would be important to determine the role of social capital for students who dropout at various intervals in the program in order to examine the impact of interpersonal networks and institutional support on their STEM choices.
- A study of the development of social capital for racial and ethnic groups other than African American students who are underachieving and underparticipating in STEM such as Hispanics and American Indians. Similar to African American populations, these groups comprise the United States workforce, however, they are underrepresented in a vast majority of the STEM disciplines. It would be important to compare underrepresented minority students' perceptions of interpersonal networks and institutional support in the development of social capital and its impact on their STEM choices.
- A gender study to investigate if male and female students differ in their development of social capital when participating in out-of-school STEM academic enrichment program. It would be important to compare male and female students' perceptions of interpersonal networks and institutional support and its impact on their STEM choices.

- A study of a students' socioeconomic status to investigate the impact of students' social class on their perceptions of interpersonal networks and institutional support in a STEM out-of-school academic enrichment program and its contribution to their development of social capital and STEM choices.

Further research is clearly warranted to gain an in-depth understanding of why such a large percentage of students are graduating from high school with insufficient preparation and the motivation to pursue STEM and STEM-related college majors and careers.

Summary

In order to meet the escalating demand for a world-class scientific and technical workforce, strategies must be researched and developed that support students' science and mathematics learning. The low percentage of students in general, and racial and ethnic minorities, females, and persons with disabilities in particular, who are selecting advanced-level mathematics and science courses in preparation for STEM- or STEM-related college majors and careers is of growing concern, particularly because of its importance to our country's security and economics, as well as our way of living. Therefore, pre-collegiate mathematics and science academic enrichment experiences that are attuned to students' development of social capital are worthy of consideration. Policy makers, practitioners, and parents must focus on ways to increase students' interest and enthusiasm for science, technology, engineering, and mathematics college majors and subsequent careers in these disciplines, especially among underrepresented populations.

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APPENDIX A

TELEPHONE CALL SCRIPT

Telephone Script used with Parent(s)/Caregiver(s) in the Recruitment of Participants under the age of 18 years:

Hello Mr. or Mrs. _________________,

My name is Rita L. Fuller. I am a student at UNC-Greensboro where I am working on my Ph.D. I am calling because of my interest in doing a study on a STEM Pre-College Program such as the one that (child's name) has participated in for the last four years. He or she was randomly selected, along with twenty other African American high school seniors from the STEM Pre-College Program enrollment database. I am calling to see if you would be interested in having your son/daughter participate in my study. This study will help me gather information about your child's perceptions, which are very important. I also believe that this study will help them make more informed academic and personal decisions regarding future STEM options and careers.

Would you be interested in (child's name) being a part of my study?

If the response is no -- thank you so much for your time.

If the response is yes -- Could I please speak with (child's name) about their participation in the study? If he/she also is interested in my study, I would like to schedule a convenient time to meet with you and your son/daughter to read over the permission forms that will need to be signed in order for him/her to participate in the study. I propose that we meet at one of your STEM Pre-College Program sessions. What date and time would be best suited for both of you to attend?

Thank you for your time.

Telephone Script used in the Recruitment of Participants after Speaking with their Parents

Hello ________________,

My name is Rita L. Fuller. I am a student at UNC-Greensboro where I am working on my Ph.D. After talking with your parent/caregiver on the telephone, I am speaking with you because of my interest in doing a study on a STEM Pre-College Program such as the one that you have participated in for the last four years. Your name was randomly selected, along with twenty other African American high school seniors from the STEM Pre-College Program enrollment database. I am calling to see if you are interested in participating in my study. This study will help me gather information about your perceptions, which are very important. I also believe that this study will help you make more informed academic and personal decisions regarding future STEM options and careers.

Would you be interested in being a part of my study?

If the response is no -- thank you so much for your time.

If the response is yes - - I would like to schedule a time that I can meet with you and your parent/caregiver so both of you can read over the permission forms that will need to be signed in order for you to participate in the study. I propose that we meet at one of your STEM Pre-College Program sessions. What date and time would be best suited for both of you to attend?

Thank you for your time.

APPENDIX B

PARENT CONSENT FORM

The University of North Carolina at Greensboro

CONSENT TO ACT AS A HUMAN PARTICIPANT: SHORT FORM WITH ORAL PRESENTATION

Project Title: AFRICAN AMERICAN STUDENTS' PERCEPTIONS OF THE DEVELOPMENT OF SOCIAL CAPITAL IN A SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS (STEM) PRE-COLLEGE PROGRAM

Project Director: Rita Lester Fuller

Participant's Name: ____

Rita L. Fuller has explained in the preceding oral presentation the procedures involved in this research project including the purpose and what will be required of your son or daughter. The interviews will take approximately two and one-half hours of your child's time at the STEM Program site over a few months. Your child will participate in one or two individual interviews that will require 30 to 45 minutes, as well as one or two focus groups that also will last approximately 30 to 45 minutes. I will also be observing your child during the STEM Pre-College Program academic enrichment classes and these observations will not require any additional time.

