2018

# Counseling Program Intervention For Improving African American Students' Science, Technology, Engineering, And Mathematics Dual Enrollment Participation

Sonja L. Taylor
*University of South Carolina*

# A Counseling Program Intervention For Improving African American Students' Science, Technology, Engineering, and Mathematics Dual Enrollment Participation

by

Sonja L. Taylor

Bachelor of Science
Stephen F. Austin State University, 1998

Master of Education
Columbia College, 2007

---

Submitted in Partial Fulfillment of the Requirements

For the Degree of Doctor of Education in

Curriculum and Instruction

College of Education

University of South Carolina

2018

Accepted by:

Suha Tamim, Major Professor

Yasha Becton, Committee Member

Rhonda Jeffries, Committee Member

Christine Lotter, Committee Member

Cheryl L. Addy, Vice Provost and Dean of the Graduate School

# ACKNOWLEDGEMENTS

I cannot imagine persevering on this journey without the help of the Lord. Certainly, His blessings are paramount in all areas of my life and for this I am eternally grateful. I have also been blessed with a wonderful family. Thank you Chris and Christopher for your unwavering love and support; and to my parents, I appreciate you for planting the seeds of excellence in us all. Daddy, I miss you and wish you could have held on just a little while longer to share in this moment with me.

I could not have successfully completed this research study without many caring and encouraging professors within the University of South Carolina's College of Education. First, I am grateful to my dissertation chair Dr. Suha Tamim for her guidance, patience, and support at all critical stages of the research process. I am also appreciative of my dissertation committee, which included Dr. Yasha Becton, Dr. Rhonda Jeffries, and Dr. Christine Lotter, for the time and energy they invested to review my writing and to offer helpful feedback.

I must also thank Dr. Richard Lussier for helping me to organize my thoughts and to structure a research study that merged my passion for STEM with my desire to improve academic and social outcomes for African American students in South Carolina. Finally, I would like to express my gratitude to the Crosstown School District and its Middle and High School leadership teams for answering countless questions and for granting me access to their data, students, and community for the duration of this study.

# ABSTRACT

African Americans are underrepresented at all points in the STEM pipeline from K-12 coursework into professional careers. The reasons for this underrepresentation are varied and reflect a myriad of contributing factors based on early academic experiences, sociocultural influences, and the effects of standardized testing. The three-fold purpose of this study was to implement a counseling program to inform nine African American study participants about the dual enrollment opportunity at their high school, to gain perspective about the factors which shaped their STEM disposition, and to determine the effect of the program on their attitudes about dual enrollment participation. The study employed qualitative methods to collect data from surveys, interviews, field notes, and observations. The data analysis was grounded in four theoretical constructs: Critical Race, Self-Efficacy, Sociocultural, and Culturally Relevant Pedagogy Theory. The study findings indicated that the participants' STEM disposition could be attributed to a broad range of factors, with some of the most significant of these being ineffective teachers, limited access to meaningful STEM learning experiences, narrowed curriculum options, and an inadequate supply of role models.

TABLE OF CONTENTS

# LIST OF TABLES

# LIST OF FIGURES

# LIST OF ABBREVIATIONS

AP .....Advanced Placement

CHS..... Crosstown High School

CSD..... Crosstown School District

ECP .....Early College Program

EOC..... End of Course

ESEA..... Elementary and Secondary Education Act

IGP .....Individual Graduation Plan

NCES .....National Center for Educational Statistics

PLTW..... Project Lead The Way

PSS.....Premier STEM School

STEM……Science, Technology, Engineering, and Mathematics

# CHAPTER 1

# INTRODUCTION

While addressing congregants attending a memorial service for Dr. Ronald E. McNair following the Space Shuttle Challenger disaster, Reverend Jesse Jackson painted a vivid portrait of McNair's rise from humble beginnings in segregated Lake City, South Carolina to become an accomplished laser physicist "chosen by God to defy the odds of oppression" (Cheers, 1986, p. 88). Despite Reverend's Jackson's declaration more than 30 years ago, Dr. McNair's victory over "the odds of oppression" remains an elusive goal for many African American students in South Carolina and throughout the United States, especially when considering who has access to and achieves in STEM fields (Brown et al., 2015; Lewis & Connell, 2005).

African Americans were credible contributors to the scientific community long before they gained legal access to educational opportunity and Dr. McNair ventured into space (Manning, 1998). Despite the efforts and successes of early pioneers and modern scientists, African Americans remain significantly underrepresented in science and related careers (Lewis & Connell, 2005; Summers & Hrabowski, 2006). This underrepresentation is reflected at all points in the science pipeline (Brown et al., 2015) and it is evidenced by significant gaps in K-12 STEM course enrollment, persistence, and achievement, as well as college degrees awarded between African American students and their White peers in the United States (Brown et al., 2015; Neuhauser, 2015; Lewis, 2003). This dilemma presents a problem worthy of further study.

Advanced placement (AP) courses are one pathway to STEM access for high school students who are "academically prepared and motivated to take on college level courses" (The College Board, 2014, p. 3). Among South Carolina's 2015-2016 student population, only 10.6 percent of AP tests were taken by African American students compared to 71.5 percent for White students (The College Board, 2016). When considering only tests administered in STEM fields, African Americans accounted for 8.7 percent of exams compared to 70.8 percent for Whites (The College Board, 2016). The racial disparity in AP STEM participation is only overshadowed by the achievement gaps it confirms. The aforementioned African American test takers had a mean passing score (3 or better, on a scale of 1–5) on only 1 of 10 STEM exams compared to 6 of 10 for White students (The College Board, 2016).

Standardized test results matter. They guide the curriculum agenda at the federal, state, and local levels, including what constitutes achievement, which courses will be offered, who will gain access to those courses, and the types and extent of resources allocated to support these curriculum choices (Pershey, 2011; Robinson, 2013). Standardized tests are also used to make school-level placement decisions and to inform educators' perceptions about a student's ability to handle advanced coursework in gifted or other accelerated programs, especially in mathematics and science (Campbell, 2012; Koba, 1996; Morgan, Farkas, Hillemeier, & Maczuga, 2016; Smith, Trygstad, & Banilower, 2016). Therefore, subpar performance on standardized testing or an unfavorable teacher recommendation in the early grades delimits African American students' access to the rigorous middle and high school courses and important learning experiences which best prepare them for STEM careers (Smith et al., 2016; Thompson &

Allen, 2012). Prior history of low achievement also shapes students' internal beliefs about their mathematics ability and their overall STEM interest (Blank, 2013; Lewis & Connell, 2005; McGee, 2015). Thus, African American students are less likely to exert effort toward subject matter which reinforces negative self-perceptions (Jacobson, 2013; Pershey, 2011).

The impact of testing and the racial achievement gaps they illuminate are a manifestation of "multiple culprits for inequitable education" (Settlage, Butler, Wenner, Smetana, & McCoach, 2015, p. 382). These culprits include poverty, imbalanced distribution of education resources, inconsistent learning environments, limited or insufficient curriculum, poor teacher quality, and ineffective school structure and leadership practices. Such factors serve only to further marginalize and oppress students as their opportunity to engage in rich learning experiences is greatly restricted (McLaughlin, 2014).

The implications of reduced opportunity for the next generation of scientists and the African American community are too important to ignore (Melguizo & Wolniak, 2012; Summers & Hrabowski, 2006). Employment inequalities are of particular concern as the Bureau of Labor Statistics reported the December 2016 African American jobless rate (7.8 percent) was nearly twice that of Whites (4.3 percent) nationally, while also proclaiming that STEM occupations have strong growth projections and a propensity to be higher-paying than other professions in the United States and abroad. Melguizo and Wolniak (2012) stated "the labor market rewards individuals trained in fields that receive more in depth training solving abstract problems and applying quantitative methods" (p. 401). For this reason, STEM achievement is a promising pathway for African Americans

to overcome the effects of racial oppression, which are at the heart the community's socioeconomic instability (Charleston, Charleston, & Jackson, 2014).

All students benefit from exposure to a rigorous curriculum (Cook, 2013). Many schools promote the AP program as an excellent option to experience college-level coursework while a student is still in high school. However, AP course credit is only granted if a student is able to succeed on the AP exam (Howley, Howley, Howley, & Duncan, 2013). Therefore many students, including African Americans, are unable to reap the college benefit from AP participation and end up demoralized by a disappointing test score after a full year of coursework (Hugo, 2001).

Dual enrollment programs are accelerated learning partnerships between school districts and area colleges that allow high school students to concurrently register for college courses (Hoffman, Vargas, & Santos, 2009). Students earn college credit by successfully completing all coursework (Hugo, 2001). Dual enrollment creates an opportunity for STEM interested students to preview college level coursework without the pressure of a must-pass examination; thus, they are a promising option to increase racial minorities' college preparation and access (Hugo, 2001).

Medvide and Blustein (2010) noted the imbalance in career development literature, with the greatest focus placed on urban racial minorities who are underexposed to advanced coursework and have no plans to pursue college. However, in order for students to learn about and prepare for postsecondary opportunities, they need guidance and support from a number of stakeholders, especially school counselors (Camizzi, Clark, & Goodman, 2009). This action research study examined the effectiveness of a counseling program designed to increase the number of African American students who

participate in STEM dual enrollment courses at Crosstown High School (CHS) (pseudonym). The study was structured by Sociocultural, Critical Race, Culturally Relevant Pedagogy, and Self-Efficacy Theory based on a review of the most current literature, which is addressed in Chapter 2.

**Statement of the Problem**

The identified Problem of Practice (PoP) for this action research study focused on low levels of participation in science and mathematics dual enrollment courses among African American students at Crosstown High School (CHS). The CHS Report Card confirmed modest dual enrollment participation and substandard STEM achievement (South Carolina Department of Education, 2016). Only 73 of the school's 813 students (approximately 9 percent) were taking advantage of dual enrollment courses and, 56 of the 73 (77 percent) were participating in a special STEM Early College Program (ECP) which required them to enroll in the dual enrollment classes.

The STEM ECP functions on the cohort model, with a new group of invited students added each academic year. Students who participate in the STEM ECP are invited to join the program as seventh graders. They complete coursework toward a high school diploma and an Associate of Science (A.S.) degree simultaneously. The program is currently in its sixth year. However, the STEM ECP attrition rates shown in Table 1.1 are concerning. Therefore, the CHS dual enrollment program may be unsustainable without increased participation among non-ECP students.

Through preliminary investigation the participant-researcher learned the Crosstown School District (CSD) administration eliminated advanced placement (AP) courses for all students in 2011. Consequently, CHS students, and in particular African

Americans, have been underexposed to the rigor of college-level coursework, especially in STEM, over the last six years.

Table 1.1

*Enrollment Data for STEM ECP by Cohort*

| Cohort | Year Admitted | Current Grade Level | Initial Number of Admitted Students | Current Enrollment* | Attrition Rate (%) |
|---|---|---|---|---|---|
| 1 | 2012 | 11 | 20 | 10 | 50 |
| 2 | 2013 | 10 | 24 | 20 | 17 |
| 3 | 2014 | 9 | 45 | 29 | 36 |
| 4 | 2015 | 8 | 32 | 23 | 28 |
| 5 | 2016 | 7 | 38 | 23 | 40 |

*As of January 18, 2017

The CSD is under new leadership since 2012. With this change, the school district has gradually increased curriculum rigor and improved course options by participating in Project Lead the Way (PLTW), reinstating some AP classes and establishing dual enrollment partnerships with a local technical college (South Carolina Department of Education, 2016). The original AP and dual enrollment classes restored and offered under this new administration have been in the humanities, and more STEM classes—both AP and dual enrollments—have been gradually added to CHS curriculum. The expanded STEM course options are directly linked to the new CSD leadership's decision to start the STEM ECP in 2012. The curriculum expansion was necessary to satisfy the A.S. degree requirements for ECP students. However, the CSD administration also viewed this decision as an opportunity to increase STEM participation and achievement among all

CHS students (CSD Superintendent, personal communication, February 10, 2016). Thus, the district opened participation in the dual enrollment courses without any costs to all interested students who meet the technical college's admissions requirements. In spite of this policy, participation in the STEM dual enrollment courses among non-ECP students has been relatively low (CSD Administrator, personal communication, February 23, 2017).

**Significance of the Study**

Crosstown High School (CHS) is located in a high-poverty, rural South Carolina county (South Carolina Department of Education, 2016). The December 2016 CSD county unemployment rate was 5.9 percent (SC Works, 2016), which placed the county's unemployment rate as the eighth highest of the state's 46 counties. Furthermore, the South Carolina Department of Employment and Workforce reported that from 2004 to 2014, the CSD county unemployment rate was consistently above both the state and national averages, reaching a maximum of 14.6 percent in 2010. Considering the county's historically high unemployment rate and Karanja and Austin's (2014) findings which connect the national employment forecast for African Americans to STEM job growth, CHS students stand to benefit from the potential increases with adequate STEM preparation. This study is important because it is a starting point for helping students to explore the possibilities of STEM, sustaining improved curriculum options at CHS, better preparing African American students for selective STEM college admissions policies which often disproportionately affect underrepresented students' chances to participate (Rogers-Chapman, 2014), and ultimately, increasing the students' opportunities for college success, career fulfillment, and economic stability.

For the past two decades, the education community has acknowledged that STEM achievement gaps exist, responded by conducting research to better understand the problem and used its findings to steer discussions about possible solutions (ACT, 2012; Wallace & Brand, 2012). As part of this dialogue, science frameworks have evolved with a greater emphasis on issues of diversity, equity, and social justice (Lee, Miller, & Januszyk, 2014). Consequently, the body of research into African American students' achievement, particularly in mathematics and science, and the most effective curriculum and instructional practices has grown significantly. Despite this progress, there remains significant gaps in the knowledge about the impact of culture and race on STEM teaching and learning (Howard, 2014; Jackson & Ash, 2012; Ladson-Billings, 1995; Milner & Laughter, 2015), the most effective methods for teaching science in underserved communities (McLaughlin, 2014; Norman, Ault, Bentz, & Meskimen, 2001), the relationship between school composition and racial achievement gaps (United States Department of Education, 2015), the causes and effects of early formation of achievement gaps (Curran & Kellogg, 2016; Ferguson, 2015; Morgan et al., 2016), and the types of data-driven, school-based interventions which may increase African American students participation in advanced STEM courses (Camizzi et al., 2009; Davis, Davis, & Mobley, 2013)

A review of the literature, which is more closely explored in Chapter 2, clearly establishes that STEM participation and achievement gaps exist (Blank, 2013; Curran & Kellogg, 2016; Koba, 1996; Morgan et al., 2016; Norman et al., 2001). The United States government has further declared that closing these gaps is a national priority (Neuhauser, 2015; United States Department of Education, 2015; The White House, 2015). However,

the exact causes of the problem and practical solutions remain a point of debate. Some researchers point to socioeconomic factors (Chapman & Donner, 2015; Ferguson, 2015), resource inequities (Brown et al., 2015; Smith et al., 2016), and policy decisions (Gross & Hill, 2016; Hartney & Flavin, 2014, Simms, 2012; Stuart Wells, 2014; T. Wright, 2011). Others purport that educators lack the skill, training, commitment, content knowledge, and cultural competence to effectively reach and teach African American students (Adamson, Santau, & Lee, 2013; Decuir-Gunby, 2009; Howard, 2014; Ladson-Billings, 2000; Milner & Laughter, 2015; Schmeichel, 2012; Wallace & Brand, 2012). Still more researchers emphasize the negative impact of high-stakes testing (Lomax, West, Harmon, Viator, & Madaus, 1995; Thompson & Allen, 2012) and the accountability movement (Rector-Aranda, 2016; Werts et al., 2013) on narrowed curriculum options which have hurt African American students' opportunity to become involved in significant learning experiences which build self-efficacy and sustain STEM interest, participation, and achievement over time.

This array of factors is addressed by Museus and other researchers (2011) through their Racial and Ethnic Minorities in STEM (REM STEM) model. This model unifies the differing perspectives of the leaky STEM pipeline and illustrates relationships among the many constructs believed to influence STEM participation and achievement. For instance, the REM STEM model explains how variables which comprise a student's K-12 experience, such as educational inequity, early STEM exposure, and culturally relevant curricula, directly influence outcomes such as academic preparation, course choices, and STEM disposition—which includes "self-efficacy, interest, and aspirations and expectations" (p. 89). Furthermore, the REM STEM model draws direct connections

between K-12 STEM opportunities and outcomes for underrepresented students, from high school into postsecondary studies and careers. Despite an ever growing body of research devoted to increasing STEM participation and achievement among African American K-12 students, the number of studies that focus on interventions which support dual enrollment as a means of improving STEM disposition for students in rural high schools is limited.

Rural students face many barriers to postsecondary ambitions and participation, including geographic isolation, poor quality teachers, limited access to rigorous classes, community cultures, which may devalue college attendance, and insufficient numbers of college-educated role models (Ferguson, 2015; Graham, 2009; Peters Burton et al., 2014; Peterson, Bornemann, Lydon, & West, 2015). Furthermore, when considering that rural students are often limited in their exposure to challenging math courses, their preparation for and likelihood of pursuing STEM careers is greatly reduced (Graham, 2009). Additionally, Cassidy (2015) called on researchers to expand the body of research dedicated to the actions—in terms of persistence and achievement—of students in challenging settings where self-efficacy and resistance to negative self-perceptions may be critical to their success. Thus, the findings of this study may potentially fill in gaps in the literature.

**Purpose Statement**

The primary purpose of this action research study was to implement a counseling program which informed African American students who are not a part of the STEM Early College Program (ECP), about dual enrollment opportunities at CHS. The secondary purpose was to determine if participating in the counseling program

encouraged students to consider pursuing dual enrollment STEM classes at CHS. Finally, the tertiary purpose of the study was for the participant-researcher to collect data amongst these African American students to ascertain information about their prior STEM experiences and their perceptions of the counseling program activities, and then to use that data to reflect with teachers, school counselors, administrators, and other stakeholders in order to institute a steady and durable dual enrollment program for African American students in the Crosstown School District (CSD). The research methodology is addressed more specifically in Chapter 3.

**Research Questions**

Through the present study, the participant-researcher sought answers to the following questions:

1. What is the effect of a counseling program intervention on African American students' STEM disposition at Crosstown High School?
2. To what extent does involvement in the counseling program influence these African American students' attitudes about math and science dual enrollment participation?
3. What are the most significant factors that shaped these African American students' STEM disposition?

**Conceptual Framework**

Hargrave (2015) presented the underrepresentation of African Americans in STEM from two vantage points, which are summarized by the following assertions:

1. African American students' participation in STEM is far less than their representative population in K-12 education.
2. African American students have underperformed in STEM, in terms of their measures of academic achievement—standardized test scores, grades earned, and attainment of related college degrees—compared to those of their White peers.

A review of the literature confirmed Hargrave's (2015) statements and linked them to a number of conceptual constructs which may explain African American students' minimal STEM participation and low levels of achievement. This action research study was grounded within four of these constructs which include Sociocultural, Self-Efficacy, Critical Race, and Culturally Relevant Pedagogy Theory.

**Sociocultural Theory**. Sociocultural theory, according to the early 20th century cognitive psychologist Lev Vygotsky, emphasized the significance of social interaction and culture on children's development. The impact of society and culture on how students develop higher-level mental functions is of particular importance, as these factors are directly linked to the choices humans make through their own will (Crowl, Kaminsky, & Podell, 1997).

Vygotsky (1987) believed children use inner speech, a form of self talk, to control their behavior. Through this type of internal communication, young people internalize challenges and talk themselves through the process of coping with and overcoming obstacles; so, a student who is struggling to solve a complex mathematics problem may engage in inner speech to construct an approach to solving it and arrive at the solution. Furthermore, Vygotsky emphasized the role that persons in positions of influence—teachers, school counselors, parents, and peers—play in students' cognitive development

and perceptions of socioculturally acceptable behaviors. Therefore educators are in a unique position to build students' self-concept, to address individual learning needs, to create culturally sensitive environments and curricula, and to engage students in meaningful learning which provides guidance and helps them to "internalize knowledge most efficiently" (Crowl et al., 1997, p. 73).

Teaching practices at CHS were not a direct focus of this action research study. However, educators' perceptions inform pedagogy and beliefs about a students' ability; and, these factors have been shown to influence curriculum and placement decisions as well as students' STEM disposition (Smith et al., 2016). Through the lens of Sociocultural Theory, this action research study may indirectly provide valuable insight into African American students' perceptions of the CHS teaching and learning culture and its effects on their course selection and STEM disposition.

**Self-Efficacy Theory**. CSD students have now been provided a platform to pursue STEM dual enrollment classes, yet many students have not taken advantage of the opportunity. When considering Alfred Bandura's (1977) Self-Efficacy Theory, students are unlikely to pursue subjects if they lack confidence in their ability to succeed. Furthermore persistence, especially in the face of adversity along the way, is directly linked to efficacy expectations. Students either expect to fail or to succeed; and, it is this belief that largely determines their attitudes, motivation, and ultimately their decision to either undertake the task or to avoid it. These efficacy expectations may be based on past personal experiences, others' experiences, receiving encouragement (or discouragement) from persons in positions of influence, and one's psychological or emotional state (Bandura, 1977). Thus, the researcher's anecdotally observed low levels of STEM self-

efficacy, and the documented subpar participation and performance in STEM coursework (South Carolina Department of Education, 2016) may be explained by inadequate efficacy expectations.

While teachers cannot and in this researcher's opinion, should not assume total responsibility for a student's efficacy beliefs, an educator's approach to curriculum and instruction may positively (or negatively) influence a student's self-efficacy and academic pursuits and outcomes. Bandura (1977) explained that personal efficacy expectations have these effects:

- They determine if a student will take the first step, such as enrolling in a challenging course.
- They determine the amount of effort the student will put into succeeding. For example, the student may invest two hours of studying each day to master important concepts.
- They determine the degree to which the student will persist, regardless of challenges or setbacks. For instance, in spite of investing time studying and earning a failing grade on the test, the student remains enrolled in the course, increases study time, and seeks additional help from the teacher to improve her chances for success.

Considering these assertions, a counseling program may be an effective intervention for improving African American students' efficacy expectations so they are more likely to persevere through challenges presented by demanding coursework, to develop resilience (Cassidy, 2015), and to use their learning to become self-advocates and overcome political, social, and economic oppression (Freire, 2013).

**Critical Race Theory**. In her introduction to W. E. B. DuBois's (2003) *The Souls of Black Folk*, Farah Griffin emphasized the book's importance to any comprehensive evaluation of Black life in America. Among its most noteworthy tenets relative to this action research study are "the scholar's role as advocate and activist" (p. xv) and the application of DuBois's writings as "a means of informing social and political action" (p. xvi).

When viewed within the lens of Critical Race Theory, the CSD's STEM quandary is best explained by the historical oppression of African Americans (Chapman & Donor, 2015). Critical Race Theory emerged from the American Civil Rights movement and draws upon many different fields of study including anthropology, politics, history, philosophy, and sociology (Mitchell & Stewart, 2013). From its Civil Rights origins, Critical Race Theory gained traction in legal scholarship but has since expanded to the address issues in education (Ladson-Billings & Tate, 1995). Essentially, Critical Race advocates purport that (1) racism is a normal part of American life, (2) racial inequality is tied to property rights, which have consistently benefitted and sustained the interests of Whites; and, (3) legal efforts to exclude African Americans from both physical (real estate) and intellectual (adequate schooling and curriculum) property are directly correlated to historic and present day economic oppression and observed educational disparities (Crenshaw et al., 1995; Ladson-Billings & Tate, 1995). Therefore, Critical Race Theory may offer insight about the perceived quality of CSD schools, economic conditions in the CSD community, the willingness of "good teachers" to work there, and the curriculum decisions, including course offerings, which influence students' STEM access and disposition.

Although it remains an evolving theoretical construct, Critical Race Theory provides a platform for examining the relationship between racism and educational disparities and how these gaps can be closed (Howard, 2014). As a research methodology, Critical Race Theory establishes the connection between racism and other forms of oppression such as classism and sexism, challenges whiteness as the normative standard, employs social justice as a means to improve the lives of historically marginalized people, and calls upon nontraditional research approaches to study, explain, chronicle, and legitimize the daily experiences of oppressed persons (Crenshaw et al., 1995; Critical Race, 2015; Howard, 2014). When considering important aspects of Critical Race Theory, Howard (2014) described the significance of including the "voices of those who rarely are heard" (p. 103) in the telling of their own stories. These voices include those of the students, who are able to shed light on their schooling experiences and internal beliefs about their own abilities, the quality of their learning environment, teacher perceptions, and the curriculum to which they are exposed. Hence, the CHS students are suited to explain their STEM disposition and provide insight regarding the reasons for their low levels of participation and achievement in advanced STEM courses.

**Culturally Relevant Pedagogy Theory.** As numerous researchers have reported, the existence of achievement gaps has caused educators and researchers to examine teaching practices closely in order to improve African American student performance (Mitchell & Stewart, 2013; Rector-Aranda, 2016; Schmeichel, 2012). Culturally relevant (or responsive) pedagogy has emerged out of these efforts. Howard (2014) described it in the following manner:

> Culturally responsive pedagogy is situated in a framework that recognizes the rich and varied cultural wealth, knowledge, and skills that students from diverse groups bring to schools, and seeks to develop dynamic teaching practices, multicultural content, multiple means of assessment, and a philosophical view of teaching that is dedicated to nurturing student academic, social, emotional, and physiological well being (p. 67).

With this definition in mind, culturally responsive pedagogy targets students' strengths as educators use students' cultural knowledge as the initial points for engagement and instruction, especially in key subject areas (Howard, 2014). Culturally relevant pedagogy also refutes negative stereotypes which portray African American students as disinterested, genetically inferior, or culturally deficient (Emdin, 2011; Howard, 2014; Eglash, Gilbert, & Foster, 2013; Schmeichel, 2012), especially in academically rigorous courses such as mathematics and science. Instead, Schmeichel (2012) explained that culturally relevant pedagogy points to the significance of how educators think, in terms of their beliefs about their students' culture, as the catalyst that drives instructional practices. For instance, Schmeichel declared that a view of African American students as culturally deprived or deficient may impede a middle class, suburban educator from the dominant culture's ability to develop positive perceptions about and relationships with African American students. Similar views may also have influenced previous CSD administrators' perceptions about African Americans' ability to achieve in rigorous STEM courses, thus the decision to eliminate them from the curriculum (CSD Administrator, personal communication, February 12, 2016).

Critical race theorists call for educators to exercise sensitivity to the effects of poverty and racism (Milner & Laughter, 2015). Within the scope of Critical Race Theory, Culturally Relevant Pedagogy Theory is an appropriate response to teaching as an act of social justice (Ladson-Billings & Tate, 1995) and as an effective means to make critical connections which are most likely to improve African American students' academic performance and overall schooling experience (Howard, 2014). Collectively these approaches require educators to consider their audience and to tailor curriculum decisions to best serve students. Doing so supports Freire's (2013) position which described the failures of several political and educational plans because they were not designed with the beneficiaries of those plans in mind. Therefore, this action research study explored if a counseling program designed to increase STEM dual enrollment participation addressed the aforementioned STEM participation and achievement dilemma among the CSD's African American students.

**Action Research Methodology**

The American Educational Research Association (2016) defined action research as a process that "seeks transformative change through the simultaneous process of taking action and doing research, which are linked together by critical reflection" (Action Research Special Interest Group, 2016, para. 1). Unlike traditional research, with its emphasis on drawing conclusions, making broad generalizations, or advancing a particular field of study, action research is about making decisions that will ultimately improve educational practices locally, such as in a specific classroom or within a school community (Dana & Yendol-Hoppey, 2014).

Zeichner (1993) presented educators, through the process of action research, as agents for positively influencing their students' life chances. Furthermore, Zeichner explained that the classroom is an important platform for "socially critical action research…that is connected to the struggle for greater educational equity and social justice" (p. 201). This point of view is directly along the lines of the Critical Race and Culturally Relevant Pedagogy constructs. Thus, action research was appropriate for this topic which focused on expanding curriculum access and options to better address CHS's African American students' immediate and long-term educational and socioeconomic outcomes.

Through this action research study, the participant-researcher used qualitative methods to gain insight into African American students' current STEM disposition and attitudes about pursuing math and science dual enrollment courses at CHS. The research methodology, which included surveys, observations, and interviews, is discussed in more detail in Chapter 3.

**Potential Weaknesses of the Study**

**Assumptions.** The researcher assumed all study participants would complete the counseling program and provide truthful responses to surveys, questionnaires, and questions posed during the counseling and interview sessions. The researcher also assumed the CSD would continue to partner with the local technical college to provide dual enrollment classes to its students for the duration of this action research study.

**Limitations.** There were several limitations to this action research study. First, the participant-researcher is neither a CSD employee nor an employee of the local technical college partner to the CSD. Therefore, the researcher's access to study

participants and the school community were limited. CSD students must be eligible to participate in the dual enrollment program, per the technical college admissions standards. This means the number of study participants was limited to students who were most likely to meet the necessary prerequisites and were willing to participate in this action research study. Therefore, this study was further limited by the small number of participants.

**Delimitations.** This action research study took place at CHS with participants only selected from within the school community. The findings from the study represent the perspectives of these students under the specific conditions of the counseling program intervention.

**Conclusion**

This action research study focused on an identified Problem of Practice (PoP) regarding low levels of STEM dual enrollment participation among African American students at CHS (South Carolina Department of Education, 2016). Through this study, the researcher sought answers to the following research questions:

1. What is the effect of a counseling program intervention on African American students' STEM disposition at Crosstown High School?
2. To what extent does involvement in the counseling program influence these African American students' attitudes about math and science dual enrollment participation?
3. What are the most significant factors that shaped these African American students' STEM disposition?

Several educational reformers view access to dual enrollment courses as a means to improve the academic climate in high schools and to promote college access and educational equity among racially diverse, underserved, low-income, and first-generation students (Howley et al., 2013). Through this study, the researcher evaluated whether a counseling program may be a culturally relevant intervention for improving STEM participation and disposition among African American students at CHS. The counseling program was structured around five weekly Lunch and Learn sessions. These sessions were designed to educate participants about the technical college partner's requirements for dual enrollment participation and the program benefits. The program also introduced participants to other CHS students who have successfully participated in dual enrollment classes and African American STEM professionals from the local and surrounding communities.

During each session, the researcher recorded detailed observations to chronicle the interactions between the researcher and study participants, among peers, and between the presenters and study participants. The researcher also gathered data from participant surveys and interviews. The methods selected to conduct this action research study are grounded in a review of the related literature, which is discussed in Chapter 2. This literature review informed the detailed research plan which is presented in Chapter 3. Chapter 4 presents the findings which resulted from the research methodology. These findings also informed the recommendations and implications, which are addressed in Chapter 5.

**Glossary of Key Terms**

***ACCUPLACER*:** The College Board (2017) defined the ACCUPLACER as "an integrated system of computer-adaptive assessments designed to evaluate students' skills in reading, writing, and mathematics." While it is administered for various reasons, many South Carolina technical colleges use the ACCUPLACER to determine eligibility and readiness for college-level coursework (SC technical college admissions representative, personal communication, October 5, 2017).

***Achievement gap***: An achievement gap is a statistically significant performance difference between two groups based on race/ethnicity or gender (National Center for Educational Statistics, 2017).

***Action research***: A cyclical process of participatory research which is guided by a practitioner's identification of a problem of practice (PoP) and quest to find an appropriate solution. The four major stages of action research are *planning, acting, developing,* and *reflecting* (Mertler, 2014).

***Advanced placement (AP) courses***: AP courses are a pathway to college credit for students who earn a qualifying score on an AP exam. AP is considered a credit-by-examination option because the student must score a 3, 4, or, 5 on the exam to receive college credit. The amount of credit offered is dependent on the post-secondary institution a student elects to attend (The College Board, 2016).

***Critical Race Theory*:** Delgado and Stefancic (2017) defined this construct as a "progressive legal movement that seeks to transform the relationship among race, racism, and power" (p. 171).

***Culturally Relevant Pedagogy*:** A model for teaching which focuses on raising student achievement, encourages students to embrace and assert their cultural identity while evaluating their school, community, and life experiences through a critical lens, and affirms a social justice mindset with a commitment to challenging inequities (Ladson-Billings, 1995). Culturally relevant pedagogy and culturally responsive pedagogy are often used interchangeably as the latter emphasizes the teacher's commitment to reconcile her own cultural differences with those of students and the curriculum in a manner that validates learners and uses culture as the starting point of instruction (Emdin, 2011).

***Culturally responsive teaching practices*:** A commitment to employing instructional practices which place value on a student's home or community culture as well as the culture within the school (Ladson-Billings, 1995).

***Dual enrollment*:** The process by which high school students simultaneously take college level courses through partnerships with community or technical colleges or other post-secondary institutions (Hugo, 2001). The terms *dual enrollment* and *dual credit* are often used interchangeably as the latter refers to both the high school and college credit students earn for successful completion of the course (Ozmun, 2013).

***Enactive attainments*:** Noble (2011) described enactive attainments as the effects of past experiences on a person's self efficacy. These experiences may include academic successes, such as earning high grades in a class or failures, such as a poor score on a standardized test.

***First generation student:*** A student whose parents' highest level of educational attainment is a high school diploma or less (United States Department of Education, 2017).

***Leaky STEM pipeline***: Defined by Lyon, Jafri, and St. Louis (2012) as the "disproportionate exit from participation in STEM by minorities and girls throughout school and college, resulting in their underrepresentation in STEM careers" (p. 48).

***Marketplace value:*** The perceived worth of a school or school district based on the race of students who comprise its majority, its location, or its classification as "good" or "bad" based on accountability measures, such as the school's report card (Chapman & Donnor, 2015).

***Persistence***: An expression of self-efficacy which serves as motivation to continue when facing adversity (Lamb, Akmal, & Petrie, 2015). It can be measured by a student's choice to remain in a STEM course, even if challenged, and by a commitment to subsequent enrollment in STEM courses (Simon et al., 2015).

