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YES WE CAN ACHIEVE IN MATHEMATICS AND WHY WE DON'T: AFRICAN
AMERICAN FEMALE ELEVENTH AND TWELFTH GRADE STUDENTS IN A
CAREER AND TECHNICAL SETTING

By

Courtenay Grace-Rochelle Mayes
B. A., University of Kentucky, 1998
M. A., University of Kentucky, 2000

A Dissertation
Submitted to the Faculty of the
College of Education and Human Development of the University of Louisville
in Partial Fulfillment of the Requirements
for the Degree of

Doctor of Philosophy

Department of Teaching and Learning
University of Louisville
Louisville, Kentucky

December, 2011

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A Dissertation Approved on

September 29, 2011

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DEDICATION

This dissertation is dedicated to my mother Joyce Ann Mayes and to my daughter Ciera Smith-Mayes; two beautiful African American women. Accomplishing this educational goal has been a challenge. Nevertheless, God has guided me through this process. Mom, thank you for your prayers, guidance, support, friendship, and faithfulness. Also, thank you for showing me that despite life's obstacles; with God all things are possible. You showed me by example that without a struggle, there is no testimony. Ciera, there is no me without you. You are truly a blessing given to me by God. As you take your journey into adulthood and pursue your collegial dreams, I encourage you to set goals, focus, make wise choices, put God first in everything that you do, push beyond that which you think you are capable, and never let anyone other than yourself define your destiny. Remember that any educational goal worth achieving will require you to work hard, commit, and persevere. Ciera, you have made me proud, and in your adult years you will accomplish greatness. Thank you for being patient, loving, supportive, and understanding.

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ABSTRACT
YES WE CAN ACHIEVE IN MATHEMATICS AND WHY WE DON'T: AFRICAN
AMERICAN FEMALE ELEVENTH AND TWELFTH GRADE STUDENTS IN A
CAREER AND TECHNICAL SETTING

Courtenay G. Mayes

September 29, 2011

The underachievement of African American students in the mathematics classroom and the underrepresentation of African Americans in advanced mathematics courses and mathematics related career fields has been a concern for the mathematics education community for many years. The objective of this research was to investigate the perceptions and mathematical experiences of seven African American female high school students who were on a continuum from succeeding at high levels to struggling in mathematics. These particular African American females were eleventh and twelfth grade students enrolled at a career and technical high school located in the Midwestern United States of America. This study utilized a phenomenological research design to get a true depiction of the participant's perceptions of their mathematical experiences. Purposeful sampling was used to select the seven research participants. Of the seven African American female research participants in grades 11-12 interviewed, three were successful, two were middle performing, and two were not persisting and achieving in the mathematics classroom. Also, to triangulate the data, the investigator interviewed the two mathematics teachers of the research participants. A quantitative analysis of existing data, mathematics autobiographies (Berry, 2002) and Fennema-Sherman Attitude Scale

(1976) survey results, was also used in this study. Implications from this research study include: (1) Mathematics teachers must provide opportunities for African American female students to become autonomous learners constructing their own knowledge; (2) Mathematics students must be taught how to problem solve and think independently in the mathematics classroom; (3) Mathematics teachers must connect the mathematics being taught in their classrooms to the mathematics involved in the students' career and technical programs; and (4) Mathematics teachers must find ways to increase the confidence of African American students in the mathematics classroom and reduce their anxiety.

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CHAPTER I

BACKGROUND

Persistent underachievement in mathematics is a constant concern for the mathematics education community. As a result of this underachievement, numerous efforts--over a time span of more than 40 years--have been made to reform the teaching and learning of mathematics at the national, state, and district levels (Ball, Lubienski, & Mewborn, 2001). During this period of reform, United States' student populations have changed substantially. With the new urgency for the United States to increase the academic performance of all students and close the achievement gap, the federal government passed the 2001 No Child Left Behind (NCLB) Act. NCLB calls for well-defined standards, more testing, highly qualified teachers, more parental engagement, and greater school accountability. Despite reform efforts attempting to comply with NCLB and to improve the outcomes of mathematics education for all ethnically and racially diverse student populations, United States high school students consistently perform at lower levels when compared to students in other developed countries ("NCLB News: International," 2005). Evidence shows quite clearly that United States students routinely enter and leave mathematics classrooms without a sound understanding of many mathematical concepts. This inference is consistent with Liping Ma's findings. After reviewing research studies on mathematics achievement, L. Ma (1999) noted that "students of some Asian countries, such as Japan and China, consistently outperformed their counterparts in the United States" (p. xix). Unfortunately, among those low