Any benefits and risks were described in the oral presentation. Rita L. Fuller has answered all of your current questions regarding your son's or daughter's participation in this project. You are free to refuse to have your child participate or to withdraw your consent and your child's assent to participate in this research at any time without penalty or prejudice; their participation is entirely voluntary. Your child's privacy will be protected because he/she will not be identified by name as a participant in this project.

The University of North Carolina at Greensboro Institutional Review Board, which insures that research involving people follows federal regulations, has approved the research and this consent form. Questions regarding your rights as a participant in this project can be answered by calling Mr. Eric Allen at (336) 256-1482. Questions regarding the research itself will be answered by calling (a) Rita L. Fuller (336) 578-5779 or (919) 966-3202 or (b) Dr. Ceola Ross Baber at (336) 334-4667. Any new information that develops during the project will be provided to you if the information might affect your willingness to continue participation in the project.

By signing this form, you are agreeing to have your child participate in the project described to you by Mrs. Fuller.

_____________________________ _____________________________

Parent/Caregiver's Signature Date

____

Witness* to Oral Presentation
And Parent/Caregiver's Signature

*Investigators and data collectors may not serve as witnesses. Subjects, family members, and persons unaffiliated with the study may serve as witnesses.

____

Signature of person obtaining consent on behalf of
The University of North Carolina at Greensboro

____

Date

APPENDIX C

CHILDREN'S ASSENT FORM

As I explained in the oral presentation, I am doing a study to help me learn more about how students develop connections/links with others in a Science, Technology, Engineering, and Mathematics (STEM) Pre-College Program. I am asking you to help me because your perceptions are important. I also think this study will help you make more informed academic and personal decisions regarding STEM careers. If you agree to be in my study, I will be asking you some questions about your participation and interaction with people in the Program and its impact on your STEM selections. For example, I will be asking about your social networks and ties, your interaction, connections, and/or links with others who participate in the Program. Remember, these questions are only about what you think. There are no right and wrong answers because this is not a test.

The interviews will take approximately two and one-half hours of your time at the STEM Program site over a few months. You will participate in one or two individual interviews that will require 30 to 45 minutes, as well as one or two focus groups that also will last approximately 30 to 45 minutes. I will also be observing you during the STEM Pre-College Program academic enrichment classes and these observations will not require any additional time.

You can ask questions that you might have about the study at any time. Also, if you decide at any time not to finish the study, you may stop whenever you want. Your real name will not be used in my research report – you will get to select your research name. All of my research materials will be securely stored at my house and I will be the only one that will have access to the locked file cabinet. Five years from the completion of the study, all documents will be permanently destroyed by shredding.

Signing this paper means that you have read this or had it read to you and that you want to be in the study. If you don't want to be in the study, don't sign the paper. Remember, being in the study is up to you, and no one will be mad if you don't sign this paper or even if you change your mind later.

______________________________________ ____________________

Signature of Participant Date

______________________________________ ____________________

Signature of Investigator Date

APPENDIX D

ORAL PRESENTATION FORM

African American Students' Perceptions of the Development of Social Capital in a Science, Technology, Engineering and Mathematics (STEM) Pre-College Program

Project Director: Rita L. Fuller

ORAL PRESENTATION (used with parents and participants together, accompanied by Consent Form for parent's signature and Assent Form for participant's signature)

The purpose of this research is to investigate how African American high school students develop connections/links with others in a Science, Technology, Engineering, and Mathematics (STEM) Pre-College Program. This is a case study which means that I will be visiting the STEM Pre-College Program three to four times to observe and interview participants about social networks/social ties, individual and group support, and their STEM choices in the Program activities. Participation in the interviews will take approximately two and one-half hours of time outside of regular STEM activities. I will conduct one or two individual interviews with each participant that will require 30 to 45 minutes, as well as one or two focus groups that also will last approximately 30 to 45 minutes. I will also be observing participants during the STEM Pre-College Program academic enrichment classes; these observations will not require any additional time.

The study has benefits for both the participants and our society. The study will help participants understand the importance of participation in research to improve the lives and prospects of others. It will also help in making more informed academic decisions and personal decisions regarding STEM careers. The study will make a contribution to our society by providing insight into African American students' perceptions of their interpersonal networks, institutional support in a STEM Pre-College Program and its impact on STEM choices.