***Project Lead The Way (PLTW)*:** According to Project Lead The Way (2017), its purpose is to provide "transformative learning experiences for K-12 students and teachers…in an engaging, hands-on classroom environment" (para. 1). PLTW is a STEM-focused curriculum which emphasizes problem solving and critical thinking skills.

***Self-efficacy*:** A student's internal belief in his or her ability to succeed in learning or completing a specific task, evidenced by the student's actions and efforts (Lamb, Akmal, & Petrie, 2015; Lamb, Vallett, & Annetta, 2014; Bandura et al., 2001; Bandura, 1977). Self-efficacy in STEM is linked to a student's past academic performance and has

significant influence on future educational pursuits and outcomes, including selection of a college major and career (Simon et al., 2015).

***STEM***: The acronym used to represent science, technology, engineering, and mathematics. STEM is defined as "an approach to learning that removes the traditional barriers separating the four disciplines and integrates them into real-world, rigorous, relevant learning experiences for students" (Vasquez, 2014, p. 11).

***STEM disposition***: A student's overall attitude toward STEM coursework and careers. It includes a combination of factors including self-efficacy, perceptions, persistence, achievement, and resilience (Museus et al., 2011).

***Underrepresented students***: Members of racial and/or ethnic groups, namely African Americans, Latinos, and Native Americans, whose representation in STEM is less than their proportion in the United States' total population (Chen, 2013).

***Underserved students***: Persons who are from lower income families, often among the first in the family to attend college, and likely part of underrepresented racial and/or ethnic groups (Rendon, 2006).

# CHAPTER 2

# LITERATURE REVIEW

Chapter 2 summarizes a review of the literature regarding several factors which may contribute to African American students' STEM disposition. This chapter begins with an overview of the rationale for increasing STEM access and achievement among African American students in general and extends to position the identified problem of practice at CHS within the broader STEM dilemma. The process used to search the literature is also described. Next, historical perspective and the theoretical constructs which helped to situate the problem of practice are discussed. The chapter also details the advantages and shortcomings of dual enrollment programs and also critiques counseling programs which have been implemented to increase student participation in advanced coursework.

Improving STEM achievement for all students is a growing priority for educators (Jackson & Ash, 2012; Lee et al., 2014). However, the shifting racial and ethnic demographics within American public schools makes the achievement of African American, Latino, and other students from racially and ethnically diverse backgrounds a main concern (United States Department of Education, 2015). It is especially troubling when the achievement data illuminate significant participation and performance gaps across racial lines (National Center for Education Statistics, 2017).

In response to an identified problem of practice, this literature review focused on the plight of African Americans in STEM and the school based interventions that

may help to close participation and achievement gaps. The problem of practice for this action research study focused on low levels of STEM dual enrollment participation among African American students at Crosstown High School (CHS). These African American students' minimal STEM participation and achievement are reflective of the aforementioned national trends, thus confirming the National Center for Education Statistics' (2017) assertion that significant racial participation and achievement gaps in STEM exist. Within this literature review, the causes and effects of racial achievement gaps in STEM are examined through the following frameworks: Sociocultural, Critical Race, Culturally Relevant Pedagogy, and Self-Efficacy Theory. Collectively, these frameworks are useful for moving beyond research that explores STEM achievement gaps only in terms of African American students' deficits and more closely examines the systemic and pedagogical deficits that impede African American students' STEM development, engagement, and performance (Emdin, 2011). Additionally, this literature review evaluated the advantages and limitations of dual enrollment programs for increasing STEM access and disposition.

The literature review was organized from the perspective that one's past shapes the present; but, with appropriate interventions, the future is yet to be determined. Hence, this literature review begins with an analysis of connections between the historical oppression of African Americans and its influence on their educational opportunity (Charleston et al., 2014; McLaughlin, 2014; Robinson, 2013). Next, this literature review ties the effects of oppression to African American students' inability to gain and leverage social, cultural, and human capital to achieve in STEM (Strayhorn, 2013). These capital deficiencies call for interventions from educators who recognize the predicament of their

students and, as committed social justice advocates, respond with pedagogy to offset the negative effects of oppression (Freire, 2013). This anti-oppression pedagogy includes strategies which build STEM interest and self-efficacy, promote rigor and excellence with adequate support, avoid reinforcing negative stereotypes, and demonstrate the interconnectedness of achievement and socioeconomic progression (Melguizo & Wolniak, 2012). Thus, a school counseling program intervention which encourages dual enrollment participation was measured against this standard of anti-oppression pedagogy.

**Searching the Literature**

The researcher's strategy for searching the literature was guided by the nature of action research as described by Mertler (2014). An online search of the literature began through the University of South Carolina's Library Catalog and was eventually expanded to include Google Scholar. Through these search engines, the researcher entered phrases such as *African American STEM interest*, *African American STEM achievement*, *dual enrollment, and school counseling programs* and limited the results to books and peer-reviewed academic journal articles. Several studies, which focused on African American students' positive and negative expressions of STEM interest, factors influencing STEM achievement in K-12, and the levels of STEM participation in post-secondary institutions, were read.

Within these studies three significant themes emerged: (1) evidence that racial participation and achievement gaps in STEM exist; (2) support for a connection between historical racial oppression of African Americans and poor STEM outcomes; and (3) the potential for culturally responsive teaching practices as a means to improve STEM disposition. These themes also pointed to several theoretical constructs which may

explain the African American STEM participation and achievement dilemma. Therefore, the literature was further searched to identify studies which were conducted within these contexts. Once related studies were identified, the researcher inspected the methodologies which surfaced as most effective for the topic, frameworks, and participants in this study.

**Purpose of the Review**

Mertler (2014) described reviewing the related literature as a critical step in the planning stage of action research. Among its many benefits, a review of the literature is important for establishing a topic, tightening its focus, and developing a plan of study. Leedy and Ormrod (2005) presented additional benefits of a literature review, such as uncovering new ideas and points of view, identifying other researchers whose works may serve as a methodological template and add validity to your own, as well as uncovering useful tools to aid in one's research which may have been unfamiliar before initiating the research plan. When embarking upon an action research study, Mertler (2014) warned against unnecessarily reinventing the wheel.

These considerations were important for this study to ensure previous attempts to answer similar research questions were uncovered, theoretical perspectives and findings were considered, and a topic which would contribute to gaps in the knowledge while building upon the works of others was pursued. By searching the existing literature, the researcher hoped to grow in her comprehensive understanding of the problem so that she might emerge more capable of facilitating change (Dana & Yendol-Hoppey, 2014).

Through a careful search of the existing literature, the researcher found studies which addressed diverse factors that hinder African American students' participation and achievement in STEM as well as the theoretical constructs which may explain the current

situation. However, addressing the identified problem of practice called for identifying interventions which may offer hope for the specific concerns among CHS stakeholders regarding its African American students' STEM disposition. The materials selected for this literature review best address the nature of the problem and appropriate actions to address it. For the most part, the studies and other resources referenced in this literature review consider the participants' race, sociocultural influences, and other factors which may influence their STEM disposition.

**Historical Significance of Race in Education**

Restrictions create boundaries. These boundaries determine who gains access and if granted, the conditions and limits imposed upon this right of entry (Cornell & Hartmann, 2007). The *Brown v. Board of Education* (1954) decision marked a significant milestone in educational access for African Americans. Before *Brown*, all aspects of educational experiences and opportunity were governed by policies and practices which controlled, denied, or greatly restricted access for persons of color. These actions, even as far back as seventeenth century colonial America, served only to reinforce the idea of white supremacy, evidenced by the poor quality segregated schools to which African Americans in the northern United States were subjected (Daniel & Walker, 2014).

African Americans in the southern United States endured more than 400 years of little to no access to education and resources through slavery and other discriminatory policies including Black Codes, Jim Crow, and *separate but equal* laws (Daniel & Walker, 2014; Hunter, 2015). While slavery, the Black Codes, and Jim Crow restricted access to education for persons of color, it is equally significant what these policies did for Whites, especially in terms of educational advancement and economic opportunity.

As slavery and other forms of discrimination sought to reinforce inferior stereotypes of African Americans and deny them the ability to develop cognitively, Whites were able to enact policies which defined schooling experiences that helped them secure the best paying jobs, acquire land, build homes, grow their wealth, and send their children to college (Hunter, 2015).

Whereas *Brown* was a defining moment for education access, *Plessy v. Ferguson* (1896) set the stage for policies that not only legalized the racial divide in society and schools but also established unequal educational funding and limited educational opportunities as lawfully acceptable practices (Daniel & Walker, 2014; Hunter, 2015). The *Brown* decision dismantled the *separate but equal* doctrine, but the white supremacist mindsets which constructed and upheld these policies were the same ones that guided the massive resistance movements to obstruct school desegregation and continue to impact the educational opportunity among students of color in the present-day (Hunter, 2015).

For the most part, states enacted and enforced educational policy from the mid-nineteenth century until *Brown* and other federal influences in the 1950s and 1960s (Gross & Hill, 2016). The 1965 Elementary and Secondary Education Act (ESEA), as part of President Lyndon Johnson's War on Poverty connected America's history of racial discrimination and poverty to limited opportunity for students of color (Gross & Hill, 2016; Hunter, 2015). Among President Johnson's most notable observations about poverty was its "total entrapment of its victims from one generation to the next" which required his administration "to replace despair with opportunity" (Spring, 2014, p. 373). While *Brown* mandated equal access to educational opportunity, federal intervention

through ESEA was necessary to regulate the availability and allocation of resources to bring its promise to fruition. For example, Title I funding and Head Start programs provided resources for students, overwhelmingly poor and African American, who had been deprived of equal educational opportunity (Spring, 2014; T. Wright, 2011). Post-*Brown* and ESEA, federal influences in school funding have waned with states resuming more control over school financing and resource allocation (Gross & Hill, 2016; Nelson, Palonsky, & McCarthy, 2007).

The consequences of this shift have been harmful to African American students as significant disparities in school resources and facilities have emerged as barriers to equal educational opportunity (Hunter, 2015; Nelson et. al, 2007). For instance, reduced federal roles in school funding have caused states, and local districts within them, to use property taxes to supplement their operating budgets. Therefore, local property and business owners have increasingly gained control over school decisions—curriculum, personnel, and funding—which directly impact access and outcomes for its students (Nelson et al., 2007; Rector-Aranda, 2016).

**Theoretical Frameworks**

This section of Chapter 2 explores the literature on STEM disposition with respect to Sociocultural Theory. Within the realm of Sociocultural Theory, the principle of cultural compatibility is one lens through which the STEM achievement gap between African Americans and Whites may be analyzed (Whaley & Noel, 2012). Whaley and Noel (2012) expressed a strong correlation between African American students' sociocultural identities and their academic achievement. Therefore, the students' STEM attitudes may be affected by their perceptions about whether such pursuits are in line with

how they define being African American (Eglash, Gilbert, & Foster, 2013). Strayhorn (2013) presented an expanded view of Sociocultural Theory to include the influences of human, social, and cultural capital on African American students' academic and economic outcomes. Strayhorn described these forms of capital in the following manner:

- Human capital connects a student's pursuit of education and training to increase his chances for securing higher wage jobs and improving his financial standing.
- Social capital refers to personal relationships—family and other supportive persons—which help a student gain access to opportunities and resources that make achievement possible.
- Cultural capital draws correlations between a student's social class, acquired through parents and family members, and the student's beliefs.

When considering the historical effects of racism and oppression on African Americans' human, social, and cultural capital, Sociocultural Theory may provide valuable insight into students' poor STEM disposition (Charleston et al., 2014) and their reluctance to enroll in challenging coursework. It is within this context that the following review of the literature is presented.

**Sociocultural Barriers to STEM Participation.** Ferguson (2015) noted that racial achievement gaps are apparent by age two. These gaps are the result of a number of factors including students' early life experiences, their parents' educational attainment, and socioeconomic status (Ferguson, 2015; Morgan et al., 2016). Curran and Kellogg (2016) further emphasized the effects of the early onset of these gaps, as they and other researchers (Blank, 2013; Morgan et al., 2016; Quinn & Cooc, 2015) noted the tendency to focus only on STEM achievement gaps with older students, despite the fact that

significant deficits are identified much earlier. For example, both Curran and Kellogg (2016) and Quinn and Cooc (2015) referenced several studies using the Early Childhood Longitudinal Study (ECLS-K) which show that African American third graders' science achievement falls about one standard deviation below White third graders. What's more, this pattern holds steady through the end of the eighth grade (Curran & Kellogg, 2016; Morgan et al., 2016; Quinn & Cooc, 2015). The findings from the ECLS-K are significant because it is the only instrument which evaluated achievement among the same set of students over time and connects their science achievement to performance in other core areas such as reading and mathematics (Quinn & Cooc, 2015). Morgan, Farkas, Hillemeier, and Maczuga (2016) noted the significance of early childhood achievement to academic performance in later grades. Specifically, the researchers identified measures of general knowledge in kindergarten as the single most important predictor of how students fare in the first grade. Furthermore, Morgan and other researchers (2016) established the first grade performance as the basis for STEM achievement in grades three through eight.

Academic achievement is often tied to one's ability to access the human, social, and cultural capital resources which foster success (Strayhorn, 2013). African American students are victimized by several different factors which influence their access to equal education opportunity and achievement; thus they remain oppressed (McLaughlin, 2014; Settlage et al., 2015). The STEM achievement gap can therefore be described in terms of multiple capital deficits which reinforce African American students' oppressed status.

***Socioeconomic capital.*** Socioeconomics alone cannot explain the STEM participation and achievement gaps; however, the connection between White students'

higher socioeconomic status, educational attainment, and academic achievement indicate potentially important correlations (Curran & Kellogg, 2016; Morgan et al., 2016). Ferguson (2015) further explained that (1) "family resource disparities predict between one-half and two-thirds (occasionally more) of the total racial achievement gap in any study" (p. 6) and (2) achievement gaps are both the source and outcomes of these resource discrepancies. For instance, Quinn and Cooc (2015) reported that families from high socioeconomic backgrounds have more financial resources to have quality health care and to invest in stimulating learning materials and experiences which aid in their children's early cognitive development. In terms of STEM achievement, students with greater financial resources tend to have more opportunities to engage in informal science learning experiences very early in life, which often translates into a more positive view of science content (Morgan et al., 2016). Moreover, Bland (2014) identified significant correlations between students' socioeconomic status, their early exposure to quality STEM instruction, and their NAEP scores.

T. Wright (2011) also highlighted economic segregation as a significant issue in preschool education opportunities. Economic segregation is often closely associated with racial segregation which results in minimal diversity in schools from preschool and beyond. Several researchers (Chapman & Donnor, 2015; Hunter, 2015; T. Wright, 2011) have described benefits of racial and socioeconomic diversity in schools, which include broader access to resources, improved peer interactions, and higher levels of student achievement. Currently, school attendance zones act as socioeconomic and racial barriers for students of color. This is especially problematic when considering the impact of district and school report cards on the marketplace value of certain schools (Chapman &

Donnor, 2015; Stuart Wells, 2014). Essentially, school zones and report cards reinforce the advantages of students with privilege. The schools with higher percentages of racial minority enrollment are viewed as less desirable than those with mostly White students. Therefore, White parents use their wealth, privilege, and social capital to access more favorable schooling options (Chapman & Donnor, 2015).

***A gap in opportunity.*** Schools should provide equal opportunity to all students; however African Americans are often in academic settings which fail to live up to this responsibility (Robinson, 2013). Within these schools, the opportunity for engaging in high-quality and meaningful STEM learning is extremely limited (McLaughlin, 2014). Even in schools where the overall opportunities for learning are better, African American students continue to receive lower-quality and less rigorous instruction than White students (Quinn & Cooc, 2015).

African American students' low levels of STEM achievement in the early grades impact their opportunity to access related coursework in high school and college, as well as their future career options (Brown et al., 2015; Curran & Kellogg, 2016; Lewis & Connell, 2005). Smith, Trygstad, and Banilower (2016) reported that most high school science classes are organized by ability grouping and these assignments are based on students' prior achievement. Consequently, both actual and perceived ability influence placement decisions (Campbell, 2012; Koba, 1996, Morgan et al., 2016; Smith et al., 2016). When considering the most significant factors in placement decisions, the effects of standardized testing and teacher recommendations cannot be ignored. For instance, Lomax, West, Harmon, Viator, and Madaus (1995) explained the importance of math and science standardized test scores on placement decisions. With such a considerable

emphasis on math and science test results as a measure of readiness, it is unlikely that African American students will be placed in gifted and talented (GT) classes during the elementary years which prepare them for the more advanced courses later on (Thompson & Allen, 2012). Therefore, ability grouping greatly impacts African American students' opportunity to engage in higher-level STEM learning (Campbell, 2012; Koba, 1996; Smith, Trygstad, & Banilower, 2016).

The importance of early placement in GT programs for African American students is underscored by Lomax and others (1995), who reported that respectively, 50 and 52 percent of math and science educators in high- racial minority classrooms viewed results of state mandated tests as extremely important in GT placement decisions. Furthermore, Lomax et al. reported that teachers in classrooms with low numbers of minority students viewed these tests as less important in GT placement recommendations (46 percent for math and 33 percent for science). The consequences of teacher perceptions of ability should not be ignored since underrepresented minorities tend to be overrepresented in classes with low-achieving students (Smith et al., 2016).

Moody (2004) examined the impact of African American students' life stories on their mathematics learning experiences through a sociocultural framework. Moody's research sought to shed light on specific factors which shaped her participants' mathematics identities from grades 1–12 and into their undergraduate studies. Although Moody's study was small (two participants), her findings emphasized the negative effects of standardized testing and ability grouping on African American students' access to advanced courses. For example, Ashley (one of Moody's study participants) explained how her removal from an advanced mathematics class in the third grade was tied to a

poor placement test score. She further explained the traumatic effect of this experience, which caused her to fear taking a placement test for early access to Algebra 1 as an eighth grader.

***Deficits in interest.*** Lewis and Connell (2005) cautioned against the oversimplification of the STEM participation and achievement gaps by focusing exclusively on high school course enrollment as a precursor to related careers. The researchers' findings indicate that African American students in the advanced science and math courses in high schools overwhelmingly demonstrate prior interest in these subjects and are already considering science-related careers. Therefore, more emphasis is needed on engaging students in content-rich and appealing experiences early so this interest as well as the self-confidence needed to "do science" can be developed (Blank, 2013; Lewis & Connell, 2005). Ashford and other researchers (2016) evaluated the connections between expressed STEM interest and students' persistence in advanced high school coursework and careers. These researchers emphasized that early STEM interest is directly correlated to students' pursuit of and persistence in rigorous mathematics and science classes.

***Teachers are an important resource.*** While the current research is not able to fully explain all the causes and consequences of the STEM participation and achievement gaps, numerous researchers point to the unequal distribution of critical resources as a noteworthy contributor to the problem (Blank, 2013; Coats & Xu, 2013; Ferguson, 2015; McLaughlin, 2014; Morgan et al., 2016, Quinn & Cooc, 2015; Smith et al., 2016). The most critical of these resources are well-prepared teachers, access to the necessary materials, and solid instructional practices in a supportive learning setting as priorities

(Smith et al., 2016). One of the most significant of the aforementioned practices is quality instructional time.

In the elementary grades, Blank (2013) reported that average times spent on science instruction consistently declined from 1993-2008. During the 1993-1994 school year, teachers in grades one through four spent an average of 3.0 hours per week on science instruction. This average instructional time was only 2.3 hours in 1994. These values are as high as five times less than the averages for English instruction and approximately half of the time invested for mathematics instruction. While Blank (2013) noted achievement gains as a result of increased science instruction time, the researcher cautioned that this factor alone is not adequate for closing achievement gaps, especially when considering the effects of family background and low socioeconomic status and the fact that novice and less-prepared teachers (in terms of content knowledge and ability to effective reach culturally diverse audiences) are overly represented in urban and rural schools (McLaughlin, 2014; Smith et al., 2016).

Nevertheless, the research supports the assertion that teachers have the ability to effect change within their own classroom and schools (Ferguson, Phillips, Rowley & Friedlander, 2015; Quinn & Cooc, 2015). Smith et al. (2016) went further—declaring that "among the factors affecting students' science education experience, research suggests that teacher quality is prominent" (p. 4). Therefore, an effective teacher is often the most significant resource available for helping to bridge achievement gaps (Settlage et al., 2015). In order to effect change, teachers—especially those who work in urban, high racial minority, or underperforming schools—need the resources and support to implement effective teaching practices and raise student achievement (McLaughlin,

2014). For STEM instruction, these resources include adequate laboratory equipment, curriculum materials, content-area professional development, and a supportive school level organization and structure (Settlage et al., 2015).

Many sociocultural factors can be linked to African American students' STEM disposition. In the next section, the STEM predicament will be evaluated through the lens of Self-Efficacy Theory.

**Self-Efficacy Theory.** Self-efficacy theory is the relationship between a person's beliefs about her ability to accomplish a task, especially when facing adversity, and her response to the challenge (Cassidy, 2015). Bandura (1977) hypothesized that efficacy expectations determine if and to what degree a person will put in the effort required to achieve specific outcomes. Therefore, Bandura connected self-efficacy to persistence and ultimately, achievement. Bandura defined an efficacy expectation as, "the conviction that one can successfully execute the behavior required to produce the outcome" (p. 193). Bandura intentionally distinguished efficacy expectations from outcome expectancy—belief that a certain behavior produces specific outcome—to call attention to the role of conviction and persistence in both pursuing and persevering to accomplish a goal. Therefore, efficacy expectations are a significant determinant of human behavior in terms of the choices a person makes and how much energy he or she expends to follow through on actions linked to those choices.

Ashford et al. (2016) examined the patterns of enrollment and persistence in rigorous mathematics and science courses among high school students in Florida. Although the study participants expressed STEM interest upon exiting middle school and enrolled in challenging courses as part of STEM-focused career academies, the

participants did not necessarily persevere through the coursework and into related careers. These findings raised concerns among the researchers about the actual experiences of students enrolled in these classes and their lower rates of persistence, especially among African American and Hispanic students.

***Implications for African Americans in STEM.*** Bandura et al. (2001) explored the potential impact of various factors on children's career aspirations and the paths they pursue. Among the factors studied were parental influences, familial socioeconomic status, actual academic achievement, and student's perceived self-efficacy. Of all aspects explored, the child's perceived academic self-efficacy was the most significant determinant of the student's career choice. As part of the methodology, Bandura et al. (2001) studied 272 middle school students' self-efficacy toward several specific career categories, including medical-oriented professions, agriculture, business pursuits, and architecture and design. The study participants responded to a number of different assessments including one which contained 37 items related to academic self-efficacy and another which contained 69 different items designed to evaluate perceived occupational self-efficacy. The data collected from the academic self-efficacy measures were tied to how the participants rated the likelihood that they would put forth the effort to pursue each of the career paths presented. The participants were then reassessed a year later using a 3-point scale to declare that they would, might, or would not consider each of the 69 options as career choices. The researchers established a direct correlation between the student's self-efficacy toward academic content related to certain professions and their willingness to pursue them. For instance, students who expressed high efficacy levels in scientific and technical areas were attracted to careers in architecture, design,

and professorships. Likewise, Bandura et al. (2001) observed that students with low levels of perceived self-efficacy toward specific academic content were unlikely to pursue related careers. These findings support Bandura's (1977) emphasis on the impact of efficacy expectations tied to performance accomplishments.

Lamb, Vallett, and Annetta (2014) noted the evidence which supports the connection between self-efficacy and students' STEM career pursuits. However, the researchers also stated that inappropriate measures of STEM self-efficacy may restrict educators' ability to make appropriate interventions while the opportunity to change their self-perceptions still exist. Therefore, the researchers developed an instrument with the specific intention of measuring STEM self-efficacy. As they contemplated an appropriate approach, the researchers perused the literature to evaluate existing measures of STEM self-efficacy. One instrument, the Self-Efficacy in Technology and Science (SETS) survey served as a guide for their work, but they expressed the need for a more succinct survey that would be both efficient and reliable. Using a sample of 651 students in grades 5–12, the researchers presented science content in a video game format to validate specific items for their Self-Efficacy in Technology and Science Short Form (SETS-SF).

Through their approach, Lamb et al. (2014) identified 16 items which effectively represented the "processing effects seen in science education within a technology-integrated learning experience" (p. 646). These processing effects include science reasoning, computer skills, and self-efficacy in science and technology. The researchers concluded that self-efficacy is set early in life, which reinforces Bandura et al. (2001) observations. However, Lamb et al. (2014) also determined that the SETS-SF may be a promising intervention for improving self-efficacy. Furthermore, self-efficacy is at least

in part domain specific, with some carryover toward related tasks. Therefore, students who demonstrate high levels of self-efficacy in scientific reasoning tend to exhibit high levels of expectancy in that area, but may also apply their higher self-efficacy to accomplishing associated general science processes and activities. This finding is expected based on Bandura's (1977) explanation of the transferability of efficacy gains, which refers to a learner's ability to apply increased self-efficacy in one area or task to a similar field of study.

For African American youth, academic self-efficacy is linked to two factors: (1) whether they personally value achieving a specific goal; and (2) if they are able to see how achieving the goal can positively impact their future (Jonson-Reid et al., 2005). Therefore, a student who is able to identify a direct benefit of a high school diploma or college degree will likely put in the effort to acquire one. But in order to persist toward the goal, the student must believe she can achieve it. Bandura et al. (2001) emphasized the role of direct experiences in a shaping student's academic self-efficacy, which is particularly important to African American students (Jonson-Reid et al., 2005; Lamb, Akmal, & Petrie, 2015). Negative experiences, such as struggling to understand specific academic content and achieving little to no success in spite of studying, chip away at children's self-efficacy and discourage their persistence (Jacobson, 2013). In the same manner, positive experiences build the student's self belief and encourage her persistence (Bandura, 1977). When considering the impact of negative learning experiences on persistence, Jacobson (2013) emphasized the urgent need to "retrain young minds to believe in effort, persevere, develop resilience, and attain high levels of achievement" (p. 41). Cassidy (2015) went even further and directly connected self-efficacy to a student's

academic buoyancy—the ability to overcome day-to-day challenges and demonstrate resilience, even when experiencing setbacks.

Dewey (1938) discussed the impact of mis-educative experiences on students' future experiences. Many students' lack of self-efficacy and persistence is directly tied to mis-educative experiences, such as an instructional method not aligned with the students' learning style, or interpreting the subject matter as boring or irrelevant based on how the material is presented. In Dewey's discussion of the principle of continuity, he explored the effects of spoiling a child to present and future experiences. Among these effects is being rendered "averse to and comparatively incompetent in situations which require effort and perseverance in overcoming obstacles" (p. 37).

The research suggests a broad number of factors influence African American students' internal beliefs about ability and persistence in STEM. As a result of in-depth interviews conducted with six African American STEM majors to better understand the variables which influenced their STEM disposition, Palmer, Maramba, and Dancy (2011) emphasized the influence of peer group support and solid academic preparation throughout elementary, middle, and high school on the students' self-efficacy and persistence. The researchers also explained the value of peer support (in the form of peer interest), but concluded that the student's intrinsic STEM interest is most important to his self-efficacy and persistence over time. The positive impact of peer interest is supported by Lyon, Jafri, and St. Louis (2012) as they observed a direct correlation between students' long term participation in a STEM focused group and their persistence through high school and into college. These results may be linked to social persuasion, which Bandura (1977) expressed as a factor in building efficacy expectations by verbal

persuasion first, and subsequently, by performance modeling. Lyon and other researchers surveyed and interviewed participants in Project Exploration, a Chicago-based after school program designed to increase STEM access to underrepresented and underserved students. The researchers noted that Project Exploration's key tenets – equity, relationships, student-centered engagement, access to content experts, and meaningful work – fostered authentic relationships between caring adults and the participants and among peers.

Early curriculum engagement and family involvement are important for building initial STEM interest and self-efficacy among younger children, which may wane as students enter high school (Lamb, Akmal, and Petrie's, 2015). Although, Lyon, Jafri, and St. Louis (2012) did not investigate direct family influences on STEM persistence, the researchers did report that a purposefully structured approach—comprised of students, teachers, and scientists—created "meaningful engagement in a community of practice that nurtured relationships while helping them learn from one another, envision careers in science, and conceptualize their futures" (p. 50). This observation is supported by Jonson-Reid et al. (2005), as they described how encouragement and having models of success positively influence self-efficacy and persistence and Bandura (1977) who tied vicarious experiences to improvements in efficacy expectations. Furthermore, Lamb et al. (2014) concluded the effective measurement and tracking of students' STEM self-efficacy is a useful tool for developing appropriate interventions and leading "more students to choose STEM careers and assist them in positive achievement outcomes" (p. 655).

***Mathematics is important.*** African American students often have a poor STEM identity based on negative messaging from persons within their communities and schools about their mathematics ability (McGee, 2015). For many African Americans, mathematics self-efficacy is linked to their performance on standardized testing, as students associate poor test performance with a reduced self-perception of academic competence (Larnell, Boston, & Bragelman, 2014; Moody, 2004; Pershey, 2011). Thus, these students are likely to exhibit low levels of self-efficacy toward STEM classes (Linnenbrink & Pintrich, 2003). It is important to preemptively manage these stereotypes by (1) using naysayers as motivation to persist through the challenge and (2) highlighting the resilience of other African American students in similar settings (Larnell et al., 2014).

Noble (2011) reinforced the importance of these vicarious experiences on developing mathematics self-efficacy among African American students, especially males. In addition to self-efficacy theory, Noble grounded his study in culturally appropriate methods with a significant emphasis on qualitative approaches including autobiographies and individual interviews. The participants were all African American males who attended historically black colleges and universities (HBCUs) and had a history of mathematics success. With his study participants, Noble reported a significant increase in persistence toward higher level math classes once self-efficacy in lower level courses was established. Specifically, with respect to African American males' mathematics sell-efficacy, Noble's findings contradict Bandura's (1977) proposal that enactive attainment (rather than vicarious experiences), is most influential on self-efficacy. Of important note, Miller and Benbow (as cited by Peterson et al., 2015) reported a direct correlation between students' intentions to pursue STEM related post-

secondary studies and three factors: (1) math performance in twelfth grade, (2) exposure to math and science courses in high school, and (3) math self-efficacy attitudes.

**Dual Enrollment: A Pathway to Early College Access**

Students have several options for earning college credits while still in high school (Hoffman et al., 2009). One of these options is the early college high school, where students earn an associate's degree and high school diploma simultaneously. Other choices are credit by examination courses, such as advanced placement (AP) and dual enrollment partnerships (Woodcock & Olson Beal, 2013). Out of the early college model, dual enrollment has emerged as an option for students who are not participating in a structured program leading to an associate's degree (Karp, 2012). Several states struggling to remain competitive in terms of student achievement have begun to embrace the ideas of early college and dual enrollment as pathways for increasing college and career readiness for at-risk students (Howley et al., 2013).

Among underrepresented populations, dual enrollment is especially beneficial for preparing students for college level coursework as well as the college admissions process (Hugo, 2001). These programs have also been shown to have greater positive effects on students from lower income and less educated families (Hoffman et al., 2009). Dual enrollment participation has several positive effects including increases in motivation, confidence, persistence, college-readiness, and achievement (An, 2015). Fischetti, Mackain, and Smith (2011) also reported their study participants expressed higher levels of both social and academic readiness for college. Furthermore, Karp (2012) identified that dual enrollment participants demonstrated positive shifts in their perceptions regarding what it means to be a college student. For example, study participants

understood the "need to take greater ownership of their learning and seek help, as well as describe concrete strategies for academic success" (p. 103).

Ozmun (2013) conducted a study among rural high school students in Texas which sought to identify if any connections exist between students' college and academic self-efficacy and their participation in dual-credit courses. Ozmun's participants, 114 juniors and seniors, represented eight area high schools. Most of the study participants (88.6 percent) were White and an overwhelming majority (73.7 percent) stated their self-motivation was the most significant factor to enroll in the courses. Thus Ozmun identified a student's internal motivation as a noteworthy variable in his decision to enroll in dual credit courses. Despite high levels of motivation and a history of academic success, the study participants did not exhibit comparable levels of academic and college self-efficacy upon enrolling in the dual credit classes. Ozmun's findings point to the dual credit program structure itself as a factor in building academic self-efficacy. Therefore, students who have been lower-performing or traditionally underserved are likely to benefit from dual-credit participation (Ozmun, 2013).

In a different study, Kanny (2015) evaluated the experiences of five, low SES Latino students enrolled in a Los Angeles charter school. The study participants were all high school juniors with unweighted grade points averages of 3.0 or better. In this qualitative study, the researcher relied on semistructured interviews to explore the distinctive aspects of each participant's journey in the dual enrollment courses. Kanny identified three major benefits of dual enrollment participation: (1) being exposed to a college environment, (2) understanding the hidden curriculum, and (3) developing a sense of independence.

**Mixed reviews.** Not all student experiences in dual enrollment programs are positive. In terms of academic preparation for college, some studies confirm Zalaznick's (2015) findings regarding the ease of transition, but others indicate that students are ill-prepared for college level coursework. For example, Ongaga (2010) stated that study participants reported feeling underprepared and that their courses were not representative of college level rigor. This latter point is a common criticism of dual enrollment programs, which Woodcock and Olson Beal (2013) explained, may be due to students' lack of social and academic maturity. The mixed reviews of dual enrollment programs may also be due to the various settings in which they occur. Some programs bring students onto college campuses for their classes, while others send college instructors to the students' high school (Lukes, 2014). Kanny's (2015) study also revealed some drawbacks of dual enrollment, which included lower high school GPAs among participants who struggled with the increased rigor, concerns with transferability of earned credits to other post-secondary institutions, and limited academic support. The research into the specific benefits and shortcomings of dual enrollment for increasing African American students' STEM disposition is limited. Thus this action research study may fill important gaps in the knowledge.