performing groups in the United States, African American students are the lowest at all grade levels (Berry, 2003; Braun, Wang, Jenkins, & Weinbaum, 2006; Moses-Snipes & Snipes, 2005; Snipes & Waters, 2005; Stinson, 2006). Convincing evidence from international and national accountability assessments supports this argument. Results from the 2003 Program for International Student Assessment (PISA), a test of 15 year olds from 41 countries, concluded that on the average, African American students received the lowest scores of all races and ethnicities participating in the United States in the areas of mathematics literacy and problem solving (Lemke et al., 2004). The National Assessment of Educational Progress (NAEP)—federally administered to collect national and state data--also documented in 2007 the mathematics achievement performance gap of eighth-grade African American students, as compared with their White, Hispanic, Asian/Pacific Islander, and American Indian peers (National Center of Education Statistics [NCES], 2007). The average scale score of African American eighth-grade students on the NAEP assessment was 260 out of a possible 500. Analysis of the data revealed that this mean scale score for African Americans was 31 points below the national average and once again the lowest score obtained by any of the participating races and ethnicities. Researchers argued that the achievement gap continues to widen (Education Trust, 2003; Ikpa, 2004; Jordan & Cooper, 2003) due to African American students persistently performing “at significantly lower levels” (Tate, 1997, p. 673). This finding is consistent with the NAEP mathematics scale scores of African American eighth graders from the years 2000, 2003, 2005, and 2007 (NCES, 2007). The 2005 NAEP mathematics data for twelfth-grade students reported that “the average for White students was 31 points higher than for Black students” (NCES, 2007a,

p. 14). In short, African American students consistently continue to be the lowest achieving group of students in the United States. Over the years the mathematical performances of African American students continue to be uniformly low and stagnant. Analyses of NCES data by Ikpa (2004) supported this conclusion. She writes that “by the end of high school, African Americans have acquired skills in reading and mathematics that are the same as those of eighth-grade European American students” (p. 5). Also, Lubienski and Crockett (2007) discuss how African American students consistently score lower on standardized test than White students.

The underperformance of African American students in mathematics in relation to their United States peers is also evident on college entrance examinations. The Scholastic Assessment and Achievement Test for mathematics (SAT-M) reveals a considerable difference between the mathematical performance of African American students and other races and ethnicities. In 2008, African American students were the lowest performing students on the SAT-M. African American students scored a mean score of 426 out of a possible 800 (College Entrance Examination Board 2008). These students scored at substantially lower levels than both Asian (mean score of 581) and White students (mean score of 537). Since the SAT is a college readiness exam, it is plausible that this performance gap on the SAT-M is due to the underrepresentation of African American students in higher level mathematics courses at the secondary level. Research has consistently found that African American students exhibit different enrollment and persistence patterns than their peers in higher level mathematics courses. This is evidenced by the 2005 comparison of results from NCES (2008a). For example, 3.9% of African American students took trigonometry, 17.9% took Pre-Calculus, 5.5%

took Calculus, and 2.9% took Advanced Calculus. This is in direct contrast to the data that 9.6% of White students took Trigonometry, 32% took Pre-Calculus, 15.3% took Calculus, and 10.1% took Advanced Calculus. These statistics are consistent with researchers who conclude that more middle-class White males enroll in higher level mathematics courses (Lee, 2004). This underrepresentation of African American students in rigorous, advanced level mathematics courses has an impact on the students' mathematics performance and knowledge base at both the secondary and postsecondary levels and on college readiness exams since course-taking in mathematics has been shown to be significantly and positively associated with mathematical outcomes including higher gains on college entrance exams (Burkam & Lee, 2003; Csikszentmihalyi & Schneider, 2000; Riegle-Crumb, 2006). Failure to enroll in higher level mathematics courses limits African American students' exposure to important advanced mathematical concepts. Thus, African American students are perhaps inadequately prepared for the more demanding mathematical skills and concepts that are tested on the SAT-M and other college readiness exams, as well as the mathematics content covered at the collegiate level. Generally speaking, the failure of African-American students to enroll in advanced-level mathematics courses can potentially widen the achievement gap and skew the possibilities for mathematical success later in life especially in business and industry. In brief, the achievement disparity as measured on these assessments between African American students and their peers does not point to an ability differential due to being African American. Although this rationale has been offered (Moody, 2003), it is far too limiting and is unsatisfying. Instead, the more generalized problem of underperformance may point to the social context of the African

American student's classroom experience and the inequities therein. The reality is that African American students can perform as well as other races and ethnicities, but their underperformance remains a challenge. Nevertheless, there is hope that African American students can one day reverse these disappointing academic outcomes.