There are no risks involved in this study and no real names will be used. Participants may ask questions of the investigator or withdraw from the study at any time. Parents may also ask questions or withdraw your child at any time. All research material will be securely stored in a file cabinet in my home; I am the only one who will have access to this file cabinet. Five years from the completion of the study, all documents will be permanently destroyed by shredding.

____

Signature of person obtaining consent on behalf of
The University of North Carolina at Greensboro

____

Date

APPENDIX E

SEMI-STRUCTURED INTERVIEW PROTOCOL

Project: **AFRICAN AMERICAN STUDENTS' PERCEPTIONS OF THE DEVELOPMENT OF SOCIAL CAPITAL IN A STEM PRE-COLLEGE PROGRAM**

Time of Interview:
Date:
Place:
Interviewer: Rita L. Fuller
Interviewee:
Position of Interviewee:

I am doing a study to help me learn more about how students develop social capital in a Science, Technology, Engineering, and Mathematics (STEM) Pre-College Program. I am asking you to help because your perceptions are important. If you agree to be in my study, I will be asking you some questions about your participation and interaction with people in the Program and its impact on your STEM selections. Remember, these questions are only about what you think. There are no right or wrong answers because this is not a test.

Questions:

1. What are meaningful experiences that stand out for you about the STEM Pre-College Program?

2. How have these experiences helped you with your STEM choices?

3. Who are the important people in the STEM Pre-College Program?

Semi-structured Interview Protocol
Rita L. Fuller
Page Two

4. How would you describe your STEM choices while participating in the STEM Pre-College Program?

5. Could you tell me about the support provided by people in the STEM Pre-College Program and their impact on your STEM choices?

6. How would you describe your relationships (*e.g.*, connections/links/ associations/interactions) with people (other STEM participants, STEM instructors, parents, etc) in the STEM Pre-College Program and its influence on your STEM choices?

Thank you for your cooperation and participation in the interview. Please be aware that there may be the potential for future interviews. The responses provided in this interview will be kept confidential.

APPENDIX F

OBSERVATION PROTOCOL

Project: AFRICAN AMERICAN STUDENTS' PERCEPTIONS OF THE DEVELOPMENT OF SOCIAL CAPITAL IN A STEM PRE-COLLEGE PROGRAM

Setting/Individual Observed:
Observer: Rita L. Fuller
Role of Observer: Non-Participant
Time:
Place: Saturday Academy Circle one: Mathematics Class Science Class
Length of Observation:

Descriptive Notes	**Reflective Notes**

APPENDIX G

FOCUS GROUP INTERVIEW PROTOCOL

Project: AFRICAN AMERICAN STUDENTS' PERCEPTIONS OF THE DEVELOPMENT OF SOCIAL CAPITAL IN A STEM PRE-COLLEGE PROGRAM

Time of Interview:
Date:
Place:
Interviewer: Rita L. Fuller
Interviewees:

FOCUS GROUP QUESTIONS:

1. How do the STEM Pre-College Program activities influence your STEM interest?

2. How does participating in Math and Science Competition Day help with your STEM decision-making?

3. Describe how course, college, and career advisement provided by key people in the program help with your STEM choices?

4. How do you feel about being pushed academically by people who are in the STEM Pre-College Program?

5. How does the support from people in the STEM Pre-College Program impact your STEM choices?

6. How do the academic options presented in the STEM Pre-College Program help in your decision-making?

7. Tell me how the interactions and conversations that occur between you and key people in the Program impact your STEM decisions?

8. Tell me how people in the Program influence your self-confidence?

9. How comfortable do you feel about enrolling in advanced-level mathematics and science courses?

APPENDIX H

DATE ANALYSIS RELATED TO THEME

The following data points from semi-structured individual interviews, focus group interviews, and observations provide an example of how *Theme Two - Institutional Support through Dialogue and Discourse* emerged from the data analysis.

DATA POINTS (number of participant responses)	**INDICATORS**	**THEME**
Direct/Guide (8) *Interview, Focus Group and Observation*	Advocacy	INSTITUTIONAL SUPPORT THROUGH DIALOGUE AND DISCOURSE
Push us (17) *Interview, Focus Group and Observation*		
Caring (10) *Interview, Focus Group and Observation*	Nurturance	
Help us (32) *Interview, Focus Group and Observation*		
Encouraging (25) *Interview, Focus Group and Observation*	Encouragement	
Supportive (13) *Interview, Focus Group and Observation*		
Asking questions (8) *Interview, Focus Group and Observation*	Conversation	
Talk to us (37) *Interview, Focus Group and Observation*		