**School Counseling Programs**

Despite its complexities, culture is an important component of African American students' learning experiences which should not be delegitimized or deemed insignificant (Ladson-Billings, 2000). Instead, effective educators must embrace the uniqueness of African American culture as a useful tool to improve these students' achievement (Ladson-Billings, 2000). This means educators must understand how issues of poverty,

oppression, social injustice, and inequality impact learning and achievement (McLaughlin, 2014). In so doing, educators are better equipped to engage in culturally relevant pedagogy, which creates synergy between a student's home and school cultures (Barton & Tobin, 2001; Ladson-Billings, 1995) and supports targeted teaching and learning strategies to improve achievement (ACT, 2012) with better awareness of entrenched oppression and its impact of students' educational outcomes (Wallace & Brand, 2012).

Ladson-Billings (1995) explained that culturally relevant pedagogy "addresses student achievement…and helps students to accept and affirm their cultural identity while developing critical perspectives that challenge inequities that schools (and other institutions) perpetuate" (p. 469). Within the framework of culturally relevant pedagogy, teachers must hold students to high standards with expectations that they can and will achieve (Howard, 2014; Ladson-Billings, 2000).

School counselors are uniquely positioned to use culturally responsive approaches to create interventions that improve student achievement while helping students to realize their academic and career potential (Camizzi et al., 2009). Medvide and Blustein (2010) conducted qualitative research to determine the impact of career planning, self knowledge and motivation on urban minority students' dual enrollment participation. The researchers noted their study's value for understanding how the participants, who were mostly African American, benefitted from specific educational and career planning interventions. For example, the 12 study participants were recruited to participate in a dual enrollment program and supported by peers and other adults to connect their dual enrollment program participation and success to future career aspirations. Among their

findings, Medvide and Blustein observed increases in participants' internal (33 percent) and external (42 percent) motivation as well as their levels of self-knowledge (58 percent). Furthermore, the researchers identified connections between the participants' improved qualities of self-awareness and self-reflection and their desire to achieve career goals.

Wallace and Brand (2012) evaluated the impact of educators' backgrounds, beliefs, and practices with respect to Critical Race Theory and culturally responsive practices. The researchers identified a direct correlation between the teacher's level of sociocultural awareness, their beliefs, and practices. For example, the teachers understood the social implications of race on the educational experiences of African American students. This awareness informed their understanding of the students' needs and behaviors and the teachers responded with appropriate instructional practices. Therefore, Camizzi et al.'s (2009) targeted approach to identify low-income students with demonstrated college potential (GPA above 2.75) and purposefully expose them to a more rigorous curriculum was a culturally responsive approach to improving their life chances.

Using Critical Race Theory as their framework, Solorzano and Ornelas (2004) examined the inequitable access to AP courses among Hispanic and African American students as compared to White and Asian students in California public schools. Their study confirmed the significant disadvantages, in terms of college preparation and admissions, for students of color. Furthermore, Solorzano and Ornelas stressed that the AP dilemma is only one representation of educational inequities facing underrepresented

students and proposed several suggestions to establish a college-going culture within K-12 schools. These suggestions include:

- A school culture which supports all students toward college regardless of race or socioeconomic background
- Access to rigorous coursework for all students
- Qualified teachers for all students
- Building a sense of community among parents and students around advanced study

Many research studies which focus on increasing African American student participation in rigorous coursework are based on AP classes rather than dual enrollment programs. Within these studies, several researchers reiterate the importance of methodologies which reflect Solorzano and Ornelas' (2004) aforesaid proposals. For instance, Davis, Davis, and Mobley (2013) created a counseling program to increase African American students' participation and achievement in an AP Psychology class. The researchers noted that participants must be identified through collaborative efforts among stakeholders (school counselors, teachers, and others), recruited to participate, and supported to ensure their persistence and success. Other researchers also endorse this approach (Camizzi et al., 2009; Lukes, 2014; Medvide & Blustein, 2010; Ohrt, Lambie, & Ieva, 2009). Ohrt, Lambie, and Ieva (2009) summarized the best practices for instituting a school counseling program to increase participation in rigorous courses through the following steps:

- Collaborative review of data and trends to establish under participation

- Targeted selection of student participants based on expressed interest or demonstrated potential to succeed
- Informative group sessions to explain program structure, expectations, and benefits of participating
- Program delivery which includes support services through role models, mentoring, parent engagement, group counseling about study skills, self-advocacy, and goal setting, and vicarious experiences of students who have succeeded in advanced coursework.

Davis et al. (2013) conducted their study after collaborating with several stakeholders to assess the problem and devising a plan to address it. The researchers identified and recruited 35 potential candidates based on their GPAs, prior standardized test performance, teacher recommendations, and other academic information contained within their school counseling record. All of these participants were African American. Their program structure included an orientation session held over a two-week period in the summer, which emphasized relationship building in a community of supportive adults. Therefore, the cohort of students entered the AP Psychology class with trusted peers (Davis et al., 2013). When focusing specifically on increased STEM participation among African Americans in middle and high schools, B. L. Wright (2011) also praised the targeted recruitment strategy and further emphasized the value of workshops which build a sense of community among participants and help them to connect their racial identity to their "rich history of African Americans from STEM present and past" (p. 8).

A review of literature indicates notable value to culturally appropriate research methods, especially when both the researcher and participants are African American

(Noble, 2011; Tillman, 2002). The primary characteristics of culturally appropriate research are (1) techniques, such as interviews and participant observations, which shed light on the African American experience; (2) efforts to understand unequal power structures; (3) culturally cognizant data collection and analysis; (4) African American focused theories and practices, and (5) experiences of African Americans in their own words (Noble, 2011).

The research overwhelmingly supports qualitative methods, especially interviews, for studies designed to better understand African American students' STEM disposition. Strayhorn (2015) noted that well-constructed interview questions help students' recollection of pivotal experiences in their academic lives, a point supported by Jacobson's (2013) use of direct questioning to clearly understand students' beliefs and mindsets and Woodcock and Olson Beal's (2013) use of narrative inquiry to allow students to tell their own story. Noble (2011) echoed these viewpoints as he noted the positive effects of interviews in understanding African American male students' "feelings toward and approaches to education" (p. 194).

**Conclusion**

A review of the literature established that African American students are underrepresented and underperforming in STEM (Charleston et al., 2014; Peters Burton et al., 2014; Rogers Chapman, 2014). The reasons for this underrepresentation are extensive and include sociocultural factors, historical oppression, and racism. Nevertheless, the consequences of these factors are best described by Ireland's (2016), emphasis on the quality of education one receives and his ability to negate the effects of all sorts of inequities. Many African American students fall into the category of those for

whom a top-flight education remains elusive. And, when considering the promise of STEM achievement for bridging socioeconomic and opportunity gaps, African American students must gain access to the same quality of education available to their more affluent peers. McLaughlin (2014) referenced Freire (2013) as she described pedagogies that inhibit students from fully participating in STEM as oppressive. Therefore, African American students, who have been subjected to failing and underfunded schools, ill-prepared and biased teachers, limited opportunities for meaningful learning, deculturalization, racism, and other sociocultural barriers to achievement, are in fact, oppressed.

Through this action research study, the participant researcher employed evidence-based, qualitative research methodologies to evaluate the potential of a counseling program to serve as one step toward an anti-oppression pedagogy for African American students in the CSD community. Again, a review of the literature supported qualitative methods, especially interviews, as a best practice and culturally responsive technique for engaging African American students in the telling of their own stories (Strayhorn, 2013). Furthermore, the efforts of several researchers (Camizzi et al., 2009; Davis et al., 2013; Medvide & Blustein, 2010) support school counseling programs implemented in collaboration with other stakeholders as an appropriate intervention for improving access and academic outcomes in rigorous classes for racial minorities. These practices are evident in the research methodology for this study, which is addressed in more detail in Chapter 3.

# CHAPTER 3

# METHODOLOGY

Chapter 3 describes the research methods that were used to explore the effects of a counseling program on African American students' attitudes about participating in math and science dual enrollment courses at Crosstown High School (CHS). This chapter begins with a description of the action research study followed by the rationale for employing the selected research methods to explore the identified problem of practice. The chapter also includes a discussion of the participant-researcher's role in this qualitative study. The research context, which includes background information about CHS, the study participants, and the dual enrollment partnership, is also described. Finally, Chapter 3 details the research plan and specific procedures that structured the counseling program, guided the recruitment of study participants, and determined how data were collected and analyzed.

## Dual Enrollment Partnerships

Dual enrollment programs enable students to access college-level coursework in the safety and familiarity of a high school setting (Hugo, 2001). The classes are also promising for bridging STEM participation and achievement gaps and strengthening the high school to college STEM pipeline (Lukes, 2014). Dual enrollment programs are established and maintained through partnerships between school districts and post-secondary institutions. Therefore, many stakeholders, including building level administrators, representatives of the technical colleges and universities, school

counselors, career development facilitators, and students, work collaboratively to ensure the success and sustainability of dual enrollment partnerships (Lukes, 2014). The perspectives of these stakeholders are critical to understanding the nature of the partnership and any interventions designed to improve the structure and outcomes of the dual enrollment program.

School counselors are distinctively positioned (1) to access achievement data and use it to inform students about opportunities during and after high school; (2) to advocate for educational equity on behalf of socioeconomically disadvantaged students; and (3) to design and implement strategic and appropriate interventions in collaboration with other stakeholders (Camizzi et al., 2009). Furthermore, programs created to increase student participation in advanced coursework have greater chances for success when school counselors work in partnership with other educators (Davis et al., 2013). Therefore, the participant-researcher partnered with the CHS counseling department, the CHS technical college representative, and other CHS stakeholders to create and implement the research plan, collect and analyze data, and use findings from this study to propose recommendations to create a durable dual enrollment program for the CSD community.

**Rationale for qualitative action research methodology.** In this action research study, student perspectives were significant; thus qualitative methods were most appropriate for interacting with the participants and gathering information which revealed their views about the counseling program intervention, dual enrollment courses, and their overall STEM disposition. Medvide and Blustein (2010) stated that qualitative methods are particularly suitable for exploring the educational and career plans of racial minorities participating in a dual enrollment program. They further emphasized that qualitative

methods create a platform for the researcher to ask open-ended questions which encourage study participants to share their experiences in their own words, while also providing the researcher with a "means of assessing both the frequency and meaning of students' responses" (p. 544).

Qualitative methods are especially fitting for studies focused on increasing African American students' participation in STEM (Noble, 2011; Strayhorn, 2015) as they create opportunities for students to tell their own stories. When considering this effect, qualitative methods present African American students' attitudes and achievement in STEM in a culturally appropriate manner, rather than the deficit perspectives which rely on quantitative measures to frame the achievement gap without input from the students who are most affected by it (Welton & Martinez, 2014).

**Role of the participant-researcher.** When considering the role of action researchers, Marti (2008) explained that as integral and invested contributors in the study, the researcher's position is an important consideration. Through this present study, my role is that of a participant-researcher, an "insider collaborating with other insiders" (p. 5). This insider status in the CHS community is based on serving as a frequent guest STEM instructor to students, providing curriculum professional development for its teachers, and by engaging in STEM outreach and support at several CSD schools. These roles have allowed the participant-researcher to establish deep levels of trust and solid relationships in the community, which are critical to effectively engaging in participant research (Mertler, 2014). Additionally, Marti (2008) addressed these two major benefits associated with a researcher establishing trust while operating as an insider working alongside other insiders:

1. Being uniquely positioned to balance appropriate levels of observing and distancing; and,
2. Having the ability to manage potential power struggles and conflicts that may arise within the research setting and among community members.

**Action Research Validity**

Zeichner (1993) discussed the increasing acceptance of action research as a powerful tool for informing and improving educational practices, while also cautioning against its over glorification. At the heart of Zeichner's warning is the implication that action research should be undertaken to address real problems in classrooms or schools with the intention of arriving at and implementing solutions that are supported by the data. The data ascertained from this action research study have been used to address the low levels of African American student participation in dual enrollment courses and to develop a practical plan which reflects the unique needs of the CHS community.

Hine and Lavery (2014) underscored a number of criticisms of action research, such as (1) the possible conflict of teachers functioning as instructors and researchers simultaneously and consequently, negatively impacting the quality of instruction; (2) challenges of remaining objective in both data collection and analysis; and (3) managing any influences based on preconceived ideas about study participants and the answer to the research question. However, several researchers have established the importance of developing a solid research plan and remaining committed to reflection as effective means for reducing these potential threats to validity (Dana & Yendol-Hoppey, 2014; Hine & Lavery, 2014; Mertler, 2014). Action research, as a participatory and reflective process, is valid because it is centered on a critical examination of one's own practices

with the specific intention to arrive at a solution to a clearly articulated problem of practice.

**Research Context**

This action research study took place at Crosstown High School (CHS). CHS is a rural high school located in the Midlands region of South Carolina. The school's racial and socioeconomic composition, the established dual enrollment and STEM Early College programs (ECP), and the Crosstown School District's (CSD) status as an outreach partner to the participant-researcher's primary employer, the Premier STEM School (PSS) (pseudonym) were all factors in the purposeful selection of the research site.

CSD serves 2,798 students in five elementary schools, one middle school, and one high school (South Carolina Department of Education, 2016). This data represents a 4.6 percent decline in the CSD population from the previous year (South Carolina Department of Education, 2015). Within the CSD, the student population is 89 percent African American, 8 percent White, and 3 percent Other, which includes Asian and Hispanic students. In a March 2016 presentation to the local rotary, the CSD Superintendent shared that 94.6 percent of its 2,932 students qualified for free or reduced lunch. The CSD graduation rate has improved significantly under the current leadership, progressing from 76.6 percent in 2012 to its current level of 89.2 percent. Despite a relatively strong graduation rate, only 52.3 percent of CSD students (compared to 70.7 percent statewide) enrolled in post-secondary studies in the fall immediately following their graduation year (South Carolina Department of Education, 2016). Nevertheless, this is a noteworthy improvement over the previous year, in which 37.2 percent of students

began post-secondary studies after completing high school (South Carolina Department of Education, 2015).

The CHS population is comprised of 813 students: 90 percent African American, 8 percent White, and 2 percent Other, including Asians and Hispanics. The school's poverty index is 77.1 percent, a notable decrease from 86.7 percent in 2015 (South Carolina Department of Education, 2016). Over the past four years, the CHS has steadily increased the diversity of curriculum options available to its students, including numerous career and technical education (CATE), arts and foreign language classes, as well as eight dual enrollment, and seven AP courses. In 2015, fifty-three (6.5 percent) of the CHS students participated in dual enrollment classes, while 125 (15.4 percent) were enrolled in AP classes. The success rate among dual enrollment participants was 100 percent as compared to 12.7 percent for students in AP courses (South Carolina Department of Education, 2015). In 2016, 73 students (8.9 percent) participated in dual enrollment classes compared to 148 (18.2 percent) who took AP classes. Ninety-eight percent of the dual enrollment students were successful in their classes, while too few AP students took exams for sufficient data to be reported (South Carolina Department of Education, 2016).

**Study participants.** Dual enrollment courses are open to students across grade levels so long as they meet the technical college admissions requirements. This study targeted African American tenth graders who have been identified as promising dual enrollment candidates by the CHS Guidance Director and the Career Development Facilitator. While structuring an action research study to increase African American students' participation in an AP Psychology class, Davis and other researchers (2013) noted the importance of collaborating with school counselors to identify and recruit study

participants, as these stakeholders are often the gatekeepers to accessing advanced classes and college-level programs. Therefore, the participant-researcher used a comparable approach to identify potential study participants, recruit them to participate in the counseling program, and incorporate scaffolding for their success in the program. The selection criteria used to identify study participants are described below:

- Current 10th grader
- African American
- Expressed STEM interest on the Individual Graduation Plan (IGP)
- Successful completion of Algebra 1 with a grade of "B" or better and an End of Course (EOC) test score at or above the 80th percentile
- Overall grade point average of 3.0 or better

Using the aforementioned criteria, the CHS Guidance Director (with input from the Career Development Facilitator) and the researcher identified 10 potential study participants. Of these prospective study participants, nine students agreed to take part in the research study. Each study participant was assigned a pseudonym. There were six male and 3 female participants. At the outset of the study, one male participant was 16 years old. The remaining participants were 15 years old. A brief profile of each study participant is provided in below.

***Amanda***. Amanda is a lively 15-year old female. She is quite talkative and is usually among the first to share her thoughts and feelings. Amanda is the only child of divorced parents. She lives with her mother and has close relationships with her maternal grandparents. Her mother is a college graduate, a small business owner, and she has spent time in the military. Because of her mother's military service, Amanda has lived and

attended schools outside of the CSD. Amanda's close ties to her grandparents are partly due to living with them while her mother was actively deployed on overseas military assignments. While Amanda is interested in math and science, she is passionate about marching band. In fact, Amanda hopes to attend a historically Black college or university on a marching band/academic scholarship.

***Brian***. Brian is a bright but reserved 15-year old male. He is the elder of two children and lives with his mother and father. He and his family have resided in the CSD his entire life. Brian's mother is a college graduate but his father, a small business owner, did not attend college. Despite earning a college degree, Brian's mother is currently unemployed. Brian is a stellar student and he is determined to become a forensic scientist. His career interest has been inspired by African American characters on television shows that incorporate principles of forensic science to solve crimes. He expects to attend a four-year college in South Carolina and plans to earn an advanced STEM degree.

***Jada.*** Jada is an outspoken 15-year old female. She and her younger brother live with her mother. Jada's mother is a successful certified nurse practitioner and her family has long ties to the local community. The family enjoys traveling together and they vacation frequently. Jada has attended CSD schools her entire life and she has always been a good student. Jada expects to follow in her mother's footsteps and become a nurse practitioner, but she is also interested cosmetology and accounting.

***Jalen***. Jalen is a soft-spoken 15-year old male. He is one of three children and lives with his mother. Jalen has only attended schools within the CSD. His mother is also a product of the local school district. While Jalen's mother attended college, she did not graduate. Jalen takes pride in being an excellent student with a particular interest in

mathematics. He is determined to earn a college degree. Jalen self-identifies as a "tinkerer" and he plans to become a computer engineer.

***Kimberly***. Kimberly is a quiet 15-year old female but when she speaks up her comments are laced with humor and sarcasm. She is an only child and lives with her mother. Her mother works at a local grocery store. Kimberly's family has deep roots in the CSD community. At times, Kimberly has struggled with her math and science classes but her solid work ethic has enabled her to persevere through challenges. A first generation college student, Kimberly plans to pursue a nursing career.

***Michael***. Michael is a self-assured and talkative 15-year old male. He is one of three children. He has two sisters: one older and the other younger. Michael lives with his mother and is a lifelong resident of the CSD. His mother attended college but did not complete her studies. Michael has always been an excellent student and he is determined to become an engineer. Michael has thought deeply about the implications of his academic choices and he expects to reap the benefits of this preparation. Michael is also actively engaged in the CHS athletic program as a member of the basketball and track teams.

***Quincy***. Quincy is a polite and inquisitive 16-year old male. He has several siblings who live with different family members. Quincy spends time with his mother but mostly considers his maternal grandmother's home his primary place of residence. Admittedly Quincy's home situation is "unstable." Quincy has no relationship with his father. His mother attended high school but did not graduate. She is currently unemployed. Although Quincy has experienced difficulties in his courses at times, he has maintained a solid academic record. Quincy is unsure if he will be financially able to

attend college but he would like to pursue a career that involves computers and technology.

***Roger***. On the surface, Roger appears somewhat immature. However, this 15-year male old uses comedy to mask his introversion. Roger lives between his mother's and father's homes, but he spends more time with his father. Both of Roger's parents are native to the CSD area. Roger's father is married and has a preschool-age child with his new wife. Neither of Roger's parents has attended nor graduated from college but both of his parents are employed. Roger has maintained good grades throughout his schooling but he has not always worked hard in his classes. Roger is interested in electronics, technology, and computers. He is considering attending college but his plans are uncertain.

***Steven***. Steven is a kind but reticent 15-year old male. He speaks softly and is extremely self-conscious. He hardly ever makes eye contact with the person to whom he is speaking. Steven and his younger sister live with their mother, who works at a local hospital. The family has lived in the CSD his entire life. In spite of his self-described "laziness" Steven has maintained very good grades, especially in math and science. Steven would be the first in his family to attend college. He is interested in studying computers and possibly engineering, but he is unsure of his exact career plans. Steven is an avid player of video games and he loves muscle cars.

## Design of the Study

Mertler (2014) presented several models of action research. While there is variation among these models, all contain common elements based on the cyclical nature of action research with dedicated stages for planning, acting, developing, and reflecting. This study employed this four-stage procedure with purposeful consideration for the process steps contained within the practice of action research.

**Planning**. The planning phase is the first of the four action research stages (Mertler, 2014). During this phase, the researcher identified a problem of practice which shaped the research focus. The research questions were then crafted and evolved, eventually become clearer and more specific through a review of related literature, which was addressed in Chapter 2. This process shaped the research plan (Appendix C).

***Development of the research plan.*** A review of the literature revealed helpful research on cooperative interventions designed to increase African American students' participation in college-level coursework as high school students. Some studies focused on bolstering AP participation (Cook, 2013; Davis et. al., 2013; Ohrt, Lambie, & Ieva, 2009) while others focused on dual enrollment programs (Kanny, 2015; Lukes, 2014; Medvide & Blustein, 2010). From these studies, the researcher identified common themes for implementing a collaborative, data-driven, and culturally responsive research methodology. To this point, the significance of working with various stakeholders, especially school counselors, and using institutional data to identify, recruit, and support students toward advanced STEM coursework was paramount (Camizzi et al., 2009; Cook, 2013; Davis et al., 2013; Lukes, 2014; Medvide & Blustein, 2010). Therefore, the researcher met with several CSD and CHS stakeholders including the superintendent,

school principal, director of guidance, career development facilitator, and the technical college's site recruiter and dual enrollment program manager to gather information, solicit their assistance and support as members of the recruitment team (Davis et al., 2013), and to obtain input toward and feedback about the research plan.

***The counseling program structure***. Several researchers stressed that programs designed to increase underrepresented students' participation in rigorous STEM classes should foster a sense of community among students and engage parents (Davis et al., 2013; Ohrt et al., 2009), incorporate practicing STEM professionals who may serve as mentors (Wright, 2011), empower students and parents to make decisions about their futures (Cook, 2013) and build interest in the subject matter (Lukes, 2014). Each of these recommendations was incorporated in the research plan, which is summarized in Table 3.1.

Table 3.1

*Overview of Counseling Program Activities*

| Week | Activity |
|---|---|
| 1 | Welcome and Orientation |
| | Meet a STEM Professional – Physical Sciences Presentation |
| | Overview of the CHS Dual Enrollment Program and Support Structures |
| 2 | Dual Enrollment Teacher and Student Presentations—Expectations, Experiences, Overcoming Obstacles |
| 3 | Meet a STEM Professional – Biological Sciences Presentation |
| 4 | Meet STEM Professionals – Computer Science, Engineering, and Technology Presentation |
| 5 | Technical College Dual Enrollment Representative Presentation |

The counseling program took place over five weeks from September to October 2017, with activities set up to inform participants about the dual enrollment program, to meet and engage with STEM professionals, to receive tips to increase their chances of success on the technical college placement test, to hear from current CHS dual enrollment students about their experiences in the classes and how they overcame obstacles, to build a sense of community among prospective students (Emdin, 2007), and to establish a culture of achievement (Davis et al., 2013). The researcher met with study participants each Thursday over the five-week period. Each session was held during the second CHS lunch period, with meals provided for all study participants. Although they were invited to attend all sessions, none of the parents were present at any of the Lunch and Learn meetings.

**Acting.** The acting phase of action research is centered on data collection and analysis (Mertler, 2014). These procedures are summarized in Appendix D. The data collected during this phase have determined the degree to which the selected methodology effectively answered the research questions. Through this study, the researcher collected qualitative data to determine if, and to what extent, the counseling program influenced students' attitudes about dual enrollment participation and to identify factors which have shaped and continue to influence their STEM disposition. The specific action steps are described below.

***Identify study participants***. During the spring semester of each academic year, CHS school counseling staff meets with rising sophomores, juniors, and seniors to evaluate their progress toward graduation. The Individual Graduation Plan (IGP) is initially created by the Crosstown Middle School counselors in cooperation with eighth

graders and their parents as they prepare for the middle to high school transition. When the initial and subsequent IGP meetings are held, counselors discuss career goals, post secondary plans, and propose appropriate courses of study to accomplish the students' desired outcomes. At the conclusion of the spring 2017 IGP meetings, the researcher met with the CHS Guidance Director and the Career Development Facilitator to identify prospective study participants. Again, the purposefully identified participants were: (1) African American; (2) rising 10th graders; (3) STEM interested (per the IGP); (4) had at least a 3.0 overall GPA; and (5) scored 80 percent or better on the Algebra I End of Course (EOC) test. The CHS Guidance Director and the Career Development Facilitator initially identified 15 prospective participants but at this point, the Algebra I EOC test scores were not yet available. Therefore, the researcher agreed to delay the final identification of potential study participants until the EOC scores were available. Once the EOC results were released, the list of potential study participants was reduced from 15 to 10 students.

***Recruit study participants***. With a finalized list of potential participants, the researcher and CHS Guidance Director worked collaboratively to purposefully recruit the previously identified 10 students to become involved with the action research study. In August 2017, each potential participant and his or her parents received an invitation to be a part of the Lunch and Learn program (Appendix F). The invitation letters commended the students on their prior academic success, acknowledged their STEM interest, provided an overview of the Lunch and Learn program structure and activities, explained that participating in the program was voluntary, and described the potential benefits of participating in the program. Along with the invitation letters, the students and their

parents received Consent and Assent Forms (Appendix E) which explained the scope and sequence of the study, provided contact information for the researcher, and detailed deadlines and procedures for returning all necessary documentation should the parents and students agree to participate in the Lunch and Learn program. Nine of the 10 purposefully recruited students agreed to participate in the program. With the participant and parent permissions secured, the researcher met with the CHS Guidance Director to confirm the meeting dates and location, discuss technology and other material needs, and to finalize the list of weekly presenters.

***Data collection—phase 1***. The data collection process, which is summarized in Table 3.2, began at the start of the first Lunch and Learn session with a brief Google Forms survey to gather demographic data. The Google format was selected because all CHS students possess Google Chromebooks provided by the district through a one-to-one technology initiative. The first survey data collected included the participants' preferred name, age, email address, home living situation, gender, mobile number, preferred method(s) of communication, and their parents' educational and employment backgrounds. The initial Google forms survey also allowed the researcher to share her contact information and to establish that each participant had a reliable method for maintaining contact with the researcher outside of the weekly Lunch and Learn sessions. Next, each participant completed a researcher-prepared STEM Attitudes and Interests (AIS) survey (Appendix A). The STEM AIS was informed by several research studies and instruments, including Kier, Blanchard, Osborne, and Albert's (2014) STEM Career Interest Survey (CIS). The participants also used Chromebooks to complete the STEM AIS and their submissions were collected and managed through Google Docs.

Table 3.2

*Summary of Data Collection Process*

| Week | Data Collected | Methods Used |
|---|---|---|
| 1 | Demographic data | Google Forms |
| | STEM Attitudes and Interest Survey | Google Forms |
| | Researcher observations | Handwritten notes |
| | Video recording | iPad |
| | Semi-structured interviews | Google Hangouts/Face-to-face |
| 2 | Post-session survey | Google Forms |
| | Researcher observations | Handwritten notes |
| | Video recording | iPad |
| 3 | Post-session survey | Google Forms |
| | Researcher observations | Handwritten notes |
| | Video recording | iPad |
| 4 | Post-session survey | Google Forms |
| | Researcher observations | Handwritten notes |
| | Video recording | iPad |
| 5 | STEM Attitudes and Interest Survey | Google Forms |
| | Researcher observations | Handwritten notes |
| | Video recording | iPad |
| | Semi-structured interviews | Google Hangouts/Face-to-face |

This method mimics Kier and other researchers' (2014) approach, which allowed participants to submit responses using an iPod Touch and served as a record of their detailed responses to open-ended questions. While the researcher identified a number of potentially useful instruments, none of the existing instruments as constructed allowed the researcher to collect the data needed to answer the research questions. Still, the STEM CIS was a good starting point (with respect to instrumentation) because its design was based on Alfred Bandura's social cognitive theory, which declared a student's self-efficacy as the most important factor in setting goals and taking necessary actions to fulfill the goals (Kier, Blanchard, Osborne, & Albert, 2014). The STEM CIS tied specific survey items to unique aspects of social cognitive theory. For example, a student's favorable rating of "I am able to get a good grade in my science class" (p. 470) is a measure of high self-efficacy. Or, a student who indicated that she believes doing well in math coursework will be helpful for her future career had high outcome expectations. Furthermore, the STEM CIS has been validated among racial minority students in several rural, high-poverty school districts in the southeastern United States (Kier et al., 2014).

The researcher-created STEM AIS (1) accounted for the age of participants, given that the STEM CIS was constructed with middle school students mind; (2) restricted questions to focus only on mathematics and science (rather than also including technology and engineering) since participants were being encouraged only toward math and science dual enrollment classes; (3) used open-ended questions to allow the participants' own words to emerge; and (4) sought permission to interview study participants throughout the study so they could share more details about their experiences in the counseling program. The study participants completed the STEM AIS as a pretest

at the beginning and posttest at the conclusion of the research study in order to compare the participants' disposition before and after the Lunch and Learn program intervention.

***Data collection—phase 2.*** Again, the STEM AIS included a question seeking permission to engage participants in one-to-one interviews (Appendix B) throughout the study timeframe. This approach to data collection is supported by several researchers (Strayhorn, 2015; Noble, 2011; Tillman, 2002) focused on culturally appropriate methods for gaining valuable insight into the mindset of African American students and the rationale behind their decisions and feelings. The interviews were semistructured, which means they allowed for follow-up questions based on the participants' responses (Mertler, 2014). In addition to these one-to-one interviews, the researcher gathered data via field notes and other observations made during the five-week counseling program. Study participants also received a brief Google Forms survey after each weekly session. These were the survey questions:

- Briefly describe what you learned during today's session.
- What did you enjoy most?
- What did you enjoy least?
- Is there any topic that was not covered you hoped this session would address?

The researcher used these data to evaluate how specific activities within the program structure may have influenced the students' attitudes about math and science experiences, as well as their attitudes about dual enrollment classes. The participants' responses were helpful for shaping participants' stories about their experiences in the counseling program.

***Data collection—phase 3***. After the conclusion of the counseling program, the participant-researcher conducted exit interviews (Appendix B) to allow students to express their thoughts about the Lunch and Learn program, STEM in general, and dual enrollment classes. The researcher was particularly interested in learning about the effects of the participants' experiences in the Lunch and Learn program, if they were likely to pursue STEM dual enrollment classes after completing the program, and the rationale for their decisions.

*Field testing interview questions*. Before study participants were interviewed, the researcher field-tested the questions to ensure they were appropriate for the research context and worded in a manner that would help the researcher to obtain useful information about the participants' thoughts and experiences. First, the researcher identified two African American high school students with prior dual enrollment experience. The students were asked to evaluate each question and to explain how they interpreted the question. Once the students reviewed the questions and shared their insights, the researcher shared the student comments with an experienced high school guidance counselor and then asked for her feedback. The school counselor provided additional suggestions to strengthen the exit interview.

Based on interactions with the students and the counselor, the researcher learned that a few questions required modifications to help with clarity. For example, in the first version of the exit interview questions the participant was asked, "What do you think about this program?" The improved version of this question was: *How much did you enjoy your experience in this program?* This change resulted in the addition of a new question: *Please explain why you described your experience this way.* It also meant that

the question. “Are you satisfied with your experience in this program?” could be eliminated to avoid redundancy. A second modification to the exit interview was to amend the original question 6 so that students were able to consider dual enrollment participation beyond the next semester. Because the study participants are all tenth graders, they have the option of dual enrollment for junior and senior years. The guidance counselor emphasized the importance of keeping participants open to the option further down the road.

Based on feedback from the guidance counselor, the researcher also added a new question to the exit interview. This question: *What would you need from persons at CHS to support you in a math or science dual enrollment class?* allowed the participants to explain how various stakeholders – school and district leadership, teachers, and others – could structure support for students with limited prior experience in rigorous coursework. The researcher has also incorporated participants’ responses to this question into the action plan resulting from this study.

During the field-testing process, one student suggested adding a question to directly address the testing requirements from dual enrollment participation. After consulting with the school counselor, the researcher elected to exclude this question. However, the semistructured nature of the interview lent itself to following up with any participant who specifically mentioned a fear of testing as a reason to avoid dual enrollment. Therefore, the researcher reserved this right for such cases.

***Validity***. Mertler (2014) explained the importance of ensuring that data collected during an action research study is valid. Through the analysis process, the researcher expected the emergent data to prove accurate, credible, and dependable for the specific

purposes outlined by the research questions. Essential measures of validity relative to the research questions guiding this action research study were the following:

- Employing multiple methods of data collection including surveys, interviews, field notes, and other observations used to assess initial and final STEM disposition, student perceptions of the math and science dual enrollment opportunity, and attitudes about the various counseling program activities.
- Sharing drafts of the interview notes with participants to ensure their thoughts and statements were accurately represented.
- Investing time and effort to establish and nurture relationships with the study participants through multiple interviews and informal engagement within the CHS community.

When conducting qualitative studies, validity procedures consider the perspectives of the researcher, the study participants, and external persons who review the study findings and provide feedback to improve its presentation (Creswell & Miller, 2000). For the current study, the researcher's perspective is reflected in the themes which emerged from the process of triangulation and were used to present findings in Chapter 4. The study participants' perspectives were validated as they reviewed the transcripts of their statements from interviews and other collected data. Finally, external reviewers, such as the dissertation study committee chair and other members were able to audit the researcher's journey through the research design and data collection processes to establish the credibility of the study and its findings.