Significance of the Study

In light of the NCLB legislation and *The National Educational Goals Report: Building a Nation of Learners* (National Educational Goals Panel, 1995), mathematics teachers are faced with the important task of raising educational quality and closing the achievement gap by providing all students with the resources and opportunities needed to be successful in the mathematics classroom. For this reason, a few researchers have accepted the charge of identifying specific causes and explanations for the achievement gap. Despite research and legislative efforts, the current state of the mathematics education of African American students is still quite dismal. African American students continue to face barriers and immeasurable challenges that are hindering them from making significant gains in achievement in mathematics. Needless to say, the dismal mathematics outcomes of this population of students are indicative of the achievement disparities that continue to plague the mathematics education community and its reform efforts. When confronted with pervasive and persistent problems in the face of repeated efforts to correct them, one must assume that there are deep-seated causes of underachievement that are perhaps being overlooked. Other researchers, (Lubienski, 2002; Cokley & Moore, 2007), have pointed out that many researchers have not taken into account the cultural backgrounds of African American students and others. According to these researchers, although there has been some research on the effects of

“psychological and/or cultural factors” on African American students’ performance, there is a lack of such research. Part of the problem is that the unique needs and unique background experiences of African American students are not being investigated. Taking these unique needs and backgrounds into account may enable us to more fully understand their achievement disparities in the mathematics classroom.

One plausible explanation for the achievement difference between African American students and their peers is that teachers are not guided to adequately take the cultural differences of students into account in their teaching methods. Also, researchers are not adequately taking these cultural factors into account in their research. In an effort to address achievement gap issues, effective teachers must possess knowledge of their students’ cultural backgrounds to promote more equitable learning opportunities for diverse groups of students (Banks, 2006; Koppelman, 2005). In *Young Gifted and Black: Promoting High Achievement among African American Students*, Perry (2003) pointed out that in order to improve “African American school achievement” educational stakeholders and researchers need to examine “the nature of the task of achievement for African Americans” from their perspective (p. 4). One might ask, can we fully understand or be sympathetic to this task of improving the achievement outcomes of African American students if we have not walked in their shoes or attempted to understand their experiences? Can we relate to the frustrations that the African American student inevitably feels going through the K-12 educational system in America? The challenge of every teacher is to figure out where the student is and teach according to the student’s individual needs. Now, it is appropriate and necessary for researchers to seek the perspective of African American students so that the students in their studies can

identify both personal and environmental factors that either limit or enhance their achievement. The findings of such research can be used by teachers to understand that these frustrations exist and adjust teaching strategies to address these frustrations minimizing the effects. Flores (2007) wrote, “While it is important to recognize a symptom such as low achievement, it is even more critical to understand and address its underlying causes” (p. 29). In order for African American students to move past these obstacles of disappointing outcomes, it is imperative that these underlying causes be identified. Examining socio-cultural factors (from the viewpoints of the students) in relation to the learning of mathematics could potentially be a critical impetus for changing the academic outcomes of African American students. Accordingly, it is important to take socio-cultural factors into account when examining the underachievement of these students. Lim (2008) contended that “[r]esearchers suggest that various social and cultural factors may influence minority students’ experiences in learning mathematics and affect both their motivation to acquire advanced mathematical knowledge and their actual performance in the domain” (p. 304). According to Lim and other researchers like Lubienski and Bowen (2000), research examining socio-cultural factors is sparse. Thus, merely attacking the superficial symptoms of underachievement will potentially lead to perpetual failure in reform efforts and exacerbate rather than ameliorate the problem. Although the mathematics community acknowledges that the challenges to improving the mathematics education of African American students in the United States are enormous, it is nonetheless necessary that they be met so that these students can fairly “compete in the global world” (Conference Board of the Mathematical Sciences [CBMS], 2001, p. 4) and gain economic self-sufficiency. More and more