***Data analysis.*** The qualitative data collected from surveys, interviews, field notes, and observations were coded using the NVivo 11 software program and then organized by common themes. These themes became increasingly more evident as the data were carefully read and reviewed several times to ensure no significant points were missed. Once the data were coded and the characteristics of each theme emerged, the researcher used the coded data to describe its relationship to the research questions, explore potential areas of conflict, and decide the best means to represent the findings. The researcher used the constant comparative method for coding the data. Glaser (1965) described the constant comparative method as a four-stage process which includes (1) making comparisons between incidents within categories; (2) combining properties of categories; (3) restricting the theory, and (4) presenting the theory. Since the participants' culture and language are important to their worldviews and narration of their math and science experiences, the constant comparative method was useful for ongoing identification of specific incidents, making connections between these and other occurrences, and understanding how they may be related.

**Developing.** The third stage of the action research cycle is the developing phase (Mertler, 2014). Once the data were collected and analyzed, the researcher used the findings to create individual profiles which encapsulated each participant's unique Lunch and Learn program experience, including the personal and social conditions which influenced their thoughts, feelings, and other factors affecting their lived experience (Woodcock & Olson Beal, 2013). This approach reiterates the significance of culturally responsive research practices, such as African Americans telling their own stories to better understand how their attitudes and outcomes are shaped (Ladson-Billings, 2000;

Noble, 2011; Strayhorn, 2013). Collectively, these findings have informed an appropriate action plan for the CSD with respect to engaging more African American students, who are not in the STEM Early College Program, in math and science dual enrollment classes. For example, since the data showed that study participants were positively impacted by the counseling program experience in terms of their STEM disposition, then the researcher believes it is appropriate to collaborate with the CSD and CHS leadership to devise a plan to incentivize, prepare, and encourage more students to enroll in the dual enrollment classes.

**Reflecting.** Mertler (2014) presented the reflecting phase as the fourth stage of the cycle; however, action researchers engage in constant reflection during the course of their study. The researcher maintained a reflection weblog throughout the study as a means of effectively managing personal notes regarding her practice and other observations as well as "the feelings and interpretations associated with those observations" (p. 134). This weblog was useful for placing details and notes recorded over a significant timeframe in the proper context and for ensuring the participants' words were accurately represented. Dana and Yendol-Hoppey (2014) described the benefits of maintaining a reflection journal for organizing and interpreting data, generating additional questions, and assessing the quality and validity of action research.

**Ethical Considerations**

The National Education Association's Code of Ethics, as cited in Dana and Yendol-Hoppey (2014), emphasizes the importance of an educator's commitment to "the equal educational opportunity for all" (p. 148). This ethical consideration—the full access

for underrepresented students to equal educational and economic opportunity—is at the heart of the researcher's interest in the research topic.

According to the South Carolina Department of Education (2016), African American students are performing lower than any other racial or ethnic group in both mathematics and science across all grade levels. When considering that Brown et al. (2015) identified a direct correlation between a student's early STEM success and their matriculation in related fields, the underperformance of African American students described in the South Carolina Department of Education (2016) report provides little hope for their perseverance in STEM. The subsequent economic impact for African American students is reduced access to college and the more stable, higher paying jobs associated with earning STEM degrees (Karanja & Austin, 2014). Ultimately, the participant-researcher viewed these disparities in achievement and outcomes as an issue of social justice (Dana & Yendol-Hoppey, 2014) and hopes the data yielded through this action research will "help reform classrooms and schools" (p. 56).

This study employed qualitative methods which presented a number of ethical considerations. With respect to gathering and evaluating qualitative data, it was important to adhere to standards of honest and truthful reporting without fabricating or falsifying findings (Mertler, 2014). The researcher also assessed the participants' responses objectively, without making unfair judgments about their intelligence or motivations. Likewise, the researcher employed objectivity when interacting with the CHS community stakeholders, several of whom differ both in socioeconomic status and culture from the study participants.

Furthermore, the study participants are all African American, so it was important to avoid adding to existing racial stereotypes or negative perceptions. It was equally vital to guard against gender biases, such as using language which excludes females from or marginalizes their roles in the STEM community at CHS and in the general population. The research plan also included using surveys and conducting interviews with students to learn more about their attitudes and perceptions. Therefore, it was important to obtain necessary consent from all involved parties, especially considering that all participants were minors. While engaging in inquiry, it was imperative to seek answers while maintaining a sense of commitment to caring, fairness, and openness (Dana & Yendol-Hoppey, 2014).

As a non-CSD employee, the researcher conducted this study in a community other than her primary place of employment. Thus, the researcher committed to protect the privacy of the students and fellow educators throughout the study (Dana & Yendol-Hoppey, 2014; Mertler, 2014), as the researcher was privy to participants' academic data as well as their personal thoughts and experiences. This was the rationale for incorporating pseudonyms throughout this action research reporting. Finally, the researcher adhered closely to the CSD's guidelines for conducting research to avoid any violations of their policies.

**Conclusion**

Too few African American students at CHS are participating in higher level STEM classes and many students express low levels of achievement in these courses (CSD, 2016; South Carolina Department of Education, 2016). Through a recent curriculum expansion, CHS students have the option to participate in dual enrollment

classes offered through a partnership with a local technical college. The purpose of this study was to determine if a counseling program would encourage African American students at CHS to participate in math and science dual enrollment classes. The research was guided by the following questions: *(1) What is the effect of a counseling program intervention on African American students' STEM disposition at Crosstown High School (CHS)?(2) To what extent does involvement in the counseling program influence these African American students' attitudes about math and science dual enrollment participation? (3)What are the most significant factors that shaped these African American students' STEM disposition?*

The research methodology was shaped by a review of the literature (Chapter 2). The literature review revealed that studies focused on African American students in STEM are most effective when the students' own voices are at the heart of the research (Ladson-Billings, 2000; Noble, 2011; Strayhorn, 2015; Woodcock and Olson Beal, 2013). Therefore, this action research study emphasized the participants' journey through a counseling program in their own words. The Lunch and Learn format also allowed the participants to develop agency and build solidarity in a communal setting (Tobin, Elmesky, & Siler, 2005), which reinforced African American cultural ways of being. In the upcoming chapters, the researcher will share detailed data and observations (Chapter 4) and will use these data to summarize findings, share conclusions and propose specific suggestions for the CSD community (Chapter 5).

# CHAPTER 4

# FINDINGS

Chapter 4 presents the analysis of data collected using the qualitative research methodologies detailed in Chapter 3. These methodologies included recruiting nine study participants, conducting surveys and semistructured interviews, collecting field notes, and engaging in whole group discussions in order to answer the following research questions:

1. What is the effect of a counseling program intervention on African American students' STEM disposition at Crosstown High School?
2. To what extent does involvement in the counseling program influence these African American students' attitudes about math and science dual enrollment participation?
3. What are the most significant factors that shaped these African American students' STEM disposition?

This research study is guided by four theoretical constructs: Critical Race Theory (CRT), Sociocultural Theory, Self-Efficacy Theory, and Culturally Relevant Pedagogy Theory (CRPT). In the field of education, CRT explores the effects of systemic and structural racism on historically marginalized groups, including African Americans (Delgado & Stefancic, 2017). Sociocultural Theory emphasizes the role of influential persons on humans' self-concept, cognitive development, and perceptions of socially acceptable behavior (Vygotsky, 1987). With African American students in mind, Sociocultural

Theory also allows for deeper scrutiny of the ways that human, social, and cultural capital affects their academic experiences (Strayhorn, 2013). Bandura's (1977) Self-Efficacy Theory linked an individual's beliefs about his or her ability to perform certain tasks with acting on this belief to accomplish a task. Therefore, a person with a high self-efficacy is more likely to initiate an action and persevere through it than someone with relatively lower self-efficacy. CRPT examines teaching practices and how they either uplift or devalue students' culture as a significant component of their academic experience. With these theoretical constructs, the researcher used methodologies which were likely to expose the sociocultural, educational, and economic factors that shaped the participants' STEM disposition and attitudes about college-level math and science coursework.

**Recap of Data Collection Strategy**

This section of the chapter summarizes the research methodology which was detailed in Chapter 3. First, the process of recruiting study participants is reviewed. Next, the data collection process, including methods and instruments used, is briefly revisited.

**Recruitment of study participants.** The researcher worked with the CHS Director of Guidance to identify and recruit participants. In April 2017, the researcher and Director of Guidance identified 15 potential candidates who were African American rising 10$^{th}$ graders with stated STEM interest on the IGP and an overall GPA of 3.0 or better. Once the Director of Guidance received the final Algebra I end-of course (EOC) scores, the participant list was further refined to include only students who successfully completed the course and scored at least 80 percent on the EOC. As such, the number of purposefully recruited students was reduced from 15 to 10. Nine students – six male and three female – agreed to participate in the study.

**Data collection**. The first data collected were demographic. These data included each participant's age and gender, preferred name and method of contact, home living situation, and family educational background. After collecting this data, each participant was assigned a first-name only alias. Thus, all subsequent data collected was coded using pseudonyms to protect participant identities. This study was structured as a five-week Lunch and Learn series. The researcher met with participants on consecutive Thursdays throughout the month of September 2017 into the first week of October 2017. The sessions were held during a common lunch period from 1:00 PM – 1:40 PM in the Guidance Director's conference room. The researcher provided lunch each week. At each session, participants heard presentations from the researcher, current CHS dual enrollment students, practicing STEM professionals, and college and career advisors. The topics included testimonials about STEM career and economic benefits, early access to college through dual enrollment participation, and many applications of STEM education. The last five to ten minutes of each session were reserved for question and answer (Q & A). However, participants were allowed to interrupt the speakers as questions arose.

**Methods and instruments**. At the start and conclusion of the study, participants completed the STEM Attitudes and Interest (AIS) survey and the researcher held one-on-one interviews with each participant. These interviews were semi-structured. Each week, the researcher used an iPad to record the Lunch and Learn sessions and used a handwritten journal to take notes and track observations during the presentations. The participants received a Google Forms survey after each session and were given a chance to ask follow-up questions about the presentation or any other topics. The researcher maintained a weblog as a reflective tool throughout the data collection process.

**Findings and Data Analysis**

This part of Chapter 4 addresses the findings based on data collected from several instruments including the STEM AIS, semi-structured interviews, Google Forms surveys after each Lunch and Learn session, and the researcher's field notes. Through these data collection methods and their ensuing analysis by the processes of coding and categorizing three major themes emerged: (1) interconnectedness of academic experiences and STEM disposition; (2) significance of sociocultural influences; and (3) effects of testing. In the next sections, the themes and supporting data patterns will be analyzed at length.

**Theme 1: The interconnectedness of academic experiences and STEM disposition**. The first theme resulted from data which helped the researcher to contextualize the participants' STEM journey from elementary to high school. This journey reflected academic experiences which proved to have a significant impact on the participants' STEM disposition. Thus, the participants' experiences were shaped by four observed data patterns illustrated in Figure 4.1 and detailed in the next sections.

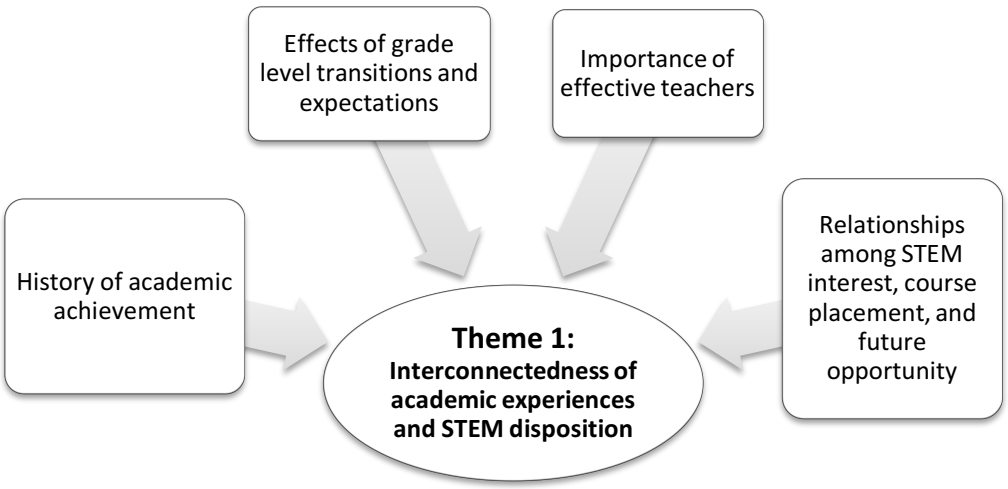


*Figure 4.1*: Academic Experiences and STEM Disposition. Figure 4.1 describes data patterns which shaped participants' academic experiences and STEM disposition.

***History of academic achievement***. Within the self-efficacy construct, enactive attainments include the effects of academic experiences on students' efficacy beliefs (Noble, 2011). Therefore the participants' earned STEM grades shed light on their past academic experiences and put into perspective their current disposition. The participants frequently referenced their STEM grades and achievement on tests concurrently and as points of pride. Jalen explained, "I've always gotten As in math class and I got an A on the Algebra I EOC too." Jada added, "Math has always been my favorite subject so I usually don't have any problems…I don't make poor grades in the classes I take." Thus, past earned grades and test scores emerged as indicators of achievement and influencers on the participants' math and science outlook.

The participants have done well in math and science with most (eight of nine) reporting "good grades" and earning "mostly As and Bs." For example, Michael said he has "always been an A student, especially in math and science." Unlike his peers, Roger said that despite "doing very well" in math and priding himself on being a "really good math student," he has not always "[done] well in science classes for some reason." The participants' pattern of high achievement remained consistent throughout the study and when asked about his progress at the end, Roger said he was "doing better" in science and "had a B in Biology." Their academic achievements were due in part to the effort they expended to do well in their classes, which included completing homework with or without support from others. These findings and related factors are discussed next.

*Effort and achievement*. The students were consistently willing to put forth the effort needed to succeed, although the amount of effort they expended and the reasons for doing so varied. Amanda said she "was determined" to raise her math grade "from a B to

an A" as a fourth grader and that she has "been determined to keep her grades high ever since." Like Amanda, Jada drew correlations between effort and achievement outcomes in terms of the grades she earns. Jada said, "At the moment, I have like a 98 in science class. I don't know why but it [science] is just harder so I have to work harder." While they were mostly consistent in their views about connections between effort and STEM achievement, some participants' perspectives evolved over the course of the study. Brian originally shared that he gave the same effort in all classes, "especially in math and science." However at the end of the study, Brian stated, "I don't feel that I need to work as hard in those classes because I really do well in them both. I like science better than math so I put more effort toward doing well in it." Thus, Brian's statement introduced interest as a motivating factor for achievement and emphasized his self-confidence in those courses. At first, Steven was not enthusiastic to put forth effort in math and science. He initially admitted being "sometimes lazy" but his disposition later improved, saying:

> So when you asked us about this earlier, it was closer to the start of the school year and I was not yet really into my work. I was kinda still in the summer mode. But now things are more serious and I know I need to work harder if I am going to do well this year.

*Homework and achievement*. The participants' attitudes about completing homework and its impact on their grades are notable. When Steven described his "laziness" to complete homework, he said his grades were "not as high as they could be" because he "does not always get his homework in on time." However, Kimberly explained that her homework grade "has helped to bump her up a grade level" in classes where she had not "done well enough to get an A" without the added points. Most participants' said their teachers provide homework regularly and as Amanda explained, "the extra points from homework could be the difference between getting an A and a B."

*Self-perceptions of support needed to complete homework*. The participants' attitudes about expending effort to complete homework speaks to their commitment to achieving a goal, such as maintaining high grades, and their physiological state, particularly self-confidence toward specific tasks (Bandura, 1986). Early on, most participants expressed confidence to complete STEM homework alone, using words and phrases such as "capable" and "don't usually need any help." Quincy was the only exception as he initially stated his ability to complete homework without assistance "depends on the situation." Despite the mostly high initial levels of self-confidence when completing homework, the students were more forthcoming about their challenges toward the end of the study. For example, Jada stated, "Sometimes I do struggle with the homework, especially in science." Steven was the only participant to admit he needed "someone to stay on him" to ensure homework was completed on time. Steven was confident in his ability to do the work, but he expressed the need for external support to help him "get over the struggle to get things in on time." Again, Steven's need for extrinsic motivation was a rare characteristic among the study participants as most described themselves as academically self-reliant.

The timing that participants expressed need for support was noteworthy. The STEM AIS was first completed near the start of the school when the students faced a relatively low level of academic challenge. However the post-survey was given in early October, one week before first quarter exams. Though the researcher did not collect data about the academic climate in STEM classes during this time period, Steven's account for needing "to work harder" and other participants' awareness that they needed help are

signs of an increased work load and progression toward more complicated material. Thus, the participants' outlook may have been altered as they needed to work harder to succeed.

***Discussion about the history of participants' academic achievements***. The participants' history of achievement has fostered a strong sense of STEM self-efficacy. Their prior successes have encouraged them to expend the effort required to maintain past levels of achievement; so, the students have coupled effort with the outcomes they realize. These efforts have required minor external support; and, with the exception of Steven, the students' intrinsic motivation has been sufficient for maintaining their STEM success. As the school year progressed and courses increased in rigor, some students recognized effort alone may not translate into academic success. Thus, several participants, including Quincy and Kimberly acknowledged they need help from other adults, especially teachers to "do well" and "get the grades they want." The researcher did not ask the participants about persons outside of school who may be able to help with homework and related tasks. But, when considering their family backgrounds, it is unlikely the students could receive help at home or from a paid tutor. Thus, the participants' achievement rests largely on their ability to persevere through challenges and to seek help from teachers and others at CHS. This may be difficult for students considering dual enrollment classes as they are certain to require extra support to succeed. The second data pattern revealed that the participants were affected by differences in their elementary, middle, and high school experiences. These experiences were shaped by the participants' expectations and self-perceptions of academic maturity, which are discussed in the next section.

***Effects of grade-level transitions and expectations***. As they transitioned from elementary to middle to high school, the students and their teachers' expectations did not always align. So, the participants' STEM disposition has been affected by effortless success in the early grades and the lack of rigor they faced in middle school. As Brian explained, "more was expected of us in high school."

*Student expectations*. The participants believed their middle school experiences ill-prepared them for high school. In fact Michael said, "I am not saying that high school is easy because it is not but I can definitely say we learn in high school where that was not really the case in middle school." The perception of middle school as "easy" and high school as "hard" was typical. Roger stated, "Middle school is so easy, you don't think high school will be much different." However, Quincy explained, "high school classes are much, much harder." Steven shared an example stating, "I am taking Biology I Honors right now and the class is moving pretty fast. I'm doing my best to keep up."

*Student maturity amid growing expectations*. Amanda shared perspective on the link between grade-level transitions and student maturity when she stated:

> In middle school we are trying to find ourselves and make the adjustment from elementary to middle. We don't have the sixth grade in middle school, it is still elementary so when you get in middle school, you don't know what to expect. But, when you get to ninth grade you are much more mature and it was easier for us to go into the classroom, learn, and get involved.

As they realized the need to work harder in high school, the participants admitted the shift in expectations helped them to mature. Michael explained his growth, stating that although his grades "have been good all along, his A's are even stronger now…because he is more mature." This maturation is tied to accepting responsibility for their success. Quincy shared:

> …in high school you have to be more responsible because the teacher is not going to tell you to do everything. So if you want to do well and make it then you have to step up and do what you need to do. You got to pay attention to what you are missing and do it."

The participants' concerns about their grades, especially their high school transcript, have also helped them to take ownership of their learning. Michael stressed the permanence of "the GPA record" and the student's duty "to take that responsibility upon yourself." Jalen spoke about "knowing that [he] is the only person who can do the work" and that he "cannot blame anyone else for not getting the grades he wants." When considering their growing maturity and acceptance of personal responsibility for their academic outcomes, most participants realized they have room for growth. For instance, Roger talked about his need "to get serious" in classes even if he "doesn't like the subject so much." More than any other participant, Steven was very specific about his need to mature and grow in self-confidence as it pertains to his high school academic performance when he said:

> But, now I hope to gain more confidence in what I am able to do. I want to trust myself rather than second-guessing myself. Sometimes I have an answer that is right but then I start second-guessing myself and change the answer. When I realize that I was right the first time, I get frustrated. I want to change that. I know I need to work on my confidence so I can show them [teachers] what I know every day, not just on the test.

***Discussion of the effects of grade-level transitions and expectations***. The students indicated the transition from middle to high school STEM classes has been tough. Yet, they have developed the maturity needed to achieve. Certainly the transition from traditional high school classes to dual enrollment will be difficult as the instructor's expectations are likely to surpass any the participants have faced thus far. However, the participants' positive attitudes and resolve to accept personal responsibility for their success will serve them well if they pursue dual enrollment classes. The more self-

confident students may more easily meet the expectations of dual enrollment; but, for Steven and others who lack self-confidence, it may be an insurmountable hindrance considering the relationship between one's self-efficacy and persistence through challenging situations (Bandura, 1977).

The third pattern revealed the significance of high-quality teachers in terms of their pedagogical content knowledge, use of culturally relevant methods, and affective qualities. The findings with respect to these factors are addressed in the next sections.

***Importance of effective teachers***. The interviews were helpful for understanding how teachers have shaped the students' attitudes about STEM and their perceived ability to succeed in rigorous coursework. The participants have had only a few effective STEM teachers but they are at the heart of the students' most substantive academic experiences.

*STEM teachers need pedagogical content knowledge*. Boutte (2016) emphasized that African American students need teachers with solid pedagogical content knowledge and the ability to make culturally relevant connections in the classroom setting. Thus, STEM teachers need content expertise and "the necessary instructional skills to deliver the content" (p. 21). This assertion is supported by numerous participants' correlations between teachers' instructional methods and the learning environment. For example, Jada said her sixth grade math teacher "was really good because he knew his stuff and he explained things really well." Both Jalen and Kimberly talked about "a bad experience" with a teacher who "did not teach well." As it turns out, these students were referring to the same math teacher. Kimberly and Jalen's experience is typical within the CSD due to the district's small size. Many students had the same classes and teachers and their perceptions of these teachers' effectiveness were consistent.

*A model teacher*. Of all the teachers mentioned, Coach Shane was discussed most often despite having taught only five of the nine participants. Jalen called him "a really good teacher" and Amanda said, "He is amazing!" Coach Shane teaches Algebra I to freshmen and he coaches several athletic teams. Based on the students' remarks, Coach Shane's pedagogical content knowledge is remarkable. In an interview session Kimberly said, "Coach Shane explained things well and he did not move on until everyone got it." Amanda explained the value of his teaching methods when she stated:

> Algebra was a tough class but Coach Shane got students involved. We got up and wrote things on the board and tried to solve problems ourselves. We also did worksheets and used different learning tools to help us to understand. Coming up to the board helps you to learn how to solve the problem because when you are at the board working on it, he can stop you and say things like, "Hold on!" and "Wait a minute, you might want to try this" and "You could do it this way."

Jalen said he "stayed on topic and didn't do unnecessary stuff like some other teachers" and Quincy praised his "way of breaking things down and providing visuals to help us understand things better." The students liked Coach Shane because of his teaching style and their academic success in his class. Several students said they "did a lot better" in his class compared to others. Kimberly said her middle school math grades "were mostly B's with a few C's" but "improved to A's" in Algebra "since she had a better teacher." Jalen said, "I definitely got an A in Coach Shane's class because of how he taught."

*Very few effective teachers*. Some participants noted a few elementary and middle school teachers who had solid pedagogical content knowledge. These included Jada's sixth grade math and science teacher who "did not do only bookwork the way other teachers did…and was really good because he knew the material and how to explain it" and Amanda's fourth and seventh grade science teachers who "worked hard and did fun

things to keep us interested." Otherwise, the students did not view their math and science teachers prior to high school as effective. Roger stated, "I really have not had a good science teacher, at least not one I think could make me really want to do science." Jalen shared the following about an encounter with a middle school math teacher:

> So, we were assigned a project where we had to cook and we could not tell why were cooking and what it had to do with math. She could not explain what it had to do with math. She did that type of stuff all the time.

Kimberly had the same teacher and said she "made the whole class mad" and added:

> In middle school we were just jumping around from one thing to the next. One day we were on one thing and the next day something else. They didn't explain stuff either. If you didn't get it, they just moved on anyhow. My teachers just did not explain things well at all.

Steven also mentioned a middle school teacher who "was nice but when it got closer to end of the school year…was really serious and piled more work up on us, and was going really fast." Therefore, the class "wasn't really fun anymore." Amanda shared her middle school math teacher "just check[ed] it and mark[ed] it wrong without you even really understanding what it is that you need[ed] to do and why." Amanda went on to say:

> …everything was like, you either got it – check, or you did not get it – no check. It wasn't so much about making sure you understood it but more-so like did you do the assignment or whatever we were working on. If you only do a check or no check, that doesn't tell you if I really understand the work.

The participants often compared their high school teachers to those in earlier grades. Quincy shared, "I kinda struggled some in middle school because those teachers didn't really explain the things well, and they didn't help you to get it either. But high school teachers try to help you understand." Michael summarized the study participants' comparisons of middle and high school math and science teachers by saying, "The high

school teachers are just better. It's not because the classes are easier, because they are not, but the teachers are just much better. They really know what they are doing."

*Qualities of effective teachers*. In addition to a greater degree of "know-how," the students identified other characteristics of good STEM teachers. These included affective qualities and incorporating culturally relevant practices. Steven talked about "two teachers he really liked because they were funny, told great jokes…were more kind to him than most other teachers…and had great control over the class rather than just letting students do whatever they wanted to do." Other students, including Michael, emphasized the teachers who "told him he was smart and believed in him." Several participants, including Kimberly spoke well of teachers "who cared about every student in the class."

The participants' comments indicated they preferred teachers whose methods went beyond presenting content to creating a fun and engaging culture of high expectations where students knew they are valued. For instance, Amanda said her fourth grade science "class was fun and [she] was able to learn because of the hands-on activities." Jada shared how her Biology teacher "goes out of her way to make sure [students] have fun in the lab while learning…without doing just worksheets." These culturally relevant practices set the tone within high school classrooms where students' dispositions were most positively influenced. Quincy shared an example, when he stated:

> I have noticed that my high school teachers definitely have high expectations for us to learn, especially in the advanced classes, like honors sections. In pre-algebra in middle school, I really did not understand a lot of the subject. But, when I got to high school, the teachers broke it down better so I could understand. It's like the teacher know[s] better what you need to really get it. I feel they get my learning style and know how to reach me better than middle school teachers did.

The participants indicated motivation is a vital part of setting a culture of high expectations. They were fond of teachers who believed they could succeed in the classroom and on state-mandated tests. Kimberly explained that Coach Shane "kept telling me that I would do well all year long, and in the end I did." Roger told how Coach D "pushed him hard because he wanted him to do well." Amanda also provided details about how Coach Shane incentivized students to achieve.

> All year long when we were in Algebra class and learning all the different concepts that we needed for the test at the end of the year, he made a deal with us. If you got an A on the test he would give you $20 and if you got a B then he would give you $10. That really motivated me and some other kids too. I worked really hard and I got some of that money [laughing].

Effective teachers are also able to help students make important connections between prior and current learning, and again, the participants identified this as strength among their high school teachers. Amanda explained:

> High school teachers are much better at this. So when a teacher teaches a standard, they don't just cover the basic stuff. They go deep into it, to the next level to make sure we get it. They even go to higher levels to make sure we understand. So like in my Geometry class that I'm taking right now, I can see how the stuff we did with in Algebra class is connected to what we are doing now.

*Teachers in the dual enrollment classes*. As the Guidance Director explained, "dual enrollment teachers may or may not be CHS teachers." While some CHS teachers meet the qualifications for teaching on behalf of the technical college partner, several instructors are "brought in from the outside." In the week 2 session, the STEM ECP students told the participants about the experience of being "taught by professors who treat them just as if they were at a college campus." In the week 5 session, Mr. HL* also talked about dual enrollment teachers, telling participants that "they don't play around with students the way regular high school teachers do." Several participants said teachers

would be a factor regarding their pursuit of and success in dual enrollment courses. Quincy was adamant that he would "need a teacher who worked with [him] one on one and make it to the point where it is easy enough to understand the material." Jalen also stressed he would need "good teachers…to do well" in the classes and Jada stated that she hoped the dual enrollment teachers would be willing "to provide extra tutoring."

***Discussion of the importance of effective teachers***. Teachers are important shapers of STEM disposition so the students' perceptions about the effectiveness of high school STEM teachers compared to those in earlier grades are significant. In early grades, participants had limited exposure to teachers with strong pedagogical content knowledge. In fact, most participants were unable to identify a teacher whose methods helped them to grow in STEM knowledge and achievement before high school. With a few exceptions, the participants' prior STEM learning was mostly "bookwork" and "worksheets."

The CSD has struggled with teacher retention (CSD Superintendent, personal communication, October 5, 2017). Jalen said it is not uncommon for a teacher "to leave in the middle of the year" and have students in a classroom with a long-term substitute "who can't teach." The participants noted three separate times where a math or science teacher started the school year but did not complete it: twice in elementary and once in middle school. Within the CSD, teachers like Coach Shane have been rare and the study participants' respect and admiration for him is unparalleled. Based on the students' comments and body language when talking about him, Coach Shane is a model teacher. He has inspired students to achieve by establishing a culture of high expectations. He has also affirmed them culturally by tailoring pedagogy to meet the needs and interests of his students without compromising on high-quality content instruction.

The CHS dual enrollment program does not guarantee teachers with the pedagogical content knowledge and cultural sensitivity needed to support the participants in college level coursework. If the dual enrollment teachers come from within of the CSD community, they may better understand the school culture and the participants' past experiences. However if the instructors are unfamiliar with the local culture, the affective relationships and culturally relevant methods the participants have come to appreciate from teachers like Coach Shane may not be replicated. For it is the combination of pedagogical content knowledge and culturally relevant teaching practices that helps to improve African American students' science learning experiences (Emdin, 2011). It is worth noting that Coach Shane attended schools in the CSD and returned to teach there after completing college. In view of the value the participants placed on teachers who care and know how to teach them, it is difficult to imagine them pursing dual enrollment courses without a significant commitment from teachers to ensure their success. The final data pattern which related the participants' academic experiences and their STEM disposition was informed by the sources of the students' early STEM interest, the rigor of coursework to which they have been exposed, and their subsequent course placement. These interrelated factors are discussed next.

***Relationships among early STEM interest, course placement, and future opportunity***. Most students' STEM exposure has been limited to the classroom. Amanda and Kimberly are exceptions, as their initial interests were sparked by out-of-school experiences. Regardless of how the participants were first introduced to STEM, the academic environment has been an important factor in sustaining their interests.

*Sources of early STEM interest*. Most students became STEM interested in the upper elementary and middle grades. Jada said she "started getting into math in the fifth grade but…really started to like it and understand it in the sixth grade." Roger "got into math in fifth grade." While he was "always good at math and science," Jalen said he "started liking it in the eighth grade because that's when we would do experiments…in the lab." Each participant said hands-on learning experiences reinforced their STEM interest. Brian shared he doesn't think "math is as much fun as science because math is about working problems on paper but in science you get to do stuff in the lab." Jada said her science "class was fun when they did labs." Unlike their peers, Amanda and Kimberly's interest started with family. During her interview, Amanda shared "how she fell in love with math and science."

> Well first it started…with my grandmother. I was like three and counting money because she owned a store…in the country part of South Carolina, in a little town called [named town]. I used to help her around the store all the time. I didn't exactly know what is was called back then but I helped her with inventory which meant I had to be good with counting different items. That's really how I learned to count. And, when I was older I was able to help in other areas, even counting change back to her customers.

Based on experiences in her grandmother's store, Amanda "always believed [she] was capable of handling math." When her grandmother became ill, Kimberly enjoyed the nurse who provided her at-home care. Kimberly was "just a little kid" at the time but her interactions with the nurse gave Kimberly the opportunity to "ask a lot of questions." Thus, Kimberly learned what nurses do and about the "classes they take in college." Kimberly stated, "That's how I got interested in nursing. I knew I wanted to become a nurse because she was so nice to my grandmother and took really good care of her."

*Advantages of early STEM exposure*. One of the five CSD elementary schools houses the math and science magnet program which Amanda, Brian, Michael, and Jalen attended. The participants spoke candidly about the value of this early opportunity, especially in terms of their STEM interest, subsequent course placement, and readiness for rigorous coursework.

Michael stated:

> Anybody who came out of the magnet school, they like math and science because that's really what the focus is on. I went to the magnet school so I did a lot of math and science in elementary school. So when I went to middle school I was in the classes with a lot of math and science. It's the same now so when I get into a math or science class, it just makes sense to me because that's what I am used to.

Amanda also stressed the benefits of attending the magnet program, when she stated:

> …to somebody new coming to this district, I would definitely recommend their child to go to the magnet school. When you get into middle school, you see the magnet kids and recognize everybody else is trying to catch up. If the child comes from the magnet school, then they should be in a gifted and talented class which means they go to a higher level. Because like in seventh grade, the regular kids are learning stuff for the first time and the magnet kids have already learned it.

Not all CSD students have access to magnet program. Brian and other participants were quite vocal when sharing how students "with good test scores get into the magnet program." Amanda added that "if your parents go to the district office, they could probably get you in." Thus, ability grouping and parent advocacy were potential determinants of who gained access to the magnet school opportunity. Ultimately the participants who benefited from early placement in the CSD's math and science magnet program perceived it was a measure of their readiness for advanced math and science classes and set the stage for doing well in future STEM coursework.

*Middle school obstacles*. The STEM ECP starts in middle school and as the student visitors noted during the week 2 session, "the top kids from the magnet program…and those whose parents are involved usually are the ones who get into" the ECP. During their interviews, the participants said they knew nothing about the STEM ECP before participating in the Lunch and Learn program. In fact at the week 2 session, Jalen and Michael asked why they did not get any information about the ECP in middle school. Mrs. TV* (CHS STEM Coordinator) explained there was a sixth grade application process and "all parents were notified so they should have known."