African American students are falling further behind in the mathematics classroom. Many individuals see mathematics as the gateway to economic prosperity (Moreno & Muller, 1999). It has also been referred to as a “critical filter” (Fennema & Leder, 1990; Sells, 1978; Zaslavsky, 1994) because mathematically illiterate students are filtered out of advanced mathematics courses and mathematics related college majors. More is being demanded mathematically from all students. Mathematics students are increasingly required to master competencies and apply acquired knowledge to various situations both inside and outside of the classroom. When the mathematical opportunities of minorities and females are limited, they are denied entry into the gates leading to upward mobility and economic enfranchisement (Miller, 1992). Hence, they are slowly filtered out of the high paying scientific and technical professions. Losing the economic contributions of minorities and females in this capacity has consequences for our United States economy. Specifically, it stunts the growth of and diminishes the strength of the economy. Thus, the United States cannot truly prosper without the contributions of these individuals. African American students have long faced barriers to their achievement in the mathematics classroom. The inequities and in-congruencies that are a part of their educational realities must be taken into account. Academic improvement for African American students will perhaps come as more researchers take a direct course toward understanding and considering the barriers to learning that these students face. Now is the time to expose and discuss these barriers and what they mean to the mathematics futures of African American students.

Although a substantial body of literature on African American students’ underachievement in mathematics is available (Berry, 2003; Brand, Glasson, & Green,

2006; Dimitriadis, 2001; Education Trust, 2003; Parsons, Travis, & Simpson, 2005; Jamar & Pitts, 2005; Lee, 2004; Moody, 1998; Powell-Mikle, 2001; Russell, 2005; Saddler, 2005; Secada, 1992; Stinson, 2006; Tate, 1997), relatively little attention has been given to the difficult and complex issues associated with the learning and achievement of African American students within the public school system. According to Powell-Mikle (2001), "This narrowing of focus tends to blame African American students for their failure instead of examining their experiences or perceptions to help alleviate the problem" (p. 3). The majority of the published research has focused primarily on the personal characteristics of the African American student (Flores, 2007), paying only minimal attention to their mathematics classroom experiences (Stinson, 2006). After analyzing a plethora of "equity research within mathematics education" (Stinson, 2006, p. 477) Lubienski and Bowen (2000) comment, "...researchers look primarily at outcomes of these equity groups [ethnicity or class] and rarely examine how schooling experiences contribute to these outcomes" (p. 631). These researchers point out that investigating environmental factors pertaining to the educational experiences of African American students' that may potentially be limiting their achievement merits particular attention. If you do not know specifically what is causing the problem and do not recognize the complex nature of their learning, diagnosing and meeting the current and future needs of these students becomes a challenge. Moreover, Flores (2007) argued that "stopping with only an examination of the symptoms often leads too easily to a focus on student characteristics as the cause" (p. 30). While some mathematics education researchers have identified and examined the disparities in achievement and others have attempted to find the causes of these disparities, it seems apparent that this search for

causality is at best incomplete. Although there is considerable speculation, minority underachievement remains a question for research. Unfortunately, the magnitude of the academic achievement gap for African American students continues and most related issues have been with us for years. It would appear from the results of the existing research that the prime causes of these disparities are either illusive, have remained unexplored, or have not been embraced by school policy makers, administrators, and in-service teachers. We must acknowledge that the existing educational structures are failing African American students. To gain a more realistic view and obtain valuable information, it will perhaps be helpful to venture into classrooms and school settings in search of answers related to the achievement gap. Giving particular consideration to the academic and social schooling experiences of African American students from their viewpoints is a necessary process and results will provide a more precise understanding and a more specific analysis of the extent and complexity of the problem and ultimately lead to improved mathematical performances for these students. Thus, research of this sort is needed if we are to address the challenges faced by African American students in mathematics.