With the ECP as the only STEM focused track in middle school, the participants were placed in the general math and science classes. Jalen explained, "It didn't matter what we had done in elementary school, we ended up with everybody else in middle school." With only one CSD middle school and no specialized option for STEM learning, the participants faced several challenges. Amanda described how teachers were unable to meet the needs of all students in the classroom. She stated, "So the teacher is like, well I don't expect you all to sit here and do stuff you already learned. But, we are determined to do the work and want the teacher to challenge us but they don't so we are just like, stuck." While most participants expressed concerns that middle school math and science classes lacked rigor, the students who attended the elementary magnet program were especially outspoken. As such, Michael said he "learned more in elementary school" than from his middle school math and science teachers. Jalen also stated that "middle school teachers didn't really give us anything hard to do."

*High school realities*. Despite being excluded from the ECP, the participants have taken honors levels STEM coursework: Algebra I Honors in the ninth grade, and at the

time of the study, Geometry Honors and/or Biology I Honors. As Quincy noted, "there are many required classes" for high school students and the "classes are a lot harder." While STEM ECP students completed Algebra I and II as well as Chemistry I Honors as middle school students, the participants will not have earned comparable credits until the end of their junior year of high school. Therefore, Quincy's concerns about "not having time" to get to dual enrollment courses is a legitimate concern since the aforementioned honors courses are prerequisites for math and science dual enrollment participation.

***Discussion of the effects of grade-level transitions***. The participants who attended the elementary math and science magnet program demonstrated the most resolute STEM interest. Their early exposure to math and science content and hands-on learning experiences provided a level of ease within STEM classes that was not as common among participants who did not attend the magnet program. The confidence the participants gained from their early learning experiences has solidified their interests and positively influenced their STEM disposition, even when the middle school learning environment may not have been as favorable.

The participants believe the middle school STEM classes lack rigor and opportunities for meaningful learning. While some participants shared a few stories of engaging activities in elementary school, they often described middle school unfavorably. On one occasion, Kimberly actually used the word "unpleasant" to depict a middle school math class. Whether for gaining access to the magnet program or the STEM ECP, the lack of parent advocacy is also significant. If as Mrs. TV* explained "all parents were notified" of the opportunity but none of the participants' parents took advantage of it, then the students were deprived through no fault of their own. While not overtly stated, it

also appears that no teachers or other middle school personnel encouraged the participants or their parents to consider the STEM ECP. Therefore, STEM interest alone – on the participants' part – is insufficient for gaining access to advanced level coursework and the dual enrollment opportunity. This lack of parent and educator advocacy speaks to the participants' significant human and sociocultural capital deficits. And, when coupled with the lack of rigor in the standard middle school STEM track, the participants' readiness for college level coursework is questionable.

**Summary of Theme 1.** The coding process unveiled four patterns of data which explain how the participants' academic experiences shaped their STEM disposition. These patterns were their history of academic achievement, transitions from one grade level to another, quality of their teachers, and the relationships among when they become STEM interested and their ability to access rigorous math and science classes. The second theme which emphasizes the significance of sociocultural influences on STEM disposition will be addressed next.

**Theme 2: The significance of sociocultural influences.** Within the framework of sociocultural theory, Strayhorn (2013) identified the interplay among human, social, and cultural capital as noteworthy shapers of African American students' academic experiences and life outcomes. The coding process revealed the participants' significant sociocultural capital deficits and also offered hope for improvements as a result of participating in the Lunch and Learn program. In the next sections, the data patterns which undergird Theme 2 will be addressed. These patterns are illustrated in Figure 4.2. Within the presentation of findings related to the second theme, this section will explore

relationships between the students' coursework and preparation for STEM careers. The economic implications of STEM coursework and careers will also be addressed.

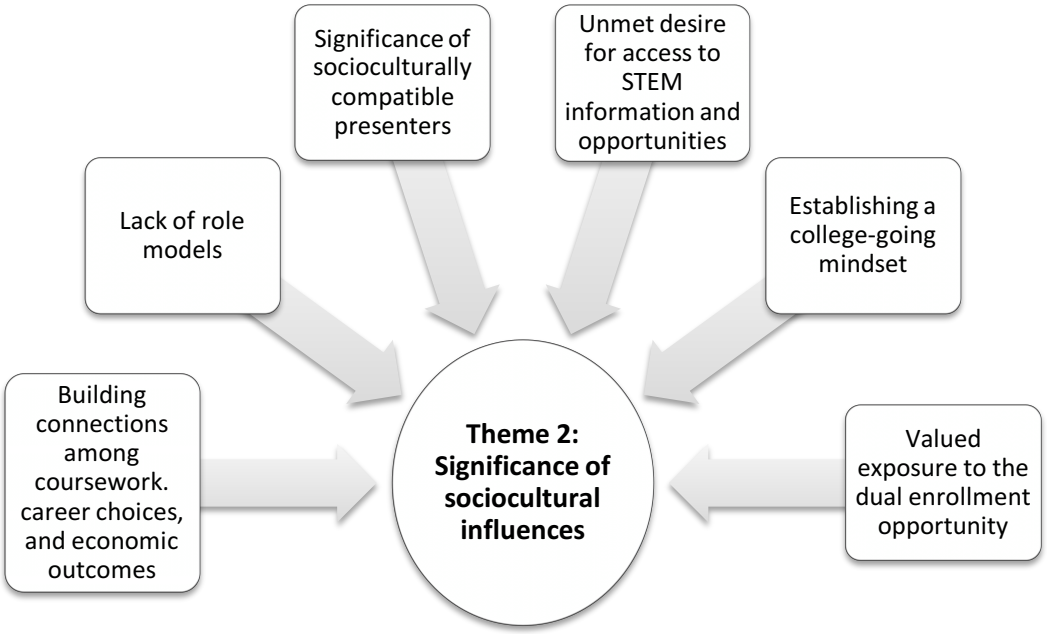


*Figure 4.2*: Sociocultural Influences and STEM Disposition. This figure describes patterns in the data which contextualized sociocultural shapers of STEM disposition.

***Building connections among coursework, career choices, and economic outcomes.*** To this point, the participants have had very little voice in the courses they have taken. As high school sophomores, the participants have mostly been subjected to state-mandated curricula and the standard options available to them within the CSD from the elementary grades to the present. Only those participants who were able to take part in the elementary math and science magnet program experienced an alternative learning setting. Despite these limitations, the participants have developed STEM interests and most plan to pursue those interests at the post-secondary level. For instance Jada wants

"to be a nurse practitioner," Michael plans to be "an engineer," Brian intends to be "a forensic scientist," and Jalen, a "computer engineer."

*Coursework and career connections*. The participants who started the counseling program with certain career plans were most able to draw correlations between STEM content and its usefulness for future careers. For example Michael stated, "Engineering is all about math so I know I've got to do well in my classes." Some participants were less certain about their career plans, but they were sure STEM would be a part of their futures. Amanda shared, "I am not sure about what I want to do exactly but I know I want it to be in the science field." Despite expressed STEM interests and stating that math and science are beneficial pursuits, some participants were initially unable to effectively communicate how math and science coursework would be applicable for their future careers. These participants – Quincy, Roger, and Steven – spoke in terms that indicated limited understanding of how to realize career goals based on their interests:

Quincy: I want to study computer science. That's why I wanted to be in this program because I can get benefits in my goals with this and know more about my career. I just need help…to figure out what I want to do and how to get it done.

Roger: I think I will study electricity. I want to extend my career choices and I believe math and science will open up my choices. Math is going to help me with my finances and science is going to help me with electricity.

Steven: Math and science are important for measuring and testing the amount of a chemical or length of a utility. I am planning to go to college and study something related to engineering. I'm not exactly sure what specifically but I think I want to be an engineering major in college.

School-driven career planning has not been a major part of the participants' experiences, which may explain their struggles to tie coursework to career goals. In fact, the CHS

Guidance Director shared during the first session that grade-level counselors "would be visiting 10th grade English classes to talk about different programs and options." Several participants said they were not taking English until the spring semester to which the Guidance Director responded, "Then y'all will get it later." The participants never got clarity about what "programs and options" or "it" referred to nor how they could acquire information before the spring semester. Kimberly and Jada were clearly perplexed.

During this same session, the participants' struggles to make coursework and career connections became even more apparent. As Quincy questioned the researcher about her career as a chemist, the following exchange occurred:

Quincy: I know you are a scientist, but I don't want to be a scientist. I want to work with computers and technology, not be a scientist.

Researcher: When we talk about being a scientist, sometimes people only think about being a chemist or a biologist and working in a lab but we use the word science broadly to include engineers, people who are interested in technology, computers, and all sorts of things.

Quincy: So a person who works with computers can be a scientist? But they don't do stuff in a lab right?

Researcher: Actually the process of making computer chips happens in a lab through a process called wafer fabrication. So some of the scientists you will meet over the next couple of weeks do different things. You will meet a computer scientist who does a lot with programming and robotics. You will meet other people, like engineers who also use and do science. I don't want you to think narrowly when we talk about science because it is connected to many different career interests. When you think about math, you use it in science; you use it in engineering, and computer science and technology. It's all connected so don't get too narrow with how you see it.

Quincy's initial disposition was not unique, as other participants were also unable to move beyond basic explanations for connections between coursework and career

pursuits. For example, although Jalen always expressed plans to become a computer engineer and that "math and science are important," he was unable to concretely explain *how* pursuing math and science classes would be valuable for his computer engineering career. Jalen said, "I am not exactly sure, I just know that I want to work with computers and that I am really good at math, so it just makes sense to me."

Regardless of the participants' STEM interests, plans to attend college, and the certainty about the careers they expect to pursue, the researcher observed their struggle to give details about how they would actually achieve their career goals when the counseling program began. Over time, the participants showed notable growth in their ability to tie their STEM coursework to specific career plans. For example, Roger explained "his math and science classes are very important now because he knows that he would really like to be a computer scientist" and "that means I've got to take some advanced math classes to learn the different computer applications" and Quincy said, "Computer scientists…solve problems and that means to be good at math and science."

*Career and economic connections*. A few participants started the program well aware of the economic benefits of STEM preparation and related careers. Jalen described these benefits by stating, "Engineers are paid very well but you have to do well in math and science to get there." Brian added, "I know math and science will be an important part of my job …and these classes will lead to a good job and increase my ability to earn a good salary." Students like Brian, with specific career goals were sure about the value of STEM coursework for their future economic opportunities; but others with vague career plans had more difficulty identifying these benefits. For example Steven said, "I think there are times when it is important and times when it does not really matter."

During the weekly sessions, several presenters stressed the positive economic outlook associated with STEM careers. These benefits included college scholarships, the ability to change careers, and sharing specific income data for persons working in various STEM jobs. Amanda said she was "excited to learn how studying science could help you do so many different things and make good money too." After week 4 when Mrs. JJ* explained how to leverage STEM skills "to make money on multiple fronts," Kimberly said, "So I figured that if I am a nurse practitioner and wanted to add something else to the things I do in my office, I could make more money if I did ultrasounds too."

At the end of the program, the students' were more aware of STEM's economic rewards regardless of their initial outlook. For example Jalen stated, "I know that I can earn a strong income if I am successful in my engineering major. That's real motivation to do well in math and science classes." The researcher observed the most growth among participants who were initially unsure about links between STEM and economic stability. These changes were influenced by the presenters' comments as Roger recalled, "like Mr. MD* said, if you want a big enough paycheck then you have to get the kinds of skills that help you to make it." Even Michael, though already convinced that STEM could be lucrative, gained a deeper appreciation for its benefits when he said, "I'm going to be an engineer and when I do, I expect to make some money."

STEM benefits were also important to students who want to improve their socioeconomic position. Quincy stressed his wish "to be somebody," Steven talked about applying interests in "gaming and technology so [he] can figure out how to turn that into a career …to make a good living," and Roger said "doing well in high school and college [means] you can have the money you need to take care of yourself and your family."

***Discussion of connections among coursework, career choices, and economic outcomes.*** The participants made incredible progress in their ability to view STEM as a vehicle for career and socioeconomic stability. Although some students were initially more resolute in their STEM disposition, each participant made progress in his ability to explain connections between coursework and careers. Thus, the counseling program appeared to help students articulate their STEM interests more clearly and to draw potential pathways toward career pursuits. Rather than simply *wanting* or *hoping* to become a scientist or an engineer, the participants were able to identify specific steps they could take to achieve their goals. This increased awareness of STEM-related opportunities and economic benefits also seemed to encourage their efforts. Thus, the researcher noted the potential for awareness of economic outcomes to motivate students.

Despite these positive effects, the findings revealed the participants had no access to STEM career information from the CHS Guidance Department before taking part in the counseling program. The Guidance Team has information about how students can access dual enrollment courses, their related cost-savings, and the potential economic benefits of STEM careers. Yet, the researcher was unable to confirm that any activities were scheduled to raise STEM awareness or access among the general CHS student population or this study group, in particular. It is also unclear if the participants will be able to interact with other STEM professionals as part of the school's career planning efforts. Without sustained intervention, the students' appreciation for STEM career and economic benefits may not remain at the level needed to pursue dual enrollment classes at CHS. The second sociocultural influence on STEM disposition presents a social capital deficit – a lack of role models. The findings related to this data pattern are discussed next.

***A lack of role models***. Role models are often the messengers about STEM's academic and economic benefits. These messages may occur in the form vicarious experiences and verbal persuasion (Bandura, 1986). Thus, a role model is often able to guide a student on the STEM journey by motivating, encouraging, and coaching him or her toward a goal based on personal knowledge and accomplishments.

Jada is the only participant with a consistent and actively engaged STEM role model. This deficit may explain the students' early difficulties to make connections between their coursework and career choices as well as their limited understanding about STEM education as a platform for socioeconomic advancement. When considering the positive impact of a role model on STEM disposition, Jada's experience is truly unique among her peers. Her mother is a nurse practitioner who pursued this career "because she likes to take care of people." Jada's desire "to be like her in every way" has motivated her to follow the same path. Jada said she thinks becoming a nurse practitioner "is the best of both worlds because I can make a good living and help people while doing something I'd love to do." Therefore having a STEM role model has enabled Jada to realize personal, professional, and economic benefits of her career choice. Early in the program, Quincy identified Coach Shane (his former math teacher) as a STEM role model. However as he interacted with more STEM professionals, Quincy's idea of a role model evolved. His career interests became better defined, which was evident when he said:

> I am now thinking about some of the people who work like in the field that I am thinking about going into. It's not that a teacher cannot be a role model but it's more like I am thinking that I may need someone who is actually doing the same thing I want to do. Coach Shane is a person I really respect and he is still somewhat of a role model, but just not for the career I am thinking about now.

***Discussion about the lack of role models***. Math and science related careers involve complex skills. Having a STEM role model is often useful for developing the coping strategies that enable students to persevere through challenges and build efficacy (Bandura, 1986). Role models can also fill the sociocultural capital deficits in the participants' lives by using their own experiences and life outcomes as examples of the socioeconomic advantages of STEM education. Despite these participants' interest, good grades, career plans, and improved knowledge about socioeconomic advantages of STEM education, their lack of support from persons who are able to share occupational successes and failures as well as provide first-hand accounts of how to navigate the complexities of STEM careers is concerning. Except Jada, it is unclear if any participant has a cheerleader to provide the verbal encouragement and emotional support needed to take the first steps toward dual enrollment participation. When considering the challenges of pursing college level coursework as a high school student, the participants' lack of role models may hinder their pursuits. Through the Lunch and Learn program, the participants were introduced to several potential STEM and academic role models. In the next section, the findings which pertain to the influences of these persons on the participants' attitudes about STEM and dual enrollment are discussed.

***Significance of socioculturally compatible presenters***. In his exploration of Critical Race Theory and teaching of the law, Lawrence (1995) described the importance of pedagogy as a tool for reshaping the narrative "within the dominant discourse [that] has systematically excluded the experience of people of color and other outsiders, and where we are trained to believe that the story told by those in power is a universal story" (p. 337). Just as African American stories have been excluded in legal scholarship, they

have also been omitted from conversations about excellence in STEM. For this reason, most of the weekly presenters were native South Carolinians. All presenters were either African American STEM professionals or students. The participants' comments, body language and deep engagement with the presenters confirmed the validity of this choice.

*Reponses to the researcher.* After the researcher's presentation Jada shared she "had never met a Black chemist before" and could not believe she was recognized "by the FBI." Brian shared he "never thought any Black people wrote science textbooks" and Quincy wanted to know "how [she] became a chemist" and "what classes [she] took in high school and college." As the researcher shared stories from her journey, the students wanted to know more, especially about her earnings. Michael was chiefly interested asking, "Would you be mad if I asked you how much money you made?" When the researcher provided specific data about STEM earning possibilities, Michael was visibly pleased and nodded his head in agreement while saying, "That's what I'm talking about!"

*Responses to CHS employees.* Two presenters, Mrs. TV* and the CHS Guidance Director, work at CHS. The Guidance Director also presented during the first session and introduced the idea of dual enrollment. Her talk was well received and as Roger stated, "helpful for learning that we could actually start college while still in high school." Mrs. TV* has an extensive background "as a mathematician and math teacher." She leads the STEM ECP and works as the CHS STEM Coordinator. During her talk, Mrs. TV* noted her small town South Carolina roots, her early "love of mathematics" and her pursuit of math as "the only Black student in the department" at a South Carolina university. The students found Mrs. TV*'s presentation "interesting" but Jada said, "She talked over our heads." The researcher detected disengagement when her talk shifted to "Carnegie units."

*Reactions to student presenters*. The STEM ECP students spoke during the same session as Mrs. TV*. Several participants described time with STEM ECP students as the most meaningful part of the program. Brian said, "Listening to the students tell about their experiences in the dual enrollment classes was great. They are doing it now, so they can really help us to understand what it is really like." The STEM ECP students' first-hand accounts also inspired Quincy who said, "The students are like us, you know, from here, and they are doing it [dual enrollment], so I think we can too." The more the STEM ECP students talked about their dual enrollment experiences, scholarships they anticipated for college, summer excursions, and the value of early exposure to college, the more engaged the participants became. Even shy participants like Steven and Brian were more talkative than usual. Michael, Amanda, and Jada talked among themselves about the information the STEM ECP students shared. The session went over time and the participants asked for special permission to continue into the next class period.

*Reactions to other STEM presenters*. The week 3 presenter, Dr. NH* is a CHS graduate, a first-generation college student, a former scientist and middle school science teacher, and currently working in STEM education leadership. The participants connected with Dr. NH* because she is a CHS graduate and a first generation college graduate. The female participants were most interested in her career journey and work as a biological researcher. Jada admired Dr. NH*'s ability to transition from one career to another based on her STEM training and said she realized, "that you can have one mindset for the longest but what you love the most will lead you to a different path." Jalen said Dr. NH* helped him realize "you don't have to come from a fancy town to become somebody."

The week 4 session was led by computer scientists, Mrs. JJ* and Mr. MD*. Both presenters spoke about being from rural SC communities and first-generation college students. They talked about "missteps" and "struggles" and Mr. MD* directly addressed how "economic advantages of STEM preparation made sense for coming out of poverty." While both speakers were very well-received, Mr. MD* was the first adult male presenter the participants met. He made a significant impression on the young men. Brian stated, "What I enjoyed most was [Mr. MD*] story about his family because as time passes I feel his story will be more or less my story." Quincy said, "I enjoyed when [Mr. MD*] was talking…about real life situations that a lot of people in [our town] go through. He made it and I feel that if he did, I can too." Michael said this session "really helped" to understand how STEM classes and "technical college certifications for computers and other topics" can be "useful for making good money."

*Reactions to the technical college representative*. Mr. HL* was the last speaker. He is a liaison between CHS and the technical college. His talk began with a video that addressed basic dual enrollment facts. He quickly shifted to the admissions requirements and honed in on testing. The more Mr. HL* said about testing, the more indifferent students became. Jalen asked, "What is your background?" and said, "All of the other speakers…told us how they got to where they are." When Mr. HL* said he was not a STEM professional and continued with "getting ready for the test," the participants were done. After the session, Jalen said his "presentation was useless" and Amanda said he "spent too much time trying to scare us about the test." It is worth noting that Mr. HL*'s session ended 10 minutes early and the participants did not thank him for coming as they had done with others. After he left Michael said he was "the worst of all" presenters.

***Discussion about the significance of socioculturally compatible presenters***.

Most presenters' messaging was effective because they were able to make meaningful connections with the students. These links included coming from similar socioeconomic backgrounds, having STEM interest, telling how STEM helped them in their careers, speaking candidly about their earnings, and using language to which the participants could relate. The STEM ECP students, Mr. MD* and Mrs. JJ* used African American language regularly and effortlessly when they addressed the participants which placed the participants at ease. For example, Jada said she liked "how they [Mr. MD* and Mrs. JJ*] weren't tryin' to be all proper and stuff when they talked and how they kept it real." Quincy emphasized how the "students broke things down." On the contrary, persons like Mr. HL* and Mrs. TV* were perceived as a bit arrogant. Amanda said Mrs. TV* "was trying too hard to use big words rather than just telling us the basics." Jalen was perturbed by Mr. HL*'s lack of STEM credibility and "his negative attitude." Through vicarious experiences and verbal persuasion, most presenters introduced the notion of African Americans in STEM as a norm. However it is concerning that the participants do not regularly encounter African American STEM professionals. In the next section, the students' desire for more information about STEM opportunities is addressed.

***Unmet desire for access to STEM information and opportunities***. While the Lunch and Learn program was useful for exposing the participants to STEM possibilities, their comments revealed how little information they have received about course and career planning from the CHS Guidance Department and the degree to which they desire to engage with persons who can help them to make key decisions about their futures. The participants repeatedly said the sessions were "too short" and they "wished for more

time" to ask questions. The range of unanswered questions was broad and touched on many topics. Kimberly wanted to know if "honors classes can count for college credit" while Jalen had questions about "getting into engineering." Brian wanted to know about "getting internships and mentors" and Amanda asked if CHS "would help interested students get ready for the [ACCUPLACER] test."

***Discussion about the unmet desire for access to STEM information and opportunities.*** The participants have few outlets to access to STEM information. The CSD has prioritized the STEM ECP students in terms of preparation and access to opportunity. As the ECP students talked about the dual enrollment classes, field experiences, testing support, and summer excursions from which they benefit, the participants wondered aloud, "why [they] don't have this information." The participants believe they have been underexposed to helpful resources to prepare for advanced classes and for their futures. The ECP is an excellent program but it only serves a small number of students. For STEM interested students, the pathway to dual enrollment and the opportunity to access STEM resources are very slim. The Lunch and Learn program has ended, so it is unclear to whom the participants may turn to receive guidance and information to explore STEM coursework and career options. The next section discusses the findings which support establishing a college-going mindset as a means of improving cultural capital.

***Establishing a college-going mindset.*** Each participant except Roger originally intended to attend college because as Brian declared, "College is definitely important."

*Messages about the importance of a college education*. Despite their intention to attend college, at first some students were uncertain if college was personally meaningful

for their future careers. About the value of college, Steven said, "Yes, well maybe it might be. I don't know for sure." Quincy stated, "It might be. I'm not sure." Roger added, "I am not sure if it is." While the researcher is unsure about the source(s) of these messages, it is noteworthy that neither of these students has a parent who attended or graduated from college. The remaining participants acknowledged the importance of earning a college education. However, the sources of this messaging varied. Some participants' attitudes about going to college were shaped by family members. Jada stated that her mother always says that "college is the only way." Amanda stated:

> I believe college is a must and I have always heard family members say that it is an experience unlike any other. I want the college experience. The most important thing I remember for myself and for my family is that my grandfather told us that education is a must. You cannot go without education.

For other participants, college attendance is linked to achieving specific career goals. As Kimberly explained, "College is important because I am planning to become a nurse." Michael said, "I am planning to become an engineer so that will require going to college." Brian added, "There's no way you can get to become a forensic scientist without going to college." While Kimberly, Amanda, and Brian made positive correlations between their career plans and the need for college, Roger's initial plans to skip college were based on his intentions to become an electrician. Roger explained, "I don't need to go to college for that [becoming an electrician]."

Still other participants emphasized the socioeconomic benefits of obtaining a college education. Kimberly said, "I know if I can go to college and do well then I will get a good job and career." Jada added, "Good jobs usually require college and since I want to do a nursing major, I know I will need to go to college for sure." The participants' ideas about the socioeconomic benefits of earning a college degree were

reinforced each week by the invited presenters as they told their own stories of social and cultural mobility as a consequence of earning a STEM related college degree. One exchange between Mr. MD* and Amanda during the week 4 session was especially impactful as Mr. MD* explained the connections between college and economic stability.

Mr. MD*: When you think about college and choosing a career field, you have to think about your paycheck. Remember I told you this earlier, right? Remember, in the end you want a check that looks like this [expanded hands] not like this [making a shrinking hand gesture and turning into a zero]. And once you get into a job and work awhile, if your check starts to look like this [small and then zero], what do you need to do?

Amanda: Get more education so you can do better?

Mr. MD*: Right, you can always get back here [expanded hands] if you are willing to learn new skills, get additional training, or pursue education to help you get promoted and earn more.

The messages which focused on college as a means of socioeconomic empowerment were meaningful whether they came from the guest presenters, a parent, or a peer. For example, during her interview Jada explained that her mother's earnings as a nurse practitioner enabled her family to take vacations often. Jada stated:

> We usually go somewhere nice whenever we have a long weekend so my mom took us to the beach this time. We get to go a lot of nice places and every time we go somewhere, my mom says, "This is what college gets you." She says it ALL THE TIME! And me and my lil' brother are like, we know…goodness. But, I get what she's tryin' to say to us, you know? You've got to get a good education if you want to have a good life.

Even students like Quincy, Roger, and Steven who had initially undervalued college education progressed in their ability to connect postsecondary studies to socioeconomic advancement. During his exit interview Roger shared, "When I started this program I was

kinda focused on being an electrician but now I think I want to go to college for something better, you know to make better money like Mr. MD* was talking about."

*Parents as college-going exemplar*s. Like Jada, Amanda and Brian are the children of college graduates. As such, these participants have first-hand knowledge of the benefits a college degree; and, the value of college has been instilled in them from an early age. When interviewed, Amanda said her mother could not "run her trucking business without a college degree." Brian stated, "I've always known I would go to college. It's just what they [his parents] expect me to do." The steadfast college-going mindsets observed among these second generation students was unmatched by most of their peers. However, the participants with at least one parent who attended but did not finish college demonstrated great value for college and some expressed a strong desire to attain the goal that eluded their parents. For example Michael stated, "College is so important to me. My mom started college but did not finish. She is still paying on student loans but she doesn't have a degree. But, when I do [go to college], I'm definitely going to finish."

Both Jalen and Kimberly's mothers started college but did not complete their degrees. Like Michael, these students are resolute in their desire to attend college and they are readily able to tie this desire to specific career aspirations. When asked about his plans to attend college Jalen stated, "Oh yes, for sure. I definitely need…college because I am planning on becoming a computer engineer." Kimberly said she wants "to go to college and become a nurse" and that achieving her goal will "help her to go far in life." Even with a solid will to achieve their goals, Jalen, Kimberly, and Michael lack parental examples of college success. For example, when asked about his mother's inability to

complete her college education Jalen said, “I’m not really sure what happened.” Thus, these students are unable to draw upon the experiences of parents who successfully persevered through the college experience. Neither of Quincy’s, Roger’s or Steven’s parents attended college. In fact, Quincy’s mother did not complete high school. Throughout the Lunch and Learn program, none of these participants talked about college as a goal inspired by their parents. Nor did they make mention of any messages they received about college from their parents.

***Discussion about the significance of establishing a college-going mindset***. When parents and other family members instill the value of college in their students early on, it is a gift of cultural capital evidenced by beliefs and actions aligned with a firm college-going mindset. Although observed at varying degrees, the participants whose parents at least attended college were committed to pursuing this goal. Thus, it is likely they received positive messages about college as a worthwhile quest. In this sense, the Lunch and Learn program was valuable for all participants. On the one hand, the presenters reinforced the already established college-going mindsets of some participants. Conversely, the participants who were initially unconvinced that college was useful received persuasive messages about the specific socioeconomic benefits of achieving a college degree. Essentially, these messages countered many participants’ sociocultural voids and exposed them to new possibilities of post-secondary pursuits.

The findings revealed exposure as the final sociocultural influence on the participants’ STEM disposition and attitudes toward dual enrollment. This section details findings that explain the students’ progress from limited knowledge about the CHS dual enrollment opportunity to their attitudes at the conclusion of the counseling program. The

findings also drew attention to the participants' need for support – from peers and others – to pursue and succeed in the dual enrollment classes.

***Valued exposure to the dual enrollment opportunity***. Dual enrollment is one pathway for students to access college level coursework while concurrently enrolled in high school (Karp, 2012). While the CHS dual enrollment program has been in existence for a few years, the participants did not really know much about dual enrollment. Only Brian, Jalen, and Michael had any prior knowledge about the classes. Brian stated, "I knew they offered some of these classes here but I did not know how to get into them."

*Initial attitudes about dual enrollment participation*. It is not surprising that most participants were either uncertain about or completely disinterested in taking a math or science class since they had "never heard of it." Only the students with prior awareness of the program were initially interested in taking the courses. When questioned about his interest in dual enrollment courses Jalen explained:

> Math and science are the subjects that I need in order to pursue my career and are helpful for my future…It is important to take advantage of anything you can to achieve something great so why not take the opportunity to help myself.

While other students were unsure about trying a dual enrollment class, they were optimistic about their potential benefits. Roger said the classes could give him "more career choices" and Amanda explained how they might "help to figure out what to major in for college." Quincy and Steven initially expressed no interest in pursuing math or science dual enrollment courses. Quincy explained his disinterest by stating, "I'm not sure I'm even going to college."

*Shifting attitudes*. Although it was mentioned at each weekly meeting, two of the five sessions were explicitly focused on the CHS dual enrollment program. These

sessions were held during weeks 2 and 5. The week 2 session included presentations by Mrs. TV* and three STEM ECP students, who were all graduating seniors scheduled to receive their high school diplomas and Associate of Science (A.S.) degrees in May 2018. As each presenter shared detailed information about the dual enrollment program, the participants' grew in their knowledge of and interest in the classes. For example, Mrs. TV* talked about the CHS's limited options "for AP STEM classes" and she pointed out advantages, in terms of GPA calculations and class ranking, when students earn college credits while still in high school. With this increased knowledge of its potential benefits, the participants' thoughts about the value of dual enrollment shifted. Amanda shared:

> I should take dual enrollment classes so I can get the feel of college work and already have my freshman college classes out the way. I really did not know much about the dual enrollment program before but now that I do, I am definitely interested in knowing more, especially for how I can get into the classes.

Jada added, "I can see there are a lot of great benefits and opportunities that come with being in the [dual enrollment] program."

Mrs. TV* also emphasized the cost-savings benefits of dual enrollment, which the STEM ECP students stressed. They shared details about college scholarships and the money saved by earning college credit as high school students. Valerie, an ECP student, was especially vocal as she explained how "she gets so much mail from…schools that are willing to offer…application fee waivers and other incentives to encourage [her] to apply to their school…and crazy emails talking about scholarships, scholarships, scholarships." Kylie (another STEM ECP student) added, "Yeah, and then like (named) University sent me a free application. Of course I did it and then ended up sending me a scholarship offer for $27,000." While many students noted the economic benefits of earning dual enrollment credits, Quincy was the most frank about this advantage as he explained that,

"scholarships could really help me for college so if I can get money to go by taking the classes, it [college] might be something I could really do." During week 5, Mr. HL* also described the cost savings of earning college credits as a high school student and the ease of having college access on the CHS campus. The participants were noticeably engaged at this point with a few students (Amanda, Michael, and Brian) commenting about their excitement "to get started in the classes."

*Developing outlook toward dual enrollment*. Over the course of the counseling program, the participants' interest in pursuing dual enrollment classes increased significantly. For students who started with existing dual enrollment awareness, their attitudes toward these courses remained positive. For example Brian said, "I want to do a science class for sure." Jalen said that he felt "pretty good about taking a math class in the future." Others who were unsure at first evolved in their positions over time. Amanda stated, "I really want to take the classes, as many as I can." Roger said he would "definitely be interested in taking a class, most likely something in math." While they expressed interest, some students were more analytical as they considered taking part in dual enrollment. For example, when asked if he thought dual enrollment is a good choice for him, Michael stated:

> Maybe. It's not because I am not planning to go to college because I am. But, there are other programs I want to get into like the Upward Bound. If taking the dual enrollment class gets in the way of that I might not want to do it. The other thing is that I remember the students saying that their grades sort of dropped at first. That might hurt my GPA and could hurt me for college. So I am not sure. I'd have to think it through some more. Once I figure out if I can do Upward Bound and dual enrollment at the same time, then I definitely plan to do a math class.

Jada also demonstrated deep consideration for her overall well-being when she said:

> Maybe it might be a good option for me. I don't know for sure. Like, if I am going to college in a few years, I don't know if starting early is going to put too much pressure on me too soon. I want to be ready but I don't want to overload myself in high school.

Despite progress in their dual enrollment interest, some participants expressed apprehension about taking the next steps toward participation. Kimberly acknowledged the value of dual enrollment courses but insisted that she "just was not sure if it would be the best choice for her" even though early STEM access "can help with college." Quincy also shared his interest in "taking a math class" while acknowledging "I am just not sure how all of that would work for me because I might not get the chance to do it with everything else we have to take to graduate." Steven said:

> I really enjoyed learning about the dual enrollment classes. I know they have some good qualities and there are many liberties of being in STEM. But I am not sure if I really am ready to go into the college classes as of yet. I am just not sure about it all right now. I would need to think about doing a class more. I mean, I might *want* to do it but I am not sure if I would *actually* do it.