Females and Mathematics

Meeting the needs and improving the mathematics education of African American students in general and African American females in particular also requires that we examine the following unresolved question often posed nationally and internationally in the field of mathematics: Do males outperform females in the mathematics classroom? Such a question has generated considerable interest and has been studied for several decades (Benbow, Lubinski, Shea, & Eftekhari-Sanjani, 2000; Ding, Song, &

Richardson, 2007; Hyde & Mertz, 2009; Ma, 2008). After inspection of the Program for International Student Assessment (PISA) data, Langen, Bosker, and Dekkers (2006) concluded, “In considerable national and cross-national research (Johnson, 1996), girls have been found to be ahead of boys in reading and language but to lag behind in mathematics and frequently also in science” (p. 157). In 2007, the average male score on the NAEP assessment was two points higher than the average female score across all grades (NCES, 2008). Since the assessment scores differ by only two points, the difference is not statistically significant. Corresponding research further asserts that an even greater gender performance gap (with males outperforming females) is prevalent at the secondary level of education (Fleming, 2000). Referencing the assessment data of the International Association for the Evaluation of Educational Achievement (IEA), X. Ma (2008) wrote “[t]he general conclusion of the IEA assessments is that, although there are scattered gender differences in mathematics literacy at both primary and middle school levels, more serious gender gaps in mathematics emerge by the time children reach secondary school” (pp.438-439). Tsui (2007) also referenced college entrance exam data that supports this finding. He analyzed results from NCES from 1990 to 2003 and concluded that eleventh- and twelfth-grade males continue to outperform females by at least 30 points on the SAT-M. This finding is also supported by the 2008 SAT-M scaled scores where males scored, on average, 33 points higher than females (College Entrance Examination Board, 2008). These gaps in scores are statistically significant and are consistent with Fox and Soller’s (2001) assertion that “[t]here is a long history of performance differences by as many as 40 points on the mean in favor of males on the SAT-M” (p. 10). The findings that males outperform females on standardized

assessments continue (Educational Testing Service, 2001). Evidence supports that the mathematically gifted male also outscores the mathematically gifted female on the SAT-M even though this gap is quickly narrowing (Hyde & Mertz, 2009). It is also important to recognize a disturbing imbalance in 2008, as African American females continued to be the lowest scoring gender group (of all races and ethnicities) on the SAT-M (College Entrance Examination Board 2008). However, although there has been substantial research on gender and mathematics most has been conducted with Caucasian students often overlooking African American students. While African American students face unique obstacles, African American females have even more difficulties than African American males. Thus, a need exists for more studies describing the mathematical experiences of African American female students in the mathematics classroom.

Despite significant gender achievement gap research which supports the theory that the female student achieves lower on average than the male student in the academic areas of mathematics and science, females have made considerable mathematical gains over the years. These gains have caused the gender achievement gap to shrink tremendously across all grade levels (Nosek et al., 2009; Rinn, McQueen, Clark, & Rumsey, 2008; Wilson & Hart, 2001). According to NAEP data in 2000, twelfth-grade males had a higher composite scale score than their female peers of only three points while eighth-grade males outperformed their female peers by only two points (NCES, 2007b). This gender difference in performance is remarkably small. Additionally, Geist and King (2008) found the same result for twelfth graders after examining 2005 NAEP data.

In recent years more females have entered colleges and other postsecondary degree-granting institutions. Kaba (2008) found that in 2004 females made up 56.4% of the college and university student body while males made up only 43.6%. This finding supports the contention of Zelding and Pajares (2000) contention that universities are presently predominantly attended by females. Additionally, in 2007 females completed 57% of the bachelor's degrees whereas males completed 42.6% (NCES, 2008b). A surprising finding of research is that the number of African American females participating in higher education institutions has also significantly increased. In comparison with African American, Caucasian, and Hispanic males, African American females had higher rates of participation in colleges and universities in 2004 (Kaba, 2008). Although in 2007 only 11.1% of African American females completed bachelor's degrees in comparison to 70.8% White females (NCES, 2008b).

Even though more females than males are entering college, the proportion of females choosing to major in science, technology, engineering, and mathematics (STEM) related career fields is relatively small (Fox & Soller, 2001; Newcombe, 2007; O'Brien, Martinez-Pons, & Kopala, 1999; Rinn, McQueen, Clark, & Rumsey, 2008; Wilson & Hart, 2001). Tyson, Lee, Borman, and Hanson (2007) analysis of STEM research, for example, indicates that "[t]raditionally, White and Asian men have filled STEM occupations, but many women and Black and Hispanic students forgo pathways toward STEM careers" (p. 248). Similarly, Simpkins and Davis-Kean (2005) studied 180 youth (54 percent female) and questioned them about their future career aspirations. They found that "females were more likely than males to want to pursue a career in the area of health and less likely to pursue a career in math-science" (p. 45). In this view, females

are simply not as interested in STEM fields as males and often perceive career fields in mathematics and science as being characteristically male career choices. Embracing this point, Fox and Soller (2001) commented that “in terms of college majors and the world of work, the view of careers in mathematics and science, especially in applied areas such as computer science and engineering, as being male dominated is accurate” (p. 12). In contrast, recently Hyde et al. (2008) found that “women earn 48% of the undergraduate degrees in mathematics” (p. 494).