*External support for dual enrollment*. Steven's response highlighted how perceived support influenced the participants' attitudes about dual enrollment courses. While they recognize its benefits, the fear of failure is a concern. Kimberly linked her uncertainty to having "to push myself to do it." Steven stated, "I know I would need somebody to stay on me to get my work done." Even the most self-assured participants acknowledged the need for support. Michael stated, "It takes courage to sign up for a new challenge and I have got plenty of that [laughing]. But you also need the people around you to encourage you so you can succeed." Brian said, "I would need some inspiration, you know like having someone else to help me to stay motivated to keep going when it got tough." Jalen was an exception among his peers as he explained, "I have the courage

to do it [take a class], so I really believe I will do it." These comments raise concerns about who might be able to encourage the participants to persevere in dual enrollment classes, especially those who lack the self-efficacy to persist under academic pressure.

*Peer support for dual enrollment*. Although the participants lack support to pursue dual enrollment courses from adults, such as role models and school-based persons, the potential of their peers to provide support is promising. This type of peer support was modeled by the STEM ECP presenters during the week 2 session as the students described how they "all hold each other accountable… ask each other did you do your work or do you need help…and work together and help each other out." Valerie went on to say, "This is why it is important to find someone to partner with so you can take the tough classes together… and study together. I don't mean cheating off of one another but really working together." The collaboration exemplified by the STEM ECP students exposed the participants to methods for overcoming their limited external sources of support. During her interview Kimberly explained, "Like if everybody in this group said they were going to do it, then I would do it too. I think if we did like the other students, doing it in a group, then we could all make it through." Amanda echoed Kimberly's sentiments as she described that, "It would be good to have someone else to do the class with, you know, somebody I already know like the other students mentioned."

***Discussion of the valued exposure to the dual enrollment opportunity***. The participants received rich information about dual enrollment and its many advantages. Since only three of the nine participants were initially aware of the CHS dual enrollment program, the exposure was meaningful. And, with this increased knowledge, each

participant expressed interest in learning more about the program and how it could potentially help them gain access to resources for college.

Under the current CHS Guidance Department structure, non STEM ECP students typically learn about dual enrollment either in the second semester of their sophomore year or the fall of the junior year, with the staff emphasizing humanities offerings as the point of entry. Thus, most students are likely to enroll in English or Psychology as seniors. But for this research study and its emphasis on STEM classes, most participants would remain unaware of the opportunity and how to gain entry into the dual enrollment program. Now that students have been exposed to dual enrollment and the requirements for participation, they are in need of school-based support to take the next steps. The participants have admitted their need for support from others to do so; however, it is unclear if CHS has any school-based advocates to assist with this need. This deficit within CHS compounds the participants' obstacles since they lack role models to help fill the external support void. Certainly the STEM ECP students were helpful for opening the study participants' eyes to the value of peer support in the dual enrollment program. However, peer support alone may not be enough to overcome the fear of failure, low levels of self-efficacy, and limited support from adults within and beyond CHS.

**Summary of Theme 2**. The findings revealed several data patterns that explained the impact of sociocultural influences on the participants' STEM disposition and attitudes about pursuing math and science dual enrollment courses. The findings indicated that the participants started the counseling program with noteworthy sociocultural deficits, which included (1) limited understanding about the relationships between the courses they took and their career and economic outcomes; (2) a lack of role models, (3) limited

information about STEM opportunities, including dual enrollment, and (4) weak foundations in terms of their college-going mindsets. However, the information shared by numerous program presenters exposed students to many benefits of the CHS dual enrollment program. In the next section, the final theme, which the effects of testing, is discussed.

**Theme 3: The effects of testing.** The findings revealed two noteworthy effects of testing on the study participants' STEM disposition and their attitudes about dual enrollment classes. The first focuses on the effects of the Algebra I end of course (EOC) exam and the second emphasizes the weight of the ACCUPLACER exam as a barrier to dual enrollment access. These effects are addressed in the next sections.

*The Algebra I EOC*. The participants comprehended the importance of the Algebra I EOC. As Amanda explained, the teachers "have to get us right for testing because they are being looked at depending on how we do." Not only are teachers concerned about the EOC, so are the students. Michael discussed the significance of the EOC as he described how students must "get ready for the test" and that "the test is a really big deal." Because there is such an emphasis on the EOC from both teachers and students, the participants' self-perceptions are affected by how they perform on the exam.

Jada talked about how "she made one of the highest grades on the test" and since "it was a really hard test and [she] did well, she was really proud of herself." In the same manner that Jada described her EOC score as a grade, other participants made similar connections. In fact, each participant made at least one comment that situated her general attitude about math and science coursework in the context of grades and performance on standardized testing. It was as if these two data points were inseparable. For example,

Quincy said he "did well in the [Algebra I] class and pretty good on the test last year for math." Jalen also stated, "I got an A in the class and on the test."

Although the participants were exposed to standardized testing in the elementary and middle grades, the Algebra I EOC was the first substantive exam – with respect to their perceived STEM capabilities – the students experienced. Therefore, the participants' performance on this exam enhanced their confidence. Amanda described her feelings, stating:

> I felt very confident because I had excelled in the class all year long. I never left my class without an A so I just felt very confident. I treated the end of course just like a regular test so I felt good. And, when I got my grade, which was a B by the way [smiling], I knew I was good in math.

*Dual enrollment implications*. The effects of participants' past math testing performance were especially obvious when they discussed which, if any, dual enrollment classes they may pursue in the future. For example Michael said, "It would be a math class for sure" and Jada stated, "If I did, it would most likely be a math class because it's always come easy to me." With the exception of Brian and Amanda, the participants only expressed interest in math dual enrollment courses; and for several students, this interest was directly tied to their past Algebra I performance. Roger stated, "I did well in Algebra class so I would focus on the math classes instead of science." Amanda and Brian were interested in both math and science classes, although Brian said that if "forced to choose, he would pick the science class without a doubt" because he wants "to get as many science credits as possible."

*Testing as a barrier to dual enrollment participation*. Despite an "OK" performance on the Algebra I EOC, Steven explicitly described testing as an impediment to his pursuit of dual enrollment classes. When asked about his plans to take a class,

Steven said, "And then there's the testing part. I am not so sure I would do well enough on that so I am just not sure." The "testing part" to which Steven referred is the ACCUPLACER exam. The ACCUPLACER is required for admission to the CHS technical college partner and for dual enrollment participation. Thus, earning an acceptable score is significant for gaining access to dual enrollment classes.

The participants were told about the testing requirement during weeks 1, 2, and 5. In the first two sessions, the CHS Guidance Director and the STEM ECP students, respectively, called attention to the testing requirement but it was not overly emphasized. It was presented in an encouraging manner that affirmed the study participants' ability to succeed. For example, the Guidance Director explained:

> You have to take a test called the ACCUPLACER. This test is very similar to the SAT and ACT so once you take that test and make a specific score, then you would qualify for certain classes. All you have to do is take the test, pass it, and then sign up for the classes. It is just that simple. And, we definitely want you to do it so you can start earning those college credits.

During the week 5 session Mr. HL* repeatedly stressed the significance of testing, which turned many participants off. At one point Mr. HL* said, "Now I have to be honest, the test is not easy and most people need to take it several times before they pass it." This statement triggered mumbling among the participants. Kimberly said, "Count me out!" and Steven turned his back to the presenter. He was withdrawn and looked down at his notebook for the remainder of the session. Mr. HL* continued to talk about the testing and the participants became less interested in his presentation. After Mr. HL* left the room Michael asked the researcher, "Why did he keep talking about the testing? It was as if he was trying to discourage us from taking the classes." Several participants nodded in agreement and Amanda said, "Yeah I know." Quincy added:

> He just kept talking about testing, testing, testing. I know we have to pass the test but that's a turnoff...just talking about tests so much. This is why we don't like certain classes 'cause it's just test, test, test.

The participants' concerns about the testing requirements were noteworthy. Brian explained that he "might need some help with preparing for the tests." Roger also said, "I would feel good if we had some help getting ready for the test you have to take to get in the classes." Each participant referenced the testing requirement when discussing their dual enrollment intentions. While some students like Jalen and Brian, remained hopeful about their ability to succeed on the tests with some support, several other participants were unable to move past the fear of failure. Kimberly said, "I am not sure if I can do it…I wonder how many times I would need to take it before I passed. I just don't know."

**Summary of Theme 3.** As an early college access option, dual enrollment courses have many benefits. However, accessing those benefits is contingent upon earning an acceptable score on the ACCUPLACER exam. Therefore, the participants need more than STEM interest to take part in the classes. They must prepare for and succeed on the exam. The most significant barrier for many students is their lack of self-efficacy; however, this challenge is exacerbated by their limited access to resources to prepare for the exam. While the College Board provides online ACCUPLACER preparation via sample test questions, the participants lack the sociocultural capital needed to receive individualized support and encouragement to get ready for the exam.

Standardized testing has been especially important in building or harming the participants' disposition, as they have frequently discussed their abilities in math and science classes in tandem with their performance on tests. The students' favorable performance on the Algebra I EOC has been a source of affirmation of their mathematics

ability. However, the EOC is a culminating event preceded by solid earned grades throughout the academic year. By contrast, students must overcome ACCUPLACER first and then they are able to gain access to coursework. Based on the weight the participants placed on testing, the researcher fears that an initial exam failure would permanently deter many students from retrying the exam and pursuing the coursework altogether.

**Discussion and Interpretation of Findings**

While the qualitative data supports the researcher's assertion that all study participants benefitted from taking part in the Lunch and Learn program, the range of benefits varied and was most dependent upon the participants' incoming STEM disposition. When considering the small sample size and each participant's unique identity, the researcher considered an individual profile the most effective way to accurately interpret the major study findings by participant. This decision is based on Noble's (2011) explanation that studies involving African Americans in STEM should consider awareness of participants' "academic worlds and how that awareness affected how each situated themselves inside their academic worlds" (p. 194). These brief summaries (Appendix G) draw comparisons between the participants' STEM disposition, including their attitudes about dual enrollment participation upon entering and exiting the program, and are juxtaposed against the theoretical constructs which ground this study.

**Reflective Stance**

"A self-aware, self-reflexive teaching population, capable of producing the highest quality learning situations for pupils, is a laudable and necessary aim in a world characterised by social fragmentation, increasing economic competition and personal turbulence" (Leitch & Day, 2000, p. 186). Within this study context, the description of

reflective practice as a critical element of action research is especially appropriate. The study participants are certainly worthy of a high quality academic environment, but they have not always been exposed to learning settings that are most aligned with their needs. Furthermore, the legacies of oppression and longstanding socioeconomic disparities these participants face within their communities have added to their challenges.

Despite these obstacles, the researcher is optimistic about future possibilities for these participants and the CHS community as a whole. With the creation of the dual enrollment opportunity and the STEM ECP, the participants are part of a shifting culture at CHS. As the STEM ECP students have experienced increased exposure and successes, the participants believed they can have comparable outcomes if they work diligently and collaboratively to take advantage of the opportunities available to them. Thus, these participants were open to the possibility of STEM in new and exciting ways and they viewed themselves as important drivers of their own futures. This shift was especially encouraging and made the efforts expended in this study worthwhile.

**Connections to the Research Questions**

In this section, the researcher will examine the major findings as they relate to the specific research questions posed in this study. While the detailed findings have already been explored through the instruments and related emergent themes, this discussion contextualizes the findings as they specifically relate to the research questions.

**Research Question 1: What is the effect of a counseling program intervention on African American students' STEM disposition at Crosstown High School?**

STEM disposition is complex as it is influenced by a number of factors, including prior experiences, persistence, motivation, and achievement (Museus et al., 2011). Thus, the

researcher could not adequately address this research question without an exploration into the experiences that fashioned participants' STEM disposition before starting the counseling program. These factors are summarized in the discussion of Research Question 3. However, a few of these factors will be briefly addressed in this section for the purposes of highlighting the effects of the intervention.

The counseling program was structured with significant consideration for best practices endorsed by Ohrt, Lambie, and Ieva (2009) and other researchers. These best practices included purposeful recruitment of participants, having student presenters as peer role models, and engaging adults whose life and career experiences exemplify possibilities for the participants. Primarily, the participants entered the program driven by past successes in the math and science classes and a history of academic achievement in terms of grades and standardized testing. However, the students had very little exposure to STEM professionals who looked like them and came from similar backgrounds and communities. The weekly presentations introduced the participants to African American scientists who connected with them socioculturally, and through these interactions, the participants began to entertain the potential to replicate the presenters' experiences. As the presenters told their stories of humble beginnings, setbacks, perseverance, achievement, career changes, and success the participants saw themselves in the speakers. The participants used phrases such as "like me" to "from here" to draw connections between themselves and the persons they encountered. Hence, taking part in the program positively influenced their self-perceptions and their ideas of who they might become.

The participants' comments about the power of these interactions were noteworthy. For example, despite appearing disinterested many times during the program

Roger shared, “I know I was not always participating but I was really listening so I was quiet. This program has really helped me. I think I have some ideas for my future now, especially after meeting people like [Mr. DM*].” Steven talked about how “good the speakers were” and Quincy explained how he “wished the speakers could keep talking more so they could learn more from them.” Amanda talked about how “motivated” she was after meeting Dr. NH* and “hearing her talk about her research at Duke University.” Kimberly also referenced Dr. NH*’s presentation and referred to her as “really inspiring, especially being from here [referring to the local CHS community].”

The participants’ positive reactions to the STEM presenters emphasized their desire to achieve and as Quincy often said, “to be somebody” while simultaneously calling attention to their underexposure to positive career role models. The adult presenters touched on many different contributors to STEM disposition and demonstrated through words and actions, how they overcame obstacles to achieve in their respective fields. Brian summarized the value of the program by stating that “he loved the opportunity to learn about more opportunities” and “the speakers were a big part of that.”

The participants started the program with positive STEM disposition, but this outlook was based on limited experiences, mostly within the context of a score on a test or a classroom-based experience. As structured, the counseling program broadened the participants’ exposure to the real-life experiences, opportunities, and lessons both within and beyond the classroom that are more likely to help them accomplish their long-term career goals. The program emphasized the balance between academic preparation and real-life adjustments that the participants would need to make in order to persevere and

achieve. The participants' comments demonstrated their understanding and appreciation for these lessons. Thus, their disposition toward STEM was positively influenced.

**Research Question 2: To what extent does involvement in the counseling program influence these African American students' attitudes about math and science dual enrollment participation?** The Lunch and Learn program introduced the participants to the possibility of gaining access to college coursework while they are concurrently enrolled in high school. Except for three study participants, the students were largely unaware this opportunity existed when the counseling program started. Therefore, the first positive effect for these participants was increased awareness about dual enrollment and its potential benefits. These benefits include earning college and high school credits simultaneously, gaining the dual enrollment credits without incurring any expenses, and taking classes with the support and encouragement from peers.

Although the participants started the program with established STEM interest and most planned to attend college, they were not exactly sure how to leverage those interests toward math and science dual enrollment classes. Through the counseling program, the participants learned how the CHS dual enrollment program works, the requirements for participation, and they received practical advice for improving their chances for successful admission. The participants also benefitted from interactions with current STEM dual enrollment students at CHS. These students spoke not only to the academic value of earning college credits as high school students but also to the readiness for the rigor of college level coursework and the economic implications for these aspiring college students. Therefore, the counseling program allowed the participants to

experience the advantages of math and science dual enrollment courses vicariously through the STEM ECP students and to imagine themselves reaping comparable benefits.

The findings support the assertion that the participants' attitudes about STEM dual enrollment participation were positively influenced. For example, all students who began the counseling program disinterested in dual enrollment classes were considering taking a class by the conclusion of the study. And, for those students who were interested from the start of the program, their interest remained by the end of the program.

The counseling program also exposed the fear of testing as an area of concern for the participants' likelihood of pursuing math and science dual enrollment classes. While the data from the STEM AIS pointed to the participants' excitement about math and science dual enrollment courses, the interviews revealed that the participants' apprehension toward actually pursuing the courses hinged greatly on the high-stakes ACCUPLACER exam. Though the vicarious experiences of the STEM ECP students instilled feelings of confidence in the participants, the realization that the ACCUPLACER could bar them from gaining access to dual enrollment exposed their lack of confidence and their fears of failure without significant support from teachers, the CHS guidance team, and others to help them prepare for the test. Thus, the participants' attitudes about math and science dual enrollment participation vary. For those study participants, like Brian and Jalen, who entered the counseling program with prior knowledge of the dual enrollment opportunity and confidence in their ability to succeed, the program reaffirmed their existing attitudes. But for other participants, like Steven and Kimberly, whose self-efficacy toward overcoming the testing obstacle is low, the

program intervention alone may not be enough to take the next steps on the pathway to accessing dual enrollment courses.

**Research Question 3: What are the most significant factors that shaped these African American students' STEM disposition?** Despite being approximately the same age, African American, and from the same community, the participants could not be more different in many other ways. Some of these differences are highlighted in previously mentioned participant profiles (Appendix G) which illustrate how the complexities of their lived experiences have influenced not only their STEM dispositions but their life outlook. These shapers of disposition include the educational attainment of the participants' parents, family expectations and their emphasis on the value of earning a college degree, and other sociocultural factors which have either limited or enhanced the participants' access to out-of-school learning experiences.

Yet as students within the CSD, these participants have similar in-school experiences which have formed their STEM disposition. The most important of these is a lack of teachers with pedagogical content knowledge and the ability to incorporate culturally responsive teaching practices. While this researcher did not set out to study teaching practices within the CSD, she could not ignore the role teachers have played in shaping these participants' STEM disposition. As Amanda explained, the participants do not believe "they have good teachers" in the CSD. They know they have not been challenged and they are "fearful" of what their outcomes would be in a rigorous setting. With the exception of Coach Shane, the participants identified very few effective math and science teachers over the course of their schooling experience.

For the participants who were exposed to the elementary magnet program and its inquiry-based learning experiences, their STEM interest and self-efficacy were established early. Teachers played a role in this strong disposition, as the magnet program instructors incorporated culturally responsive and content-rich teaching practices to engage and sustain the participants' interests. However, the students who did not have access to the magnet program were deprived of this opportunity. Despite the magnet students' head start on the STEM journey, all participants ended up in the same middle school classes, with similar teachers, and comparable outcomes. Therefore, the CSD's limited middle school curriculum options subjected the participants to inferior teachers.

The second most significant shaper of the participants' STEM disposition is their past successes on standardized testing. The participants defined their STEM interests and aspirations in terms of their self-perceptions of mathematics ability. Despite earning equally good grades in science as they have in math courses, the participants placed more value on their math achievement than their science performance. It is significant that science content is not tested as frequently and with the same consequences as mathematics in the elementary and middle grades. As the participants shared more details which offered insight into their STEM disposition, the researcher identified that math testing – from the elementary grades to the Algebra I EOC – has been emphasized by teachers and other CSD stakeholders. Therefore, the students have measured their STEM abilities and outlook in terms of how well they have performed on math tests.

Finally, the participants have been grossly underexposed to STEM as a driver of social mobility. With the overemphasis to perform well in mathematics because it is a frequently tested subject area, teachers and others within the CSD have underutilized its

resources to adequately inform students and their parents about the career and economic benefits of STEM in the early grades. Consequently, the participants have not been exposed to practicing STEM professionals who might serve as role models and the CSD schools have not used the elementary and middle schools for career planning to expose students to STEM careers. For most participants, the Lunch and Learn program was the first time they engaged in meaningful conversations with STEM professionals who provided concrete examples of the socioeconomic benefits of STEM. Therefore, they have limited ability to make important connections between STEM interest, classroom-based experiences, future career pursuits, and their long-term economic stability.

**Conclusion**

Chapter 4 presented the findings from a qualitative study designed to gain perspective about the potential impact of a counseling program on students' attitudes about math and science dual enrollment participation. The researcher collected data from surveys, interviews, observations, and field notes. The triangulation of these data exposed several factors which shaped the participants' overall STEM disposition and influenced their attitudes about taking part in the CHS dual enrollment program.

Through the data collection and analysis processes, key themes emerged. These themes depict the diverse factors which have shaped the participants' STEM disposition and offer insight into their attitudes about dual enrollment classes. These factors include the value of early STEM engagement, access to high quality teachers, achievement in math and science classes and on standardized testing, establishing a college-going mindset, and engaging with culturally compatible STEM mentors, to name a few. The participants are certainly interested in dual enrollment classes; however, the aforesaid

factors and others are at the heart of a complex web of resources the participants need to transition from interested to actively engaged participants in advanced STEM courses. These are essential considerations for the CSD and its stakeholders moving forward.

Chapter 5 features an action plan with consideration for the findings detailed in Chapter 4 and their implications on future research and practice. To set the stage for this action plan, Chapter 5 begins with a brief review of the problem of practice, research questions, and the purpose of the study. The methodology and findings are also revisited. The chapter also includes discussion that situates the action researcher as a curriculum leader and explores how the researcher's position informed the study context.

# CHAPTER 5

# IMPLICATIONS AND RECOMMENDATIONS

Racial minorities are underrepresented in STEM career fields (Lewis & Connell, 2005). This fact has created a sense of urgency as the United States "is at a crossroads as it seeks to maintain its global leadership in science and technology innovation" (Ashford et al., 2016, p. 961). Workforce shortages may be attributed to a number of factors, including an inadequate supply of skilled labor; but, when considering the relationship between one's ability to secure employment within a given field and her preparation for the occupation, educational attainment cannot be ignored (Darling-Hammond, 2005). In fact, earning STEM credentials is the end result of many years of academic preparation from elementary through post-secondary schooling (Museus et al., 2011).

This action research study began with an identified problem of practice at Crosstown High School (CHS). The CHS is located within a rural South Carolina community and serves mostly low-income, African American students (South Carolina Department of Education, 2016). Despite its status as a high-poverty school, the CHS offers a number of dual enrollment and AP courses. These advanced courses reflect an expanded curriculum designed to support the school district's STEM Early College Program (ECP). The STEM ECP serves less than 7 percent of the CHS student population; thus, the majority of the school's students are underexposed to college-level mathematics and science coursework. As such, these students are unlikely to be equipped for the lucrative and stable careers that await well-prepared STEM college graduates.

The low levels of STEM participation among the CHS' non STEM ECP students presented a predicament worthy of further study. Thus, the researcher posed the following questions to address the identified problem of practice:

1. What is the effect of a counseling program intervention on African American students' STEM disposition at Crosstown High School?
2. To what extent does involvement in the counseling program influence these African American students' attitudes about math and science dual enrollment participation?
3. What are the most significant factors that shaped these African American students' STEM disposition?

In order to answer these questions effectively, the researcher explored the literature to identify relevant studies that would (1) illuminate the most effective methodologies for conducting this action research study; (2) expose theoretical constructs to ground the study; (3) present an array of factors which may explain the STEM participation deficits among African American students; (4) explore the pros and cons of dual enrollment programs; and (5) offer practical solutions for the unique challenges faced by these African American students and other stakeholders within the CHS community. These goals aligned closely with the purposes of this action research study which were to increase CHS' students awareness of the dual enrollment program, to encourage STEM interested students to consider taking math and science dual enrollment classes, and to gain perspective about the factors which have shaped these students' STEM disposition.

A careful review of the literature revealed several useful studies that supported a counseling program as an appropriate intervention to address the identified problem of practice and the stated purposes of the present action research. When considering evidence-based best practices for engaging African American high school students in advanced STEM coursework, the body of research emphasized school counselors as effective partners. More specifically, school counselors are particularly helpful when using student data to identify and purposefully recruit study participants, to structure information sessions that raise awareness about school and career opportunities, and to devise an action plan to address identified problems which involve student achievement (Camizzi et al., 2009; Davis et al., 2013; Ohrt et al., 2009).

The researcher drew upon these exemplary studies to begin structuring a program to meet the needs of CHS' students. After consulting with the Crosstown School District (CSD) superintendent and other CHS administrators, the researcher worked closely with the CHS Guidance Director to recruit nine study participants for a Lunch and Learn program. The Lunch and Learn program allowed the researcher and other presenters to share beneficial information about the CHS dual enrollment program, the economic and career benefits of STEM education, and post-secondary STEM options and careers. Through this five-week program, the study participants gathered on Thursdays in a collegial setting over a meal, which created a sense of community among the students (B. Wright, 2011).

Over the course of the Lunch and Learn program, the study participants were informed about the CHS dual enrollment program from multiple perspectives. First, they were told about the CHS guidance department's role in managing the program, basic

facts about the program structure, how dual enrollment participation may positively impact their GPA calculations, and the requirements for taking the classes. Second, the participants engaged with current STEM ECP students who as current high school seniors have been taking dual enrollment classes for three years. The STEM ECP student perspectives allowed study participants a relatable, vicarious experience which is an important part of effective school counseling programs (Ohrt et al., 2009). Finally, the study participants were addressed by the technical college representative who shared specific information about the admissions process and testing requirements for dual enrollment participation.

Beyond learning about the dual enrollment opportunity, the Lunch and Learn program was also structured in such a manner that the study participants would engage with African American STEM professionals who could share their own life experiences. The researcher hoped these experiences would serve as a testament to the benefits of postsecondary education in general and STEM pursuits specifically. The study participants had meaningful interactions with biological, physical and computer scientists who provided practical advice for moving beyond STEM interest into rigorous classes and ultimately into the various occupations supported by STEM professionals.

In addition to model school counseling programs, a review of the literature also revealed best practices for conducting culturally sensitive research. When considering that each of the study participants was African American and that several participants identified as socioeconomically disadvantaged, it was important to structure this action research in a culturally responsive manner that would likely cultivate improved academic outcomes (Camizzi et al., 2009) and produce data that told of the participants'

experiences, thoughts, and feelings in their own words (Jacobson, 2013; Noble, 2011; Tillman, 2002). Therefore, the researcher used several data collection methods to capture the study participants' STEM disposition upon entering the Lunch and Learn program and to gain perspective about the program's effects on their attitudes about STEM and dual enrollment classes. These methods included researcher-created surveys, semistructured interviews, observations, and field notes.

After using the aforementioned methods to collect data, the researcher used the NVivo 11 software program to organize the data. As a result of the coding process, several themes emerged which helped to contextualize the findings. The emergent themes emphasized the myriad of factors that have influenced the study participants' academic experiences and outcomes, and their preparedness for and disposition toward college level STEM coursework. These factors are grounded in structural inequities that have restricted the study participants' access to high-quality teachers and schooling experiences that foster early STEM interest in a culturally responsive setting (Museus et al., 2011; Settlage et al., 2015). The participants have also been limited in their exposure to role models, school personnel, and other adults they can rely upon for support, encouragement, and useful information to develop their career interests and to illuminate the economic benefits of STEM preparation.

Furthermore, the findings from this study highlighted the disconnections between the participants' past academic successes and their STEM disposition. For instance, despite having strong grades, most of the participants still have low levels of STEM self-efficacy and they are reluctant to pursue the math and science dual enrollment classes for fear of failing the technical college entrance exams. Essentially, there is an imbalance

among the positive and negative influences on the study participants' disposition, which has tipped the scales against these African American students' chances for STEM access to and success in mathematics and science dual enrollment courses (Figure 5.1).

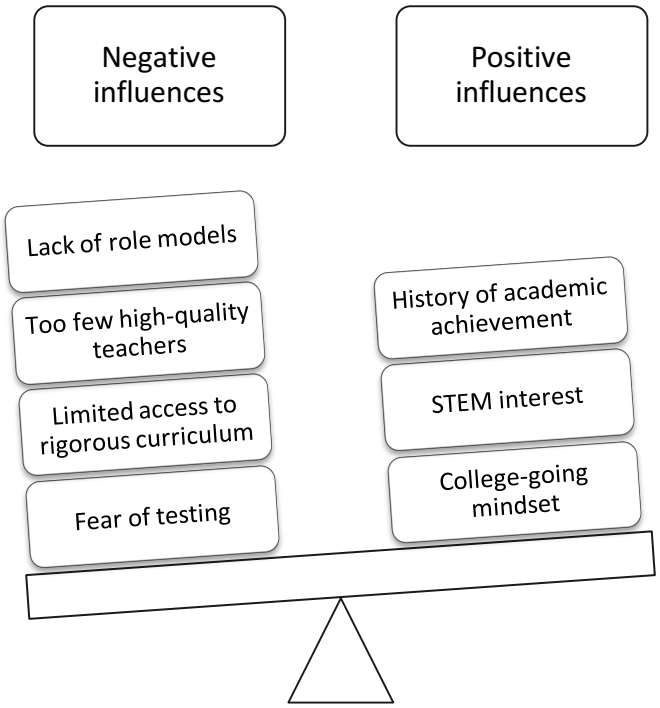


*Figure 5.1*. Negative and Positive Influences on STEM Disposition. This figure describes the imbalance among influential factors on study participants' STEM disposition.

**Reflection**

By its nature, action research is both a collaborative and reflective process (Herr & Anderson, 2015; Mertler, 2014). Therefore, the researcher must evaluate if the efforts expended to address the identified problem of practice have been fruitful – resulting in findings that answered the research questions, accurately reflect the voice of study participants, and offer a path forward for stakeholders within the school community. In this part of Chapter 5, the researcher will reflect upon her roles as action researcher and curriculum leader with consideration for her positionality within the CHS and CSD. The

researcher will also revisit the validity of this study. The path forward which is the Action Plan resulting from this study will be addressed in the next section of this chapter.

**The researcher as curriculum leader**. Curriculum leaders "help others identify and use their talents" (Brubaker, 2004, p. 71). In order to accomplish this task, the curriculum leader must be invested in the growth and prosperity of school community, have a degree of familiarity with the transformative power of curricula and a platform to lead. Within the context of this study, the researcher began her inquiry from a desire to help students identify their STEM talents and how they could use them for achieving career and economic stability. However, as the research process continued, the researcher identified additional opportunities for working collaboratively with others in the CSD to make talent identification – talent use connections. For example, the school counseling department may use its talents to help students to more effectively draw upon their academic accomplishments and interests to plan for future careers. Or, science teachers may be inspired to use their pedagogical talents to make meaningful cultural connections that spark deeper engagement with and inquiry among their students. Thus, the collaborative nature of action research – with its focus on solving specific problems within a school community – counters the notion that curriculum leadership happens in a silo (Brubaker, 2004). In fact, the action researcher leads by bringing together a team of individuals as she seeks improvement within the school community (Mertler, 2014) and charts a course for moving forward.

**Positionality**. As an African American educator conducting this study within a community of African American students and educators, the researcher has a strong sense of the cultural knowledge and perspectives that govern their experiences within the CSD.

This fact, coupled with the researcher's past experiences as a STEM professional, position her as a social justice advocate on behalf of the study participants, which Herr and Anderson (2015) identified as potential sources of strength and bias. On behalf of her primary employer, the Premier STEM School (PSS), the researcher provided professional development for CSD teachers, served as a guest instructor in middle and high school science classes, and participated in numerous STEM-related activities in support of the STEM ECP for nearly five years. This researcher's depth of involvement within the CSD has solidified her insider status, given her a platform to lead, and fostered trusting relationships with various stakeholders. Yet, her familiarity with the community could very easily skew perspectives of reality or cause the researcher to take some aspects of experience for granted (Herr & Anderson, 2015).

**Ensuring validity**. As a qualitative researcher, it is important to ensure the potential sources of bias are minimized and that the participants' voices are accurately represented in the findings. To this point, the researcher invested a significant amount of time to carefully reviewing video recordings, transcripts, handwritten notes, and weblog entries that captured the perspectives of the study participants, presenters, and the researcher. This approach allowed the researcher to confirm the accuracy of participants' statements, to appropriately represent their voices, and to establish solid themes, which were refined through the peer debriefing process (Creswell & Miller, 2000). Similarly, the researcher's own thoughts, questions, experiences, and decision-making rationale over the course of the study were captured by her personal weblog. This audit trail was useful for ensuring validity of the research process (Merriam & Tisdell, 2016).

The themes which informed the study findings reflected data from multiple sources including surveys, interviews, observations, and notes. Through the processes of repeated sorting and categorizing, the researcher compared the evidence yielded from each of these data sources. For instance, a participant's interview responses were cross-checked against her post-session survey answers and the researcher's field notes. Thus, the triangulated data produced valid themes that were supported by the different sources from which it was collected (Creswell & Miller, 2000).

**Major Findings**

The findings from this study reiterate the importance of establishing STEM interest early. It is critical to encourage early STEM interest because related achievement gaps happen in the early elementary grades (Ferguson, 2015), students' STEM self-efficacy is shaped by early learning experiences (Blank, 2013), and students who have historically pursued advanced STEM coursework in high school and persisted toward STEM careers demonstrated strong interests early, usually in the elementary and middle grades (Ashford et al., 2016).

The participants in this action research study became STEM interested early and for the most self-effacious students, this interest was sparked and sustained by hands-on learning experiences in classrooms led by a handful of high quality teachers at the CSD's elementary math and science magnet program. However, the other participants were deprived of a comparable experience in their respective elementary schools within the CSD. During the middle grades, the study participants converged at the district's only middle school; and, their middle school experiences were mostly mis-educative as they did very little to build the participants' STEM interest, self-efficacy, or content

knowledge. In fact, the participants' middle school experiences may have actually caused their initial interest to regress, primarily because the students lacked culturally competent teachers with strong STEM content knowledge (Smith et al., 2016). Therefore, these ineffective teachers were unable to employ inquiry-based practices and other strategies to help students engage in projects to construct their own knowledge, develop critical thinking skills, and apply STEM learning in real-world contexts. These methods have been shown to cultivate and sustain STEM interests, build self-efficacy, reinforce a culture of high expectations, and promote the pursuit of rigorous coursework in later grades (Adamson et al., 2016; Hansen & Gonzalez, 2014; Jackson & Ash, 2012). They are also culturally responsive practices, which have been shown to increase racial minorities' long term STEM success (Mallaya et al., 2012).

The participants have also been underexposed to school-based career planning. Prior to this Lunch and Learn counseling program, the participants' only career planning occurred during the spring semester of their eighth grade year as they, along with their parents, completed the Individual Graduation Plan (IGP). During the 2015-2016 academic year (when the study participants were eighth graders) nearly 54,000 South Carolina students completed an IGP (South Carolina Department of Education, 2017). Of these students, 23 percent expressed interest in Health Sciences careers and 13 percent stated they were interested in STEM careers. Collectively, these career paths represent the interests of more than one-third of the study participants' grade level peers statewide. CHS students are included in this data. Despite their interests in STEM and related careers, the study participants have had no follow-up from the CHS Guidance Department to encourage them toward more rigorous STEM courses in high school

which have been shown to positively impact STEM disposition (Ashford et al., 2016; Museus et al., 2011).

When considering the impact of early STEM exposure and access to rigorous coursework, the significance of mathematics cannot be overstated (Larnell et al., 2014). The most noteworthy influence on these study participants' mathematics self-efficacy has been their performance on the Algebra I end-of-course (EOC) exam. One of the reasons these study participants were selected for this action research project was because of their solid performance on the Algebra I EOC as ninth graders. For several participants, their Algebra I EOC performance was shaped by experiences in Coach Shane's classroom. Coach Shane is a capable, caring, and effective teacher. His culturally responsive teaching practices motivated the study participants to work hard and built their self-confidence. However, Coach Shane has been an anomaly in the participants' STEM experiences.

Algebra I is a gateway course that school counselors and teachers use to determine subsequent course placement (Ashford et al., 2016). When considering the progression of STEM courses from the basic to most rigorous levels, the study participants are actually late in the pipeline as the research shows that chances for STEM persistence are higher among students who take Algebra I before high school (Ashford et al., 2016). Consequently, it is highly probable that these participants will not be able to access dual enrollment courses until their senior year of high school, if at all.

Interest alone is not sufficient to take the leap into advanced STEM coursework. Past successes, such as earning good grades and performing well on the Algebra I EOC are helpful but they do not necessarily translate into pursuing rigorous classes. The

findings from this study exposed that a history of past achievement has positively shaped the participants' STEM disposition, but this has not necessarily translated into confidence toward dual enrollment courses. Unlike their traditional high school courses, the participants must apply and gain acceptance to the CHS technical college partner in order to access dual enrollment classes. Testing is a major part of the admissions process and the study participants exhibited very little confidence in their ability to succeed on the test. To their credit, the participants acknowledged that they need support from adults within the CHS community to prepare for the tests. However, it is unclear if this support is available and even if offered, that it would be enough for the participants to overcome their fear of failure.

The study participants have limited access to role models or other adults who are able to support them through challenging academic experiences. While a few participants have college-educated parents, most of the students do not have a legacy of post-secondary education. They are under resourced in terms of human, social, and cultural capital (Strayhorn, 2013) so they are unfamiliar with how to navigate the pathway from high school coursework to college access. Their parents do not necessarily know how to advocate on their behalf, and the participants rarely engage with STEM professionals who can encourage them toward achieving their goals. These are important considerations as the participants are certainly interested in attending college and they want to pursue STEM careers. But, they need help – academic preparation, financial support, and guidance – to get there.

The findings show that most of the student and adult presenters were well received and the study participants valued these interactions. As the presenters offered

practical advice and shared from their personal and professional experiences, the participants' attitudes about STEM and dual enrollment were positively influenced. With the exception of the technical college representative, the presenters were culturally compatible and their ability to connect with the participants made their messaging more palatable. These presenters were also effective at helping the participants to make important connections between STEM interests and the socioeconomic benefits of STEM pursuits. Therefore, through the Lunch and Learn counseling program, the presenters helped to bridge the capital deficits in the participants' lives, even if only for a short time.

**Action Plan**

Unlike traditional researchers who may stop at documenting the findings of their study, action researchers use these findings to apply what they have learn to address a problem (Watt & Watt, 1993). Similarly to each stage of the action research process, developing the action plan calls for deep reflection (Mertler, 2014) and consideration for how best to move forward. The findings from this action research study are complex. On the one hand, the research findings have been helpful for better understanding the study participants and their STEM disposition. Conversely, they have exposed new problems within the CSD which are worthy of further study. This action plan will propose recommendations that address policies and practices within the CSD which have impeded these students' ability to confidently pursue advanced STEM coursework and careers.

*Recommendation 1.* **Invest in regular and substantial professional development to build pedagogical content knowledge and awareness of culturally responsive teaching practices among all elementary and middle school STEM teachers within the CSD.** Every student in the CSD deserves equitable access to an

effective teacher regardless of the elementary or middle school she attends or the classroom in which he is placed. The dichotomous experiences of participants who attended the elementary math and science magnet program compared to those who did not represent a curriculum inequity. The middle school educators who the participants described as unable to lead meaningful and engaging math and science lessons may have been lacking both pedagogical skills and the laboratory equipment needed to teacher more effectively. In either case, such inequities are indicative of "substantially separate and unequal" (Darling-Hammond, 2005) schools that students within the CSD attend when compared to more affluent, neighboring school districts.

While the CSD leadership is not singlehandedly able to change the community's economic situation, the district is able to use its resources to address deficits in teacher quality. Because of the CSD's low marketplace value, the district has been challenged to attract and retain high-quality teachers. Therefore, the CSD students have often been subjected to inexperienced and ineffective teachers who lack the skills needed to evaluate students' prior knowledge, identify deficiencies, and modify instruction to meet students' needs (Darling-Hammond, 2005). Within the STEM classroom, these skills are evidenced by teachers who confidently balance content knowledge with culturally responsive practices to create challenging lessons that draw upon students' existing funds of knowledge and are personally meaningful (Basu & Barton, 2007).

For African American students within economically deprived and historically oppressed communities like the CSD, the negative effects of ineffective teachers disrupt the students' learning experiences at every point in the STEM pipeline and they limit students' access to future STEM opportunities (Museus et al., 2011). Thus, an investment

to improve K-8 math and science teacher quality would not only cultivate early STEM interests, but consistently expose students to rigorous content that as they expend effort to learn, the students' resilience and self-efficacy toward math and science coursework would also improve (Cassidy, 2015). An improved commitment to regular and substantive professional development would require the following:

- Dedicated teacher work days for STEM specific professional development
- Budget allocations for bringing renowned curriculum leaders and trainers to the CSD and for sending teachers away for off-site professional development opportunities, including national and regional conferences sponsored by the National Science Teachers Association (NSTA), the National Council of Teachers of Mathematics (NCTM), ASCD, and others
- Financial support for material purchases (laboratory equipment, inquiry kits, data collectors, etc) and the official training provided by material manufacturers to correctly align resources to curriculum
- Cultural competency training
- Tuition reimbursement / support for teachers who pursue advanced degrees in STEM content subject areas and commit to remain in the CSD for 3–5 years

*Recommendation 2.* **Develop a district-wide STEM-focused parent education and engagement program, with a designated coordinator at each CSD elementary and middle school.** Each school within the CSD currently has a parent liaison. However, these office staff persons are focused primarily on supporting parents and their academically challenged students (CSD, 2017). The STEM ECP has catalyzed meaningful curriculum expansions such as the AP and dual enrollment classes. As the

first cohort of students is scheduled to simultaneously earn their high school diplomas and associate's degrees in 2018, the parents who advocated for and supported their students through the STEM journey are reaping the benefits, which include numerous college scholarship offers and advanced standing based on earned college credits.

The findings from this study emphasized that dual enrollment access is most probable for students who are exposed to Algebra I as middle school students; and, these students are exposed to the most advanced math and science track in the elementary grades. This observation is supported by Ashford and other researchers (2016) who noted that the grade level in which students are able to access Algebra I strongly influences their access to advanced courses both in high school and college. The STEM ECP students take Algebra I as seventh graders; however, the participants did not take the class until their ninth grade year. So despite their STEM interest and achievement in Algebra I, these students are technically two years behind their peers.

As several participants noted, they were unaware of the dual enrollment opportunity and STEM ECP despite the Guidance Director's assertion that "all parents were notified." This observation indicates that parent notifications did not necessarily translate into their understanding of the value of the STEM opportunity. Therefore, there is a need for a more structured method of education about (1) the academic and socioeconomic advantages of STEM preparation; (2) how parents can partner with the CSD schools to encourage their students toward STEM; (3) what STEM learning and careers entail; (4) the requirements for middle school Algebra I placement; (5) the resources available within and beyond CSD schools to support students' STEM interests; and (6) the CHS dual enrollment program requirements and benefits.

Parents are in positions of influence so their attitudes and feelings about schooling experiences may impact their students' disposition and self-concept (Vygotsky, 1987). The researcher observed this correlation among second generation college students whose college-going mindsets were reinforced by their parents' experiences. At the same time, most of the first generation students did not receive positive messages about the value of college or STEM education. Therefore, the education component should also include culturally relevant activities which allow parents to engage in a fun and nonthreatening setting while cultivating their appreciation of the sociocultural benefits of STEM.

*Recommendation 3*. **Add a mentorship-focused, service learning component to the STEM Early College Program.** The findings show that the study participants were positively influenced by the verbal persuasion and vicarious experiences of the STEM ECP students. Thus, the STEM ECP students have the potential to serve as mentors to cultivate positive STEM disposition among elementary and middle grades students. As high school juniors and seniors, the STEM ECP students have significant gaps in their schedules since the dual enrollment courses operate on a college model and meet either on Mondays, Wednesdays, and Fridays or on Tuesdays and Thursdays. Furthermore, the CSD has assumed all costs associated with the STEM ECP students' dual enrollment participation so the students may give back to the district by serving others. Consequently, the STEM ECP students have the time and incentive to support younger students on their STEM journeys.

The proposed mentorship – service learning model charges STEM ECP students with a minimum of 50 annual volunteer hours during their junior and senior years of high

school. These volunteer hours shall be utilized in the following ways to support the CSD's elementary and middle school students:

- Serve as a teaching assistant / guest teacher within a math or science classroom
- Provide one-to-one STEM tutoring after school or on weekends
- Be a STEM buddy (mentor) for completing a science project
- Act as a peer-coach for the robotics program and competitions
- Be a guest presenter in the parent education and engagement program activities (Recommendation 2).

*Recommendation 4*. **Strengthen the middle school career counseling experience to emphasize the catalog of high school STEM offerings, the socioeconomic benefits of STEM preparation, and to expose students to STEM in action.** The findings from this action research study highlighted the importance of acquiring information about STEM coursework and career opportunities before entering high school. What's more, the cultural characteristics of persons presenting STEM messages are equally as significant as the information shared. Elementary and middle school counselors are uniquely positioned to inform students about curriculum opportunities. They are also able to work with local and regional community resources to identify culturally compatible STEM professionals to serve as role models to the CSD's younger students and to organize meaningful learning experiences. With these considerations in mind, the researcher recommends that the CSD's elementary and middle school counselors do the following:

- Work collaboratively with the school-based parent education and engagement program coordinator to inform parents about course sequencing, advanced STEM options including dual enrollment, the middle-to-high school transition, and planning for post-secondary education.
- Organize a monthly STEM speaker series featuring culturally compatible presenters who demonstrate what they do (professionally) and how STEM classes prepared them for career success.
- Schedule at least two field excursions per year to promote STEM learning. Sample excursions may include visits to an aquarium, museum, university exhibits, or an area business or manufacturing facility.
- Host an annual middle school college fair for students and their parents to foster a college-going mindset.

*Recommendation 5.* **Identify prospective dual enrollment students who are not a part of the STEM ECP and provide testing support to facilitate their transition into college level coursework.** Despite their purposeful selection based on STEM interest and past academic achievement, most of the study participants were not able to overcome their fears of failing the technical college entrance examinations. The participants were clear about what they needed from the CHS leadership in order to take the leap into dual enrollment classes: (1) support to pass the ACCUPLACER exam; (2) support from teachers to succeed in the classes; and (3) support from peers.

Before the participants can get to the point of needing support from teachers and peers, they must be admitted to the technical college. Thus, the participants and other CHS students need to become familiar with the structure of the exam including the types

of questions asked, features of a model response, and whether there is a penalty for guessing. Using comparable criteria to those employed by the researcher and CHS Guidance Director for selecting participants for this study, the CHS school counseling department should identify promising ninth graders to prepare for the dual enrollment program. To accomplish this task, the researcher recommends the model illustrated in Figure 5.2.

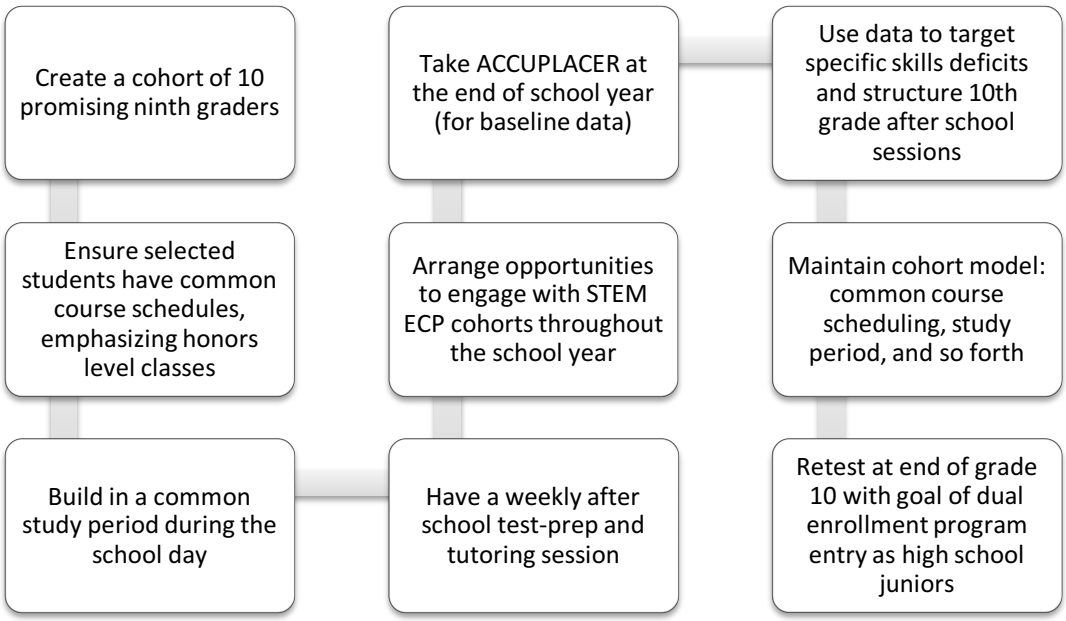


*Figure 5.2*. A Model for Test Preparation. This figure describes a potential strategy for preparing students for dual enrollment participation and testing requirements.

Within this proposed structure, this cohort of students would be prepared to take their first dual enrollment course as high school juniors. While they would not earn an Associate's degree like the STEM ECP students, this cohort would gain early access to college classes and be a part of a structured program, with the support of their peers and teachers, to persevere through their honors classes and prepare for the technical college

entrance exam. In order to successfully implement this recommendation, the CSD leadership would need to approve the following:

- A stipend for the STEM ECP Program Director to manage the staff who will support the new cohorts' after school program
- Funding for teachers who support the tutoring and test preparation efforts during the weekly after school sessions
- Funding for test preparation materials and fees
- Covering tuition costs for additional dual enrollment students

**Implications for Future Research and Practice**

The present action research study was limited by four significant factors: small sample size, time allotted for the intervention, study setting, and the qualitative nature of the study. The Lunch and Learn counseling program occurred over a five-week period, with study participants meeting once per week for 40–45 minutes per session. The sample size was limited to nine participants and the data collection methods were strictly qualitative. These limitations pose noteworthy implications for future research.

**Sample size**. This study was limited to a small number of participants, which prohibits the researcher from generalizing the findings to any population beyond the study group. In order to better understand the STEM disposition of African American students and their attitudes about dual enrollment participation, this study could be expanded to include a larger number of participants. The CSD has only one high school; therefore, this new research would call for extending the study to schools in other districts. Future studies may also be enhanced by including participants from rural, suburban, and inner-city schools to make broader comparisons among students and to

better understand the effects of socioeconomics and geographic location on the participants' access to more advanced curriculum options and other resources to support their STEM interests. Additionally, future research may be enhanced by gender-specific studies. For example, African American females' STEM experiences may be uniquely fashioned by the intersectionalities of race, gender, and class and other factors.

**Time**. The study occurred over a relatively short period of time which limited the researcher's opportunities to interact with the participants. The time limitation also prevented the researcher from following up with the participants after the intervention to discover what steps, if any, they took toward dual enrollment participation. Future studies could be modified to follow-up with participants after the intervention to find out (1) if they attempted to gain admission to the technical college; (2) were they able to pass the admissions tests; (3) in which classes did they enroll; (4) were they successful in those classes; and (5) what were the significant factors in their success or failure.

**Study setting**. Because the researcher conducted this study in a setting other than her primary place of employment, she had limited access to the participants outside of scheduled meeting times. This limitation complicated the interview scheduling process and required significant interactions through Google Hangouts, which made reading body language more difficult. For action research studies, it may be more effective to conduct inquiry within one's primary place of employment.

**Qualitative nature of the study**. As a culturally responsive qualitative study, the research generated findings that were specific to each study participant. Rarely could the researcher identify statements, ideas, or beliefs that were exactly the same for all participants. Therefore, future researchers who anticipate incorporating similar

methodologies should be aware of the time commitment for careful analysis of the findings, especially if the sample size is significantly larger. Future studies may also be enhanced by a mixed-methods approach which draws upon STEM achievement data to place previously acquired enactive attainments in context and allow for quantifiable measures of increases in STEM disposition.

**Conclusion**

At the heart of action research is a teacher's desire to improve her practice (Mertler, 2014). The process of improving one's practice often begins with an inquiry as the teacher seeks answers to questions such as, "How can I do this better or why are my students underperforming?" In order to effectively answer such questions, the action researcher clarifies the problem, develops a plan to study it, collects data and reflects upon the findings to make an evidence-based decision about next steps (Dana & Yendol-Hoppey, 2014). In an attempt to clearly define a problem and interpret the study findings, action researchers reflect deeply and situate the problem within a specific context. Thus, action researchers seek to address unique concerns and provide solutions for an exact setting. The present action research study was conducted in such a setting and was driven by the researcher's quest to better understand a specific challenge for African American students within the Crosstown High School (CHS) community.

Paulo Freire emphasized the significance of consciousness-raising to draw attention to the plight of oppressed groups and to better understand how persons within these groups are situated within society (Watt & Watt, 1993). As African American students growing up in a rural, economically disadvantaged community, the participants' predicament presented an opportunity to move beyond basic inquiry to approaching

research as an emancipating act of social justice. Hence, the researcher evaluated the potential of a counseling program intervention to gain perspective on how these African American participants were positioned as math and science students within the CSD and if exposure to a new curriculum opportunity at the CHS – dual enrollment classes – may serve as a starting point for their socioeconomic uplift.

The body of existing research suggested that a school counseling program is an effective method for informing students about academic and career opportunities (Camizzi et al., 2009). The literature also supported dual enrollment as a potentially positive method for introducing socioeconomically disadvantaged students to college-level courses (Hoffman et al., 2009). As such, this action research study was grounded in theoretical constructs which address the historic, political, and sociocultural factors which have shaped the participants' STEM educational experiences and disposition. Furthermore, this study explored how past and present experiences may have influenced their attitudes about pursuing mathematics and science dual enrollment classes at CHS.

The research methodology honored the students' voices as a critical aspect of the African American experience (Noble, 2011). So, the researcher used semistructured interviews, surveys, and observations to capture the study participants' stories in a culturally appropriate manner (Welton & Martinez, 2014). The findings stressed the power of cultural affirmation as an essential component in the STEM schooling experience, with particular emphasis on high-quality teaching, access to rigorous courses, having role models, fostering early STEM interests, and cultivating a college-going mindset in a supportive and engaging setting. Therefore, Chapter 5 presented an action plan to improve African American students' chances for dual enrollment participation.

# REFERENCES


ACT. (2012, March). *Do race/ethnicity-based student achievement gaps grow over time*? [Issue brief]. Iowa City, IA: ACT, Inc.

Adamson, K., Santau, A., & Lee, O. (2013). The impact of professional development on elementary teachers' strategies for teaching science with diverse student groups in urban elementary schools. *Journal of Science Teacher Education*, *24*(3), 553-571.

American Education Research Association (2016). http://www.aera.net/

An, B. P. (2015). The role of academic motivation and engagement on the relationship between dual enrollment and academic performance. *Journal of Higher Education*, *86*(1), 98-126.

Ashford, S. N., Lanehart, R. E., Kersaint, G. K., Lee, R. S., & Kromrey, J. D. (2016). STEM pathways: Examining persistence in rigorous math and science course taking. *Journal of Science Education and Technology*, *2016*(25), 961-975. doi:10.1007/s10956-016-9654-0

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice-Hall.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191-215.

Bandura, A., Barbaranelli, C., Caprara, G. V., & Pastorelli, C. (2001). Self-efficacy beliefs as shapers of children's aspirations and career trajectories. *Child Development*, *72*(1), 187-206.

Barton, A. C., & Tobin, K. (2001). Urban science education. *Journal of Science Teacher Education*, *38*(8), 843-846.

Bland, A. (2014). No child left behind: Why race-based achievement goals violate the equal protection clause. *Berkeley La Raza Law Journal, 24,* 59-80.

Blank, R. K. (2013). Science instructional time is declining in elementary schools: What are the implications for student achievement and closing the gap? *Science Education*, *97*(6), 830-847. doi:10.1002/sce.21078

Boutte, G. S. (2016). *Educating African American students: And how are the children?* New York: Routledge.

Brown, B. A., Henderson, J. B., Gray, S., Donovan, B., Sullivan, S., Patterson, A., & Waggstaff, W. (2015). From description to explanation: An empirical exploration of the African-American pipeline problem in STEM. *Journal of Research in Science Teaching*, *53*(1), 146-177. doi:10.1002/tea.21249

Brown v. Board of Educ., 347 U.S. 483 (1954)

Brubaker, D. L. (2004). *Revitalizing curriculum leadership* (2nd ed.) Thousand Oaks, CA: Corwin Press.

Camizzi, E., Clark, M. A., Yacco, S., & Goodman, W. (2009). Becoming "difference makers": School-university collaboration to create, implement, and evaluate data-driven counseling interventions. *Professional School Counseling*, *12*(6), 471-479. doi:10.5330/PSC.n.2010-12.471

Campbell, S. (2012). For colored girls? Factors that influence teacher recommendations into advanced courses for black girls. *Review of Black Political Economy*, *39*(4), 389-402. doi: 10.1007/s12114-012-9139-1

Cassidy, S. (2015). Resilience building in students: The role of academic self-efficacy. *Frontiers in Psychology*, 1-14. doi:10.3389/fpsyg.2015.01781

Chapman, T., & Donnor, J. (2015). Critical race theory and the proliferation of U. S. charter schools. *Equity & Excellence in Education, 48*(1), 137-157.

Charleston, L. J., Charleston, S. A., & Jackson, J. L. (2014). Using culturally responsive practices to broaden participation in the educational pipeline: Addressing the unfinished business of Brown in the field of computing sciences. *Journal of Negro Education*, *83*(3), 400-419.

Cheers, D. M. (1986). Requiem for a hero: 'Touching the face of God.'. *Ebony*, *41*(7), 82.

Chen, X. (2013). *STEM attrition: College students' paths into and out of STEM fields* (NCES 2014-001). National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education. Washington, DC.

Coats, L. T., & Xu, J. (2013). No child left behind and outreach to families and communities: The perspectives of exemplary African-American science teachers. *Research Papers In Education*, *28*(5), 609-627. doi:10.1080/02671522.2012.689317

Cook, E. (2013). A rigorous curriculum really matters. *Principal Leadership, 13*(8), 36-40.

Cornell, S. & Hartmann, D. (2007). *Ethnicity and race: Making identities in a changing world.* Thousand Oaks, CA: Pine Forge Press.

Crenshaw, K., Gotanda, N., Peller, G., & Thomas, K. (1995). *Critical race theory: The key writings that formed the movement*. New York: The New Press.

Creswell, J. W., & Miller, D. L. (2000). Determining validity in qualitative inquiry. *Theory Into Practice, 39*(3), 124-130.

Critical Race as a Methodology. (2015). *ASHE Higher Education Report*, *41*(3), 34-56.

Crowl, T. K., Kaminsky, S. & Podell, D. M. (1997). *Educational psychology: Windows on teaching*. Dubuque, IA: Times Mirror Higher Education Group.

CSD Superintendent's Report (2016).

Curran, F. C., & Kellogg, A. T. (2016). Understanding science achievement gaps by race/ethnicity and gender in kindergarten and first grade. *Educational Researcher*, *45*(5), 273-282. doi: 10.3102/0013189X16656611

Dana, N. F., & Yendol-Hoppey, D. (2014). *The reflective educator's guide to classroom research: Learning to teach and teaching to learn through practitioner inquiry* (3rd ed.). Thousand Oaks, CA: Sage Publications, Inc.

Daniel, P., & Walker, T. (2014). Fulfilling the promise of Brown: Examining laws and policies for remediation. *Journal of Negro Education, 83*(3), 256-273.

Darling-Hammond, L. (2005). New standards and old inequalities; School reform and the education of African American students. In J. King (Ed.), *Black education: A transformative research and action agenda for the new century* (pp. 197-223). New York, NY: Routledge.

Davis, P., Davis, M. P., & Mobley, J. A. (2013). The school counselor's role in addressing the advanced placement equity and excellence gap for African American students. *Professional School Counseling*, *17*(1), 32-39.

DeCuir-Gunby, J. T. (2009). A review of the racial identity development of African American adolescents: The role of education. *Review of Educational Research*, *79*(1), 103. doi: 10.3102/0034654308325897

Delgado, R., & Stefancic, J. (2017). *Critical race theory: An introduction* (3rd ed.). New York: New York University Press.

Dewey, J. (1938). *Experience and education*. New York: Simon & Schuster.

DuBois, W. E. B. (2003). *The souls of black folk.* New York: Barnes and Noble Books.

Eglash, R., Gilbert, J. E., & Foster, E. (2013). Broadening participation: Toward culturally responsive computing education. *Communications of the ACM*, *56*(7), 33-36. doi:10.1145/2483852.2483864

Emdin. C. (2011). Moving beyond the boat without a paddle: Reality pedagogy, Black youth, and urban science education. *The Journal of Negro Education, 80*(3), 284-295.

Emdin, C. (2007). Exploring the contexts of urban science classrooms. Part 1: Investigating corporate and communal practices. *Cultural Studies of Science Education, 2*(2), 319-350.

Ferguson, R. (2015). Facts on achievement gaps [PDF file]. *The Achievement Gap Initiative at Harvard University.* Retrieved from http://www.agi.harvard.edu/projects/FactsonAchievementGaps.pdf

Ferguson, R. F., Phillips, S. F., Rowley, J. F., & Friedlander, J. W. (2015). The influence of teaching: Beyond standardized tests: Engagement, mindsets, and agency. *The Achievement Gap Initiative at Harvard University*. Retrieved from http://www.agi.harvard.edu/

Fischetti, J. C., MacKain, S. J., & Smith, R. W. (2011). Mr. Watson, come here…The performance of early college students in their first year at the university and the challenge to P-16 education. *Improving Schools, 14*(1), 30–48.

Freire, P. (2013). Pedagogy of the oppressed. In D. Flinders & S. Thornton (Eds.), *The curriculum studies reader* (pp. 157-166). New York: Routledge.

Glaser, B. G. (1965). The constant comparative method of qualitative analysis. *Social Problems, 12*(4), 436-445 [PDF file]. Retrieved from http://www.jstor.org/stable/pdf/798843.pdf?refreqid=excelsior%3Ab9a69d1655d530614990b6302b80297f

Graham, S. E., & University of New Hampshire, C. I. (2009). Students in rural schools have limited access to advanced mathematics courses. Issue Brief No. 7. *Carsey Institute*. Retrieved from http://files.eric.ed.gov/fulltext/ED535960.pdf

Gross, B., & Hill, P. T. (2016). The state role in K-12 education: From issuing mandates to experimentation. *Harvard Law & Policy Review, 10*(2), 299-326.

Hansen, M., & Gonzalez, T. (2014). Investigating the relationship between STEM learning principles and student achievement in math and science. *American Journal of Education*, *120*(2), 139-171.

Hargrave, C. (2015). Counter space: Analysis of educational structures of an after-school program that fosters black academic success narratives. *Journal of Negro Education*, *84*(3), 348-361.

Hartney, M. T., & Flavin, P. (2014). The political foundations of the black-white education achievement gap. *American Politics Research,* 42(1), 3-33. doi: 10.1177/1532673X13482967

Herr, K., & Anderson, G. L. (2005). *The action research dissertation: A guide for students and faculty* (2nd ed.). Thousand Oaks, CA: Sage Publications, Inc.

Hine, G., & Lavery, S. (2014). Action research: Informing professional practice within schools. *Issues In Educational Research*, *24*(2), 162-173.

Hoffman, N., Vargas, J., & Santos, J. (2009). New directions for dual enrollment: Creating stronger pathways from high school through college. *New Directions for Community Colleges, 2009*(145), 43-58.

Howard, T. C. (2014). *Why race and culture matter in schools: Closing the achievement gap in America's classrooms*. New York, NY: Teachers College Press.

Howley, A., Howley, M. D., Howley, C. B., & Duncan, T. (2013). Early college and dual enrollment challenges: Inroads and impediments to access. *Journal of Advanced Academics, 24*(2), 77-107. doi: 10.1177/1932202X13476289.

Hugo, E. B. (2001). Dual enrollment for underrepresented student populations. *New Directions for Community Colleges, 2001*(113), 67-72.

Hunter, R. (2015). The problems of implementation of educational reform initiatives after Brown and their impact on African American children and their community. *International Journal of Education Reform, 24*(4), 376-385.

Ireland, C. (2016, February 15). The costs of inequality: Education's the one key that rules them all. *Harvard Gazette*. www.news.harvard.edu/gazette

Jackson, J., & Ash, G. (2012). Science achievement for all: Improving science performance and closing achievement gaps. *Journal of Science Teacher Education*, *23*(7), 723-744.

Jacobson, M. D. (2013). Afraid of looking dumb. *Educational Leadership*, *71*(1), 40.

Jonson-Reid, M., Davis, L., Saunders, J., Williams, T., & Williams, J. H. (2005). Academic self-efficacy among African American youths: Implications for school social work practice. *Children and Schools, 27*(1), 5-14.

Kanny, M. A. (2015). Dual enrollment participation from the student perspective. *New Directions for Community Colleges*, *2015*(169), 59-70.

Karanja, E. M., & Austin, N. N. (2014). What are African Americans doing in college? A review of the undergraduate degrees awarded by U.S. institutions to African Americans: 2005-2009. *Journal of Negro Education*, *83*(4), 530-548.

Karp, M. (2012). "I don't know, I've never been to college!" Dual enrollment as a college readiness strategy. *New Directions for Higher Education*, *2012*(158), 21–28.

Kier, M. W., Blanchard, M. R., Osborne, J. W., & Albert, J. L. (2014). The development of the STEM career interest survey (STEM-CIS). *Research in Science Education*, *44*(3), 461-481.

Koba, S. B. (1996). Narrowing the achievement gap in science. *Educational Leadership, 53*(8), 14-17.

Ladson- Billings, G. (2000). Fighting for our lives: Preparing teachers to teach African American students. *Journal of Teacher Education, 51*(3), 206-213.

Ladson-Billings, G. (1995). Toward a theory of culturally responsive pedagogy. *American Educational Research Journal, 32*(3), 465-491.

Ladson-Billings, G., & Tate, W. F. (1995). Toward a critical race theory of education. *Teachers College Record, 97*(1), 47-68.

Lamb, R., Akmal, T., & Petrie, K. (2015). Development of a cognition-priming model describing learning in a STEM classroom. *Journal of Research in Science Teaching*, *52*(3), 410-437.

Lamb, R. L., Vallett, D., & Annetta, L. (2014). Development of a short-form measure of science and technology self-efficacy using Rasch analysis. *Journal of Science Education and Technology*, *23*(5), 641-657.

Larnell, G. V., Boston, D., & Bragelman, J. (2014). The stuff of stereotypes: Toward unpacking identity threats amid African American students' learning experiences. *Journal of Education*, *194*(1), 49-57.

Lawrence, C. R. (1995). In K. Crenshaw, N. Gotanda, G. Peller, G., & K. Thomas (Eds.). *Critical race theory: The key writings that formed the movement* (pp. 336-356). New York: The New Press.

Lee, O., Miller, E., & Januszyk, R. (2014). Next Generation Science Standards: All standards, all students. *Journal of Science Teacher Education*, *25*(2), 223-233.

Leedy, P. D., & Ormrod, J. E. (2005). *Practical research: Planning and design* (8th ed.). Upper Saddle River, NJ: Prentice Hall.

Leitch, R., & Day, C. (2000). Action research and reflective practice: towards a holistic view. *Educational Action Research*, 8:1, 179-193, doi: 10.1080/09650790000200108

Lewis, B. F. (2003). A critique of literature on the underrepresentation of African Americans in science: Directions for future research. *Journal of Women and Minorities in Science and Engineering*, *9*(3/4), 361-375.

Lewis, B. F., & Connell, S. (2005). African American students' career considerations and reasons for enrolling in advanced science courses. *Negro Educational Review*, *56*(2/3), 221-231.

Linnebrink, E. A., & Pintrich, P. R. (2003). The role of self-efficacy beliefs in student engagement and learning in the classroom. *Reading and Writing Quarterly, 19,* 119-137. doi: 10.1080/10573560390143076

Lomax, R. G., West, M. M., Harmon, M. C., Viator, K. A., & Madaus, G. F. (1995). The impact of mandated standardized testing on minority students. *The Journal of Negro Education*, *64*(2). 171-185.