It is interesting to note, however, that some researchers cast a different light on the gender achievement gap research. Ding, Song, and Richardson (2007) contend that girls lag behind boys on standardized assessments, but maintain better grades in the mathematics classroom at all levels but especially at the secondary level. They noted that “grades in mathematics courses is, however, frequently ignored or downplayed in the literature” (p. 282). Ding, Song, and Richardson (2007) using a longitudinal mixed modeling method with 530 seventh graders and 367 ninth graders, found that “females had a higher mathematics GPA than males during the middle-school years and high school years in the two samples used” (p. 288). The same result, that females maintain higher grades than males, was found by Halpern (2004), Hedges and Nowell (1995), Linver and Davis-Kean (2005), the National Coalition for Women and Girls in Education (2002), and Wilson and Hart (2001). Additionally, Ding, Song, and Richardson (2007) found that “females did not show statistically significant low math test scores, and that the growth rate over time remained the same for both males and females” (p. 292).

Although earlier studies confirm a gender achievement gap, recent research findings of the gender achievement gap debate depart from previous research and suggest

that the gap no longer exists. In fact, Hyde and Metz's (2009) analysis of research that examined NCLB standardized mathematics data from 10 states and NAEP mathematics data (including complex problem-solving) indicated that "girls have now reached parity with boys in mathematics performance in the U.S. even in high school where a gap existed in earlier decades" (p. 8802). This finding was consistent for all representative racial and ethnic groups in the United States. Since there is considerable interest in knowing whether females and males are achieving at the same level in mathematics, more research is needed to corroborate the findings of Hyde and Metz. Despite the contradictory research, the mathematics gender achievement gap is still widely recognized in the literature by quite a few researchers and is still an important topic worth investigating. Thus, it is essential that researchers who are interested in gender equity issues look for ways to bridge this gap by examining a variety of factors that perhaps contribute to this phenomenon.

Statement of the Problem

This study is designed to provide descriptive information about the mathematical experiences of African American female high school students who are succeeding or struggling in mathematics by examining the factors that affect their mathematics learning and persistence. Researchers have strongly recommended that mathematics educators consider the perceptions of African American students in their research in order to gain insight into their classroom experiences (Berry, 2004; Berry, 2005; Moody, 2003). Dart, Burnett, Boulton-Lewis, et al. (1999) maintain that, "it has long been accepted that students' perceptions of their learning environments have a significant influence on their approaches to learning and the quality of their learning outcomes" (p. 138). The primary

goal of the present study is to describe the factors contributing to African American females' failure or success in the mathematics classroom. Berry (2002) conducted a similar study with African American middle school males. The main sources of data for this study will be personal accounts of the phenomenon provided from the perspective and through the voices of the participants. Hearing directly from African American females is critical for a proper understanding of their achievement and barriers to their achievement. Perry (2003) argued that "[t]he conversation about African American achievement is problematic because it fails to begin with a careful examination of all aspects of the school, with an eye toward understanding how the school's day-to-day practices participated in the creation of underachievement" (p. 9).

Potential Impact of the Study

This study has the potential to uncover the mathematical abilities and/or barriers of African American female students by attempting to determine their individual strengths and difficulties in relation to learning mathematics. Moreover, the findings of this study have the potential to equalize opportunity by giving teachers, researchers, educational leaders, administrators, policy makers, and teacher educators—who play informed and significant roles in achieving racial and gender equity and ensuring success in the mathematics classroom—knowledge and understanding of the phenomenon of African American female student achievement. The findings can be used to stimulate reflection and establish strategies and necessary resources to support the learning, achievement, and advancement of African American female students meeting their needs more efficiently and informing the conversations on achievement disparities. The results of this study will perhaps give some direction in the efforts to close the achievement gap between African