Lukes, L. (2014). Considerations and recommendations for implementing a dual-enrollment program: Bridging the gap between high school and college level science. *Journal of College Science Teaching*, *44*(1), 17-22.

Lyon, G. H., Jafri, J., & St. Louis, K. (2012). Beyond the pipeline: STEM pathways for youth development. *Afterschool Matters*, (16), 48-57.

Mallya, A., Mensah, F. M., Contento, I. R., Koch, P. A., & Barton, A. C. (2012). Extending science beyond the classroom door: Learning from students' experiences with the Choice, Control and Change (C3) curriculum. *Journal of Research in Science Teaching*, *49*(2), 244. doi:10.1002/tea.21006

Manning, K. R. (1998). Science and opportunity. *Science*, *282*(5391), 1037-1038.

Martí, J. (2008). From local practices to public knowledge: Action research as scientific contribution. Review Essay: Kathryn Herr & Gary L. Anderson (2005). The Action Research Dissertation: A Guide for Students and Faculty [46 paragraphs].

*Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, *9*(2), Art. 2, http://nbnresolving.de/urn:nbn:de:0114-fqs080320.

McGee, E. O. (2015, May 1).Why black students struggle in STEM subjects: Low expectations. Retrieved from https://newrepublic.com.

McLaughlin, C. (2014). Urban science education: Examining current issues through a historical lens. *Cultural Studies of Science Education*, *9*(4), 885-923. doi: 10.1007/s11422-014-9598-8

Medvide, M., & Blustein, D. (2010). Exploring the educational and career plans of urban minority students in a dual enrollment program. *Journal of Career Development*, *37*(2), 541-558.

Melguizo, T., & Wolniak, G. (2012). The earnings benefits of majoring in STEM fields among high achieving minority students. *Research in Higher Education*, *53*(4), 383-405.

Merriam, S. B., & Tisdell, E. J. (2016). *Qualitative research: A guide to design and implementation*. San Francisco, CA: Jossey-Bass

Mertler, C. A. (2014). *Action research: Improving schools and empowering educators* (4th ed.). Thousand Oaks, CA: Sage Publications, Inc.

Milner, H., & Laughter, J. (2015). But good intentions are not enough: Preparing teachers to center race and poverty. *Urban Review, 47*(2), 341. doi: 10.1007/s11256-014-0295-4

Mitchell, A., & Stewart, J. (2013). The efficacy of all-male academies: Insights from critical race theory (CRT). *Sex Roles*, *69*(7-8), 382-392. doi: 10.1007/s11199-011-0074-6

Moody, V. R. (2004). Sociocultural orientations and the mathematical success of African American students. *Journal of Educational Research*, *97*(3), 135-146.

Morgan, P. L., Farkas, G., Hillemeier, M. M., & Maczuga, S. (2016). Science achievement gaps begin very early, persist, and are largely explained by modifiable factors. *Educational Researcher*, *45*(1), 18-35.

Museus, S. D., Palmer, R. T., Davis, R., & Maramba, D. C. (2011). Racial and ethnic minority students' success in STEM education [Special issue]. *ASHE Higher Education Report, 36*(6), 1-140.

National Center for Education Statistics (2017). https://nces.ed.gov/

Nelson, J., Palonsky, S., & McCarthy, M. (2007). *Critical issues in education: Dialogues and dialectics* (6th ed.). New York, NY: McGraw-Hill.

Neuhauser, A. (2015, June 29). 2015 STEM index shows racial, gender gaps widen. *US News and World Report.* Retrieved from http://www.usnews.com/.

Noble, R. (2011). Mathematics self-efficacy and African American male students: An examination of models of success. *Journal of African American Males in Education*, *2*(2), 188-213.

Norman, O., Ault, C. R., Bentz, B. and Meskimen, L. (2001). The black–white "achievement gap" as a perennial challenge of urban science education: A sociocultural and historical overview with implications for research and practice. *Journal of Research in Science Teaching, 38*(10), 1101–1114. doi:10.1002/tea.10004

Ohrt, J. H., Lambie, G. W., & Ieva, K. P. (2009). Supporting Latino and African-American students in advanced placement courses: A school counseling program's approach. *Professional School Counseling*, *13*(1), 59-63.

Ongaga, K. O. (2010). Students' learning experiences in an early college high school. *Peabody Journal of Education, 85*(3), 375–388.

Ozmun, C. D. (2013). College and academic self-efficacy as antecedents for high school dual-credit enrollment. *Community College Enterprise*, *19*(1), 61-72.

Palmer, R. T., Maramba, D. C., & Dancy, T. I. (2011). A qualitative investigation of factors promoting the retention and persistence of students of color in STEM. *Journal of Negro Education*, *80*(4), 491-504.

Pershey, M. G. (2011). A comparison of African American students' self-perceptions of school competence with their performance on state-mandated achievement tests and normed tests of oral and written language and reading. *Preventing School Failure*, *55*(1), 53-62

Peters Burton, E., Kaminsky, S. E., Lynch, S., Behrend, T., Han, E., Ross, K., & House, A. (2014). Wayne school of engineering: Case study of a rural inclusive STEM-focused high school. *School Science & Mathematics*, *114*(6), 280-290.

Peterson, B., Bornemann, G., Lydon, C., & West, K. (2015). Rural students in Washington state: STEM as a strategy for building rigor, postsecondary aspirations, and relevant career opportunities. *Peabody Journal of Education*, 90(2), 280-293. DOI:10.1080/0161956X.2015.1022397

Plessy v. Ferguson, 163 U.S. 537 (1896).

Project Lead the Way (2017). https://www.pltw.org/

Quinn, D. M., & Cooc, N. (2015). Science achievement gaps by gender and race/ethnicity in elementary and middle school: Trends and predictors. *Educational Researcher*, *44*(6), 336-346.

Rector-Aranda, A. (2016). School norms and reforms, critical race theory, and the fairytale of equitable education. *Critical Questions in Education*, *7*(1), 1-16.

Rendon, L. I. (2006). Reconceptualizing success for underserved students in higher education [PDF file]. National Center for Education Statistics, United States Department of Education. Retrieved from https://nces.ed.gov/npec/pdf/resp_Rendon.pdf.

Robinson, K. J. (2013). The high cost of educational federalism. *Wake Forest Law Review*, *48*(2), 287-331.

Rogers-Chapman, M. F. (2014). Accessing STEM-focused education: Factors that contribute to the opportunity to attend STEM high schools across the United States. *Education and Urban Society, 46*(6), 716-737.

Schmeichel, M. (2012). Good teaching? An examination of culturally relevant pedagogy as an equity practice. *Journal of Curriculum Studies*, *44*(2), 211-231. doi:10.1080/00220272.2011.591434

SC Works (2016). https://jobs.scworks.org

Settlage, J., Butler, M. B., Wenner, J., Smetana, L. K., & McCoach, B. (2015). Examining elementary school science achievement gaps using an organizational and leadership perspective. *School Science and Mathematics*, *115*(8), 381-391.

Simms, K. (2012). Is the Black-White achievement gap a public sector effect? An examination of student achievement in the third grade. *Journal of At-Risk Issues*, *17*(1), 23-29.

Simon, R. A., Aulls, M. W., Dedic, H., Hubbard, K., & Hall, N. C. (2015). Exploring student persistence in STEM programs: A motivational model. *Canadian Journal of Education*, *38*(1), 1-27.

Smith, P. S., Trygstad, P. J., & Banilower, E. R. (2016). Widening the gap: Unequal distribution of resources for K-12 science instruction. *Education Policy Analysis Archives*, *24*(8), 1-38.

Solorzano, D.G., & Ornelas, A. (2004). A critical race analysis of Latina/o and African-American Advanced Placement enrollment in public high schools. *The High School Journal, 87*(3), 15-26.

South Carolina Department of Education (2017). 2015-2016 Individual graduation plan conference data summary [PDF file]. Retrieved from https://ed.sc.gov/districts-schools/student-intervention-services/education-and-economic-development-act-eeda/2017-18-individual-graduation-plan-dashboard/

South Carolina Department of Education (2016). CSD Report Card [PDF file]. Retrieved from http://ed.sc.gov/

South Carolina Department of Education (2015). South Carolina Federal Report Card [PDF file]. Retrieved from http://ed.sc.gov.

Spring, J. W (2014). *The American school a global context: From the Puritans to the Obama administration (*9th ed.*)*. New York: McGraw-Hill.

Strayhorn, T. L. (2015). Factors influencing black males' preparation for college and success in STEM majors: A mixed methods study. *The Western Journal of Black Studies, 39*(1), 45-63.

Strayhorn, T. L. (2013). *Theoretical frameworks in college student research*. Lanham, MD: University Press of America, Inc.

Stuart Wells, A. (2014). Seeing past the 'color-blind' myth of education policy. *Education Digest, 80*(3), 38-41.

Summers, M., & Hrabowski, F. (2006). Preparing minority scientists and engineers. *Science, 311*(5769), 1870-1871.

The College Board. (2016). https://www.collegeboard.org

The College Board (2014). The AP program: Resources for parents and families [PDF file]. Retrieved from https://secure-media.collegeboard.org/digitalServices/pdf/ap/ap-insights-parents-families.pdf.

The White House Fact Sheet. (2015, March 23). President Obama announces over $240 million in new STEM commitments at the 2015 white house science fair [Press release]. Retrieved from https://www.whitehouse.gov.

Thompson, G., & Allen, T. (2012). Four effects of the high-stakes testing movement on African American K-12 students. *Journal of Negro Education*, *81*(3), 218-227.

Tillman, L. C. (2002). Culturally sensitive research approaches: An African-American perspective. *Educational Researcher*, *31*(9). 3-12.

Tobin, K., Elmesky, R., & Seiler, G. (Eds.) (2005). *Improving urban science education: New roles for teachers, students, & researchers*. Lanham: Littlefield Publishing Group.

United States Department of Education. (2017). https://www.ed.gov/

United States Department of Education. (2015). School composition and the black-white achievement gap. *National Center for Education Statistics.*

Vasquez, J. A. (2014). STEM beyond the acronym. *Educational Leadership*, *72*(4), 10.

Vygotsky, L. (1987). Thinking and speech. In R.W. Rieber & A.S. Carton (Eds.), *The collected works of L.S. Vygotsky, Volume 1: Problems of general psychology (pp. 39–285)*. New York: Plenum Press. (Original work published 1934.)

Wallace, T., & Brand, B. (2012). Using critical race theory to analyze science teachers' culturally responsive practices. *Cultural Studies of Science Education, 7*(2), 341-374.

Watt, M. L., & Watt, D. L. (1993). Teacher research, action research: The Logo action research collaborative. *Educational Action Research, 1*(1), 35-63.

Welton, A., & Martinez, M. (2014). Coloring the college pathway: A more culturally responsive approach to college readiness and access for students of color in secondary schools. *Urban Review*, *46*(2), 197-223. doi:10.1007/s11256-013-0252-7

Werts, A., Della Sala, M., Lindle, J., Horace, J., Brewer, C., & Knoeppel, R. (2013). Education stakeholders' translation and sense-making of accountability practices. *Leadership & Policy in Schools, 12*(4), 397-419. doi: 10.1080/15700763.2013.860464

Whaley, A., & Noel, L. T. (2012). Sociocultural theories, academic achievement, and African American adolescents in a multicultural context: A review of the cultural compatibility perspective. *Journal of Negro Education, 8*(1), 25-38.

Woodcock, J., & Olson Beal, H. (2013). Voices of early college high school graduates in Texas: A narrative study. *The High School Journal,* 56-76.

Wright, B. L. (2011). Valuing the "everyday" practices of African American students K-12 and their engagement in STEM learning: A position. *The Journal of Negro Education, 80*(1), 5-11.

Wright, T. (2011). Countering the politics of race, class, gender, and geography in early childhood education. *Educational Policy, 25*(1), 240-261. doi: 10.1177/0895904810387414

Zalaznick, M. (2015). Evolution of early colleges. *District Administration*, *51*(3), 65-69.

Zeichner, K. M. (1993). Action research: Personal renewal and social reconstruction, *Educational Action Research, 1*(2), 199-219. doi: 10.1080/0965079930010

# APPENDIX A

## STEM ATTITUDES AND INTEREST SURVEY

1. How would you describe the grades you usually earn in math class?
2. How would you describe the grades you usually earn in science class?
3. When you have homework in math and science classes, do you feel able to complete it without help from others?
4. In what ways do you think math and science will be an important part of your future career?
5. How much effort are you willing to give toward doing well in math and science classes?
6. To what extent will math and science preparation affect your future career earnings?
7. Do you plan to attend college after high school?
8. What career are you planning to pursue after high school?
9. Are you interested in taking a math or science dual enrollment class?
10. Do you have a role model who uses math or science in his or her career? If so, who is this person and what does he or she do for a living?
11. Are you willing to participate in one-on-one interviews as a participant in this study?

# APPENDIX B

# INTERVIEW PROTOCOLS

**Entrance Interview**

Hello _____.

Thank you for agreeing to speak with me today. We will get started in just a few minutes but I will explain the process for our interview first. If it is OK, I'd like to use the iPad to record our conversation. Do I have your permission to do so? (If yes, then begin recording.)

Since this is our first session, I have prepared four questions in advance. However, your answers may prompt me to ask follow-up questions. There is no right or wrong answer to any question, so please answer each question truthfully. This interview should take no more than 30 minutes. Are you ready to begin?

**Student Entrance Interview Questions**

1. Why did you agree to participate in this program?
2. What are you hoping to gain from this experience?
3. Do you believe attending college is important for your future?
    a. If yes, then why?
    b. If no, then why not?
4. Tell me about your past experiences in math and science classes.

**Exit Interview**

Hello _____.

Thank you for agreeing to speak with me today. We will get started in just a few minutes but I will explain the process for our interview first. If it is OK, I'd like to use the iPad to record our conversation. Do I have your permission to do so? (If yes, then begin recording.)

Now that we have come to the end of the Lunch and Learn program, I want to ask a few questions. Our conversation today will be very similar to the first time we sat down for an interview. I will ask a question and you answer it as best you can. I have a few more questions this time and depending on your answers, I may have follow-up questions. There is no right or wrong answer to any question, so please answer each question truthfully. This interview should take no more than 30 minutes. Are you ready to begin?

**Student Exit Interview Questions**

1. How much did you enjoy your experience in this program?
    a. Please explain why you described your experience this way.
2. Let's talk about the specific features of this program.
    a. Which feature of this program was most beneficial to you?
    b. Which was the least beneficial?
3. Would you encourage a friend to participate in a program like this one?
    a. If yes, why?
    b. If not, then why not?
4. Do you think dual enrollment classes are a good option for you?
    a. If yes, why?
    b. If no, then why not?
5. Do you plan to sign up for a math of science dual enrollment class in the future?
    a. If yes, then which class or classes do you plan to take?
    b. If no, then why not?
6. What would you need from persons at CHS to support you in a math or science dual enrollment class?

# APPENDIX C

## ACTION RESEARCH PLAN

| | |
|---|---|
| Problem Statement | The identified Problem of Practice (PoP) for the present action research focuses on low levels of participation in science and mathematics dual enrollment courses among African American sophomores at Crosstown High School (CHS). The CHS Report Card confirms modest dual enrollment participation and substandard STEM achievement (South Carolina Department of Education, 2016). Only 73 of the school's 813 students (approximately 9 percent) are taking advantage of dual enrollment courses and, 56 of the 73 (77 percent) are participating in a special STEM Early College Program (ECP) which requires them to enroll in the dual enrollment classes. |
| Purpose of Study | The primary purpose of the present action research study is to implement a counseling program which informs African American students, who are not a part of the STEM Early College Program (ECP), about dual enrollment opportunities at CHS. The secondary purpose is to determine if participating in the counseling program encourages students to pursue dual enrollment STEM classes at CHS. Finally, the tertiary purpose of the study is for the participant-researcher to collect data amongst these African American students to ascertain their perceptions about their experiences in the program and then to use that data to reflect with teachers, school counselors, administrators, and other stakeholders in order to institute a steady and durable dual enrollment program for African American students in the Crosstown School District. |
| Research Questions | 1. What is the effect of a counseling program intervention on African American students' STEM disposition at Crosstown High School?<br>2. To what extent does involvement in the counseling program influence these African American students' attitudes about math and science dual enrollment participation?<br>3. What are the most significant factors that shaped these African American students' STEM disposition? |

| | |
|---|---|
| Context | CHS is a rural South Carolina high school within a high-poverty community. Its student body is mostly African American (approximately 90%). The school and district have a well-documented history of low achievement and limited access to rigorous curriculum. However, under its current leadership, the school district has made significant progress with respect to its course offerings and student success in college-level classes. |
| Participants | Nine tenth graders who have been identified as promising dual enrollment candidates by CHS school counselors and are likely to satisfy the technical college admissions requirements. |
| Data to be collected | The data to be collected includes observations, field notes, Google Forms surveys, STEM Attitudes and Interest Surveys (Appendix A), and interviews (Appendix B). |
| Frequency duration of data collection | Data will be collected in each of five weekly Lunch and Learn sessions as well as during the one-on-one interviews. |
| Location of data collection | Crosstown High School |
| Who will collect data | Participant-researcher |
| Data Analysis Procedures | Data analysis procedures include coding of quantitative data using NVivo 11 software and researcher-review of notes, surveys, and interview transcripts. |
| Display of data findings | The data from individual interviews, surveys, and other notes will be used to construct profiles and descriptions of the participants' experiences. Charts, tables, and graphs will be used to accentuate significant observations and findings. |

APPENDIX D

PROCEDURES FOR DATA COLLECTION, ANALYSIS, AND WRITING

| ACTIVITIES | AUG | SEPT | OCT | NOV | DEC | JAN | FEB |
|---|---|---|---|---|---|---|---|
| Finalize list of study participants | X | | | | | | |
| Collect consent/assent forms | X | | | | | | |
| Administer STEM Attitudes Interest Survey (pre-test) | | X | | | | | |
| Conduct Entrance Interviews | | X | | | | | |
| Session 1 Google Forms Surveys / Notes | | X | | | | | |
| Session 2 Google Forms Surveys / Notes | | X | | | | | |
| Session 3 Google Forms Surveys / Notes | | X | | | | | |
| Session 4 Google Forms Surveys / Notes | | X | | | | | |
| Session 5 Google Forms Surveys - Notes | | X | | | | | |
| Administer STEM Attitudes Interest Survey (post-test) | | X | | | | | |
| Conduct Exit Interviews | | | X | | | | |
| Data organization / coding | | | X | X | | | |
| Detail findings /data analysis | | | | X | X | | |
| Construct participant profiles | | | | | X | X | |
| Summarize data, findings (Chap. 4) | | | | | X | X | |
| Conclusions, summary, and recommendations (Ch. 5) | | | | | | X | X |

# APPENDIX E

## PARENT PERMISSION LETTER

**August 29, 2017**

Dear **Parent(s) or Guardian(s)**:

My name is Sonja L. Taylor and I am a doctoral student at the University of South Carolina. I am writing to request permission for your child to participate in a research study. The study is entitled, "A Counseling Program Intervention for Improving African American Students' Science, Technology, Engineering, and Mathematics (STEM) Dual Enrollment Participation." This study will be conducted at Crosstown High School (CHS) from September 2017 through October 2017, over a five-week period. Through this study, I intend to work with the school principal, guidance department, technical college admissions staff and faculty to (1) inform students about the math and science dual enrollment course options at CHS; (2) educate students about the technical college admissions and testing requirements; (3) expose students to practicing STEM professionals and related careers; (4) build a college-going mindset; and (5) increase participation in STEM dual enrollment classes among students outside of the district's Early College program. The study activities will take place during the lunch period. Therefore, your student will not miss any class time. You are also welcome to attend any or all of the sessions, if your schedule permits.

**This study is voluntary, so it is your choice to allow your child to participate**. To help you in this decision, a brief description of the session activities is provided below. In addition to these activities, study participants will complete surveys and participate in group discussions. They will also have the option of participating in interviews.

Overview of Counseling Program Activities

| Week | Activity |
|---|---|
| 1 | Welcome and Orientation<br>Meet a STEM Professional – Physical Scientist<br>Overview of the CHS Dual Enrollment Program and Support Structures |
| 2 | Dual Enrollment Teacher and Student Presentations—Expectations, Experiences, Overcoming Obstacles |

| | |
|---|---|
| 3 | Meet a STEM Professional – Biologist |
| 4 | Meet STEM Professionals – Computer Scientists |
| 5 | Technical College Presentation |

Ten high school students, both male and female, have been invited to participate in this study. Only students who have parental permission, and who themselves agree to participate, will be involved in the study. As a study participant, your child is expected to attend each session and contribute to the discussions, complete surveys, and follow basic instructions. Students or parents may withdraw their permission at any time during the study without facing any penalty. If a student or parent wishes to withdraw from the study, he or she may simply notify the researcher of this decision. There are no known or anticipated risks to participation in this study. I would like to assure you that this study has been reviewed and approved by the University of South Carolina's Institutional Review Board. I have also obtained permission and support to conduct this study from the Crosstown School District as well as the Crosstown High School administration.

I hope you will permit your child to participate in this study because I believe it will contribute to furthering our knowledge of best practices for increasing the number of students at CHS who take advantage of college level math and science classes. I also believe your child will personally benefit from the information sessions, activities, and engagement with other students who are focusing on their future career options. Please complete the attached permission form, whether or not you give permission for your child to participate. Place the form in the pre-addressed envelope provided and return it to Mrs. FF* in the Guidance Department by **September 6, 2017.**

If you have any questions about the study, or if you would like additional information to assist you in reaching a decision, please feel free to contact me directly.

Sincerely,

Sonja L. Taylor
Doctoral Student
University of South Carolina College of Education
Email: sonja@email.sc.edu
Phone: 803.500.3949

**Permission Form**

**(Included with letter about the study)**

I have read the information letter concerning the research project entitled "A Counseling Program Intervention for Improving African American Students' Science, Technology, Engineering, and Mathematics (STEM) Dual Enrollment Participation." This study is being conducted at Crosstown High School by Sonja L. Taylor, a doctoral student of the College of Education at the University of South Carolina. I have had the opportunity to ask questions and receive any additional details I wanted about the study.

I understand that all information gathered on this project will be used for research purposes only and will be kept confidential. I am aware that permission is voluntary and may be withdrawn at any time without penalty by advising the researcher. I may contact Sonja L .Taylor directly via email (sonja@email.sc.edu) or phone (803.500.3949) if I have any comments or concerns about my child's involvement in the study or any questions in general.

☐ Yes – I would like my child to participate in this study

☐ No – I would not like my child to participate in this study.

Child's Name **(please print)**

_____

Parent or Guardian Signature _____

Date _____

# APPENDIX F

## INVITATION LETTER

August 29, 2017

Dear **Parent(s) or Guardian(s)**:

Congratulations! Your child has been invited to participate in a special program which is designed to help students learn more about advanced mathematics and science opportunities at Crosstown High School (CHS). Only ten students have been offered the opportunity to participate in this five-week program. Your child was selected because he or she has performed well academically, received a recommendation from the school guidance department, demonstrated promise in mathematics and science coursework, and has the potential to succeed in a related career.

There is no cost to participate in the program. As a matter of fact, participants will receive valuable information to help them with college and career planning. The students will also meet with scientists, engineers, and other professionals who can help them to learn about their journeys from high school into their careers. We will meet at CHS during the regular lunch period; therefore classes will not be disrupted. Lunch and other refreshments will be provided for each of our weekly sessions.

I have enclosed detailed information about the program as well as forms which require your signature in order for your child to participate. Please review the attachments and let me know if you have any questions.

Sincerely,

Sonja L. Taylor
Doctoral Student
University of South Carolina College of Education
Email: sonja@email.sc.edu
Phone: 803.500.3949

# APPENDIX G

## STUDY PARTICIPANT PROFILES

**Amanda**. Amanda entered the program with a very strong college-going mindset. Her mother and grandparents have succeeded in several entrepreneurial efforts, earned college degrees, and consistently emphasized the importance of college education for life success. Thus, Amanda has the human, social, and cultural capital to thrive in math and science courses and to take advantage of dual enrollment opportunities in high school. Amanda's self-efficacy has been shaped by her family's expectations and history of personal and professional accomplishments, her past successes in math and science classes, and the support from teachers who were culturally competent. During the program, the vicarious experiences and verbal persuasion from current STEM ECP students were especially significant for Amanda's interest in dual enrollment and strongly encouraged her expressed expectations to pursue "as many classes as she can" in the future. Admittedly, Amanda entered and exited the Lunch and Learn program unsure of her exact career interests, but she remained consistent that her choice would be related to math and/or science. Unlike many of her fellow participants, Amanda has experienced life outside of the CSD and the state of South Carolina. Her mother spent some time in the military and Amanda was able to travel to different parts of the United States. This experience exposed Amanda to schools in other places including Florida, which she specifically described as "a lot better than here [meaning the CSD]. Therefore, Amanda's

perception of the CSD as relatively inferior to other places has caused her to "worry" about how ready she might be for challenging courses.

**Brian**. Although not as expressive as other participants, Brian entered and exited the program with a clearly articulated interest in forensic science. Regardless of when and how often he was questioned about this interest, Brian never wavered. Brian's interest in forensic science was specifically sparked by the African American actor Hill Harper's character on the television show *CSI: New York*. Brian did not identify Harper's character (or anyone else) as a STEM mentor but by observing Harper in this role, Brian's perception about his career possibilities were sparked and affirmed. Like Amanda, Brian's college going mindset is strong and was shaped by his mother's expectations that he will earn a college education as well as his enactive attainments, especially very high standardized test scores and grades across all subject areas. Brian has been enrolled in the CSD since elementary school and he has always been among the "top students in his class." Furthermore, Brian's home environment is very stable. He is the only study participant with two married parents in the home and his father is also a successful business owner. Therefore, Brian has the necessary capital to achieve his goals. Brian also entered and exited the program with an interest in dual enrollment classes. As a result of participating in the program, Brian's knowledge of the CHS dual enrollment program increased and he "learned more about other STEM careers." Thus, his resolve to pursue the classes was reinforced.

**Jada**. Unlike any other participants, Jada has a solid STEM role model. The impact of her mother's academic and socioeconomic achievements on Jada's disposition cannot be overstated. Of all the study participants, Jada was the most confident in her

position and she demonstrated a deep understanding of how choices about coursework and career would impact her future. Although she has a solid college-going mindset with every intention of becoming a nurse practitioner, Jada was the only participant who critically analyzed the decision to pursue dual enrollment classes in terms of her need to maintain balance as a high school student. Thus her physiological state together with solid past academic performances and socioeconomic capital are evidenced by her willingness to enjoy the high school experience without worries about if and how she will attain a college education.

**Jalen**. Jalen has consistently earned good grades in math and science classes so his self-efficacy toward higher level coursework is strong. Jalen expressed a greater degree of confidence and interest in math, thus he plans to pursue a math dual enrollment course during his senior year of high school. With the same degree of conviction that Jalen expressed his dual enrollment plans, he also consistently demonstrated a passion for computer engineering. However, during the initial one-to-one interview, Jalen's lack of sociocultural capital showed up in his limited awareness about how to actually become a computer engineer. When conversing with the researcher, Jalen was unable to clearly explain what a computer engineer does. However, through exposure to the Lunch and Learn program presenters, Jalen demonstrated significantly more knowledge of actual steps to achieve his goal. He sought out extended conversations with Trevor (STEM ECP student) and Mr. MD*, one of the computer scientists who presented from an area technology company. When the researcher discussed a specific program for aspiring African American computer scientists, Jalen was especially interested. He asked for additional information and followed up with the researcher twice with related program

questions. Thus, the Lunch and Learn program seemed particularly helpful for charting Jalen's next steps on his STEM and college journeys.

**Kimberly**. Kimberly's STEM disposition is most closely associated with access to culturally relevant pedagogy and the CSD's struggle to maintain high quality teachers in math and science courses. An average STEM student in elementary and middle school, Kimberly stated that she struggled in the early grades because she did not have the best teachers. As her academic performance improved, she credited her teachers for fostering a more favorable learning environment. These teachers were mostly in the high school in classes that included a state-mandated standardized test. Kimberly's math and science interest was fueled by her sick grandmother's caretaker. While she did not identify the nurse as a role model, the nurse's purposeful explanation of her techniques, educational background, and experiences nurtured Kimberly's passion for nursing as a career. Furthermore, this interest in nursing has been sustained by gradual improvements in her grades and standardized testing. Thus, these enactive attainments have been crucial for building her confidence. Kimberly is a first-generation college student from relatively humble means. Therefore, she is hoping to earn scholarships for college. Despite consistent uncertainties about participating in dual enrollment, she seems convinced that college is an appropriate choice for her future and that dual enrollment classes are a good idea. She is simply not convinced that she can succeed in the courses without the support of her peers. The fear of failure is at the heart of her reluctance to pursue the coursework while in high school.

**Michael**. Despite being a first-generation college student, Michael's STEM disposition was among the most rock-solid of all program participants. He entered the

program with clear plans to pursue engineering and he exited with the same mindset. Michael has a long history of STEM success which has been reaffirmed over time by consistently high grades and test scores as well as direct verbal confirmations from his teachers. Like Brian, Michael participated in the district's math and science magnet program in the elementary grades. He repeatedly described the positive effects of his experiences in the magnet program and its particular influence on his interest in engineering. He also drew correlations between his favorable course placement in advanced classes and the quality of teachers to whom he had access. Michael's first generation status and solid academic record qualify him for participation in the Upward Bound program. Because this program is a well-established pathway to college for underprivileged students, Michael recognized this opportunity as an appropriate personal choice for alleviating college related expenses. He also knows the importance of maintaining good grades for securing college access and financial support, thus Michael is not convinced the dual enrollment is the best option for him. The degree of thought with which Michael expressed the rationale for his concerns demonstrates that he is carefully analyzing potential obstacles to his success. When considering Michael's actions and comments throughout his years of schooling and participation in this Lunch and Learn program, they point to a very self-efficacious young man with a strong determination to succeed in life. Furthermore, his mother's inability to complete college and the debt she accumulated weighed on Michael's determination to earn scholarships to reduce college-related costs. Although Michael did not explain specifically why his mother did not complete college, he indicated that she "really did not have the support to finish" and is determined to avoid the same fate.

**Quincy**. When considering the major themes of Critical Race Theory and the effects of systemic poverty and lack of education on African Americans in the CSD, Quincy's STEM disposition is best described by the collection of factors that plague rural communities and the families who have not been able to move beyond them. Of all the Lunch and Learn program participants, this researcher believes Quincy benefited the most. He entered the program without the ability to share a home mailing address because his family does not have stable living arrangements. He did not have a mobile phone or other basic technologies and even though the CHS provided a Chromebook for all students, Quincy was unable to really use it because he did not consistently have access to the Internet at home. Each week, Quincy requested any leftover lunch and packed it into his backpack. His mother did not graduate from high school and has been unemployed "for as long as [he] can remember." Needless to say, poverty and limited educational opportunity have negatively influenced many aspects of Quincy's life and his lack of a college-going mindset. His family has very little sociocultural capital. Therefore, college planning has not been a high priority for Quincy. While Quincy started the program with very little clarity about a specific career interest, each presenter helped him to understand more about connecting general math and science interest to definite career pursuits. And, as Quincy learned more, his body language and confidence to speak up and ask questions improved. By the end of the program, Quincy was seriously considering attending college, seeking out financial support and mentorship, and asking about how he could possibly fit dual enrollment classes into his schedule before completing high school. Despite lasting only five weeks, the information, guidance and support provided by each presenter helped Quincy to align his strengths and enactive

attainments in math and science classes with his interests. He expressed particular fondness and appreciation for Mr. MD* and described those interactions most favorably.

**Roger**. Also a first generation student, Roger did not initially exhibit any true understanding of the value of college. He spoke in very lackluster terms about his future plans and seemed very disinterested in participating in the program. At one point, the researcher became concerned that he may drop out of the program altogether. While his peers seemed relatively certain of their STEM interests and were ready to engage in conversations easily, Roger was apathetic and unwilling to offer deep explanations about his thoughts. He often responded with one word answers or by shrugging his shoulders. There were two very distinct moments when Roger's attitude visibly improved: (1) when the STEM ECP students shared their experiences and more notably (2) when Mr. MD* talked about his journey from a small rural town in South Carolina as a first generation college student to a historically Black college to study computers to numerous career and economic successes related to his educational attainment. The experiences of students his own age and Mr. MD*'s explanations about the financial benefits of earning a computer science degree appeared to drastically shift Roger's disposition. While each male participant expressed a degree of captivation by Mr. MD*'s story, Roger was noticeably more engaged than he had been in any other session. Furthermore, Roger proposed that the group "take a field trip" to the technology company to learn more about what they do. Thus, participating in the program had a definite and positive effect on Roger's disposition and attitude about participating in dual enrollment classes.

**Steven**. Of all the participants, Steven demonstrated the most fragile physiological state. Despite having strong grades and test scores in math and science,

Steven's confidence was very low. On multiple occasions, he referred to himself as "a little lazy" and "in need of motivation." Steven also expressed emotional neediness and regularly sought out personal connections from the researcher and some of the female program presenters. For example, he once said to the researcher, "Now that your real son is all grown up, you could adopt me to be your son." He would rarely leave the guidance director's conference room without getting a hug from the researcher and other female presenters." He also sent the researcher text messages "just to chat" in between the weekly sessions. Steven's STEM interest is very closely related to his love of playing video games and it is unclear is this passion for playing games can help Steven to overcome his laziness when faced with real academic challenge. By his own admission, Steven "needs someone to stay on him" which is not positive for self-selecting into a college-level math or science course as a high school student. He also expressed concerns about succeeding on the placement test and reminded the researcher of his need for support. Of all the participants, the researcher viewed Steven as the least likely to actually pursue a dual enrollment course.