American females and other students. Achieving a clear understanding of the educational situations that may facilitate or impede the learning and performance of these students might be achieved through more insight into how these African American female students interpret their mathematical experiences within and outside of the classroom. This research study will potentially illuminate the underlying causes of African American female students' achievement or underachievement which will represent an important contribution to the research literature on African American female mathematics students. Moreover, it will potentially draw attention to the educational process rather than solely to the student, thereby meeting Lubienski and Bowen's (2000) criticisms pertaining to the lack of research along these lines. This research can potentially lead to a more in-depth understanding and to significant improvements for African American female students if the findings are reflected upon by teachers and stakeholders and instruction is adjusted as a result. Likewise, this research can potentially allow for the development of ideas pertaining to how teachers, parents, and stakeholders can hold African American female students accountable for their educational progress and goal attainments which is critical in this age of educational equality and student accountability. Out of the 3,011 articles that Lubienski and Bowen (2000) found, only 400 related to gender and 112 to ethnicity. The researcher is hopeful that as a result of this study more African American females will: (1) have successful experiences in the mathematics classroom; (2) enroll in more advanced level mathematics courses; and (3) pursue mathematics related careers at the postsecondary level of education. Because African American females are underachieving the mathematics education community are faced with the task of finding ways to improve the mathematical outcomes of these students. Mathematics researchers and teachers

should continually seek ways to improve the mathematics learning and classroom experiences of all populations of students. In an effort to increase the learning of all populations of students the National Council of Teachers of Mathematics (NCTM, 2000) developed the Equity principle. In order to ensure that students have the best opportunities to acquire necessary mathematical skills, all mathematics teachers and administrators should align with the vision of NCTM by making sure that all students “have access to an excellent and equitable mathematics program that provides solid support for their learning” (p. 13). NCTM’s vision of equity has stimulated, and continues to stimulate, researchers and others to think about how to reach and teach all students. This emphasis on equity makes it imperative that achievement gaps between race and gender groups be addressed. Unfortunately, for many reasons, closing achievement gaps is not an easy task. In order for NCTM’s vision of equity to be implemented, teachers and other stakeholders must seek to familiarize themselves with their students’ cultures, beliefs, attitudes, perceptions, and aspirations so that they can better understand how they learn. Nonetheless, finding ways that support success for all students (and continuing this success) in the mathematics classroom, is a complicated but important challenge that demands attention. In their book *Come On People: On the Path From Victims to Victors*, Cosby and Poussaint (2007) comment, “As history has shown, we [African Americans] are a resilient people. We overcome. In the face of all of the obstacles that even the most challenged of our children face, we continually come across stories that give us cause to smile and to hope” (p. 20). We hope to uncover some such stories that inspire and describe the African American female mathematical experience.

We must find ways to ensure that African American students work to their fullest potential in mathematics education. The research addresses the following questions:

1. What factors do African American female high school students attribute to their performance in mathematics?
2. How do African American female high school students describe the factors that they deem important to their success or failure in mathematics?
3. What barriers do African American female high school students perceive in being successful in mathematics?
4. How do African American female high school students describe mathematics success and failure?

Summary

In spite of school reform efforts, many students in the United States are failing to achieve in mathematics. In this chapter, an introduction to the problem of underachievement of United States students in general and African American students specifically in mathematics was presented. Also, the challenges of females in mathematics were discussed with specific ties to African American females. Furthermore, the following was presented: the significance of the study, the statement of the problem, and the potential impact of the study. The research questions were also presented in this chapter. In Chapter II, literature related to potential factors that either hinder or contribute positively to the mathematics performance of African American students will be reviewed. In Chapter III, research methods for this study will be described. In Chapter IV, the findings will be presented. In Chapter V, a discussion of

the findings from the research questions will be discussed along with areas for future research.

CHAPTER II

LITERATURE REVIEW

Self-Efficacy

Self-efficacy theory serves as a framework for this research study. The “student-centered cognitive-motivational” (Walker & Greene, 2009, p. 463) construct of self-efficacy originated from Albert Bandura’s social cognitive theory which focuses on understanding the complexity of human behavior and achievement in relation to personal and environmental factors (Bandura, 1977; Stipek, 1998). Self-efficacy has been defined as, “the belief in one’s effectiveness in performing specific tasks” (Pajares & Urdan, 2006, p. 45). In the literature, self-efficacy beliefs are influenced by: (1) previous experiences and accomplishments on tasks; (2) vicarious experiences; (3) verbal persuasion and encouragement; and (4) psychological states (Bandura, 1977; Stevens, Olivarez, Jr., Lan, Tallent-Runnels, 2004, p. 209; Stipek, 1998; Walker & Greene, 2009). The lack of self-efficacy is not necessarily related to actual performance or actual ability, per se, but it is related to the perception of performance or ability. Bouffard-Bouchard, Parent, and Larivee (1991) emphasized, “Students’ self-perceptions of their abilities play a mediating role between their actual capabilities and the appropriate expression of these capacities” (p. 161). Self-efficacy is “domain specific” (Jonson-Reid, Davis, Saunders, Williams, & Williams, 2005, p. 6). For instance, a student that has high mathematics self-efficacy may not necessarily have high English self-efficacy. Walker and Greene (2009) contend that self-efficacy “has a long established place in motivation research” (p.

469). Other studies have supported the link between self-efficacy and a student's motivation to learn and achieve academically (see Bandura, Barbaranelli, Caprara, & Pastorelli, 2001; Pajares & Urdan, 2006; Zimmerman, 2000). Studies have reported the negative consequences of low self-efficacy. According to Bandalos, Yates, and Thorndike-Christ (1995) students with low self-efficacy "tend to give up easily; dwell on their perceived deficiencies, thus detracting their attention from the task at hand; suffer from anxiety and stress; attribute their success to external factors" (p. 612). In particular, self-efficacy has been found to play an important role in "career choice and development" (Bandura, Barbaranelli, Caprara, & Pastorelli, 2001).

Available evidence supports the finding that self-efficacy is positively associated with academic performance (Bouffard-Bouchard, Parent, & Larivee, 1991; Pajares & Miller, 1994; Pajares & Urdan, 2006). For example, in a study of 107 seventh grade mathematics students Chen (2003) found that "math self-efficacy was a crucial variable in predicting students' math performance" (p. 89). In general, perceptions of high ability are typically associated with high performance (Pajares & Urdan, 2006). In congruence with this view, Multon, Brown, and Lent (1991) conducted a meta-analysis of 39 studies investigating the relationship of self-efficacy beliefs to academic performance and reported that these two variables were positively correlated and statistically significant. Moreover, Stevens, Olivarez, Jr., Lan, and Tallent-Runnels (2004) reported that "self-efficacy has been shown to significantly influence academic achievement and has been associated with semester and final-year grades, student class work, homework, and student examinations" (p. 210). The conclusion of this study was consistent with the work of other researchers (McKenzie, Gow, & Schweitzer, 2004). Additionally, Harper

and Tuckman (2006) assert that “self-efficacy for academic achievement is lower among African American students than it is among White students” (p. 388). Also, research pertaining to self-efficacy in general also indicates that females often report lower perceptions of their academic abilities than males (Bandalos, Yates, & Thorndike-Christ, 1995). This finding is not surprising given that “females, more than males, report less confidence” (Fennema & Leder, 1990, p. 4)

The implications of self-efficacy for mathematics education are that highly efficacious students are confident in their ability; therefore, they successfully complete mathematical tasks, exert more effort and as a result perform better on mathematical tasks, make sound mathematical choices, and persist. In fact, these students thrive in richer mathematical problem-solving situations and “are more likely to experiment with a larger number of strategies in their attempt to solve a problem” (Stevens, Olivarez, Jr., Lan, Tallent-Runnels, 2004, p. 210). In this view, the failure to believe in one-self when confronted with challenging mathematical tasks will produce anxiety.

Research shows that self-efficacy is a predictor of students’ motivation (Stevens, Olivarez, Jr., Lan, Tallent-Runnels, 2004), and motivation is vital to mathematics persistence and participation. For this reason, it is not surprising that “self-efficacy predicts math-related choice” (Lent, Brown, & Gore, Jr., 1997, p. 313) both inside and outside of the classroom. Highly efficacious students are more than likely to participate and perform in advanced-level mathematics courses and mathematics-related career fields (Lent, Brown, & Larkin, 1984). Gwilliam and Betz (2001) pointed out that “there is some evidence that self-efficacy explanations play a role in African Americans avoidance of these [mathematics and science] careers” (p.262).

One of the most important factors contributing to a student's high self-efficacy beliefs is their successes in the mathematics classroom (Bandura, 1997; Campbell & Hackett, 1986; Stipek, 1998), whereas in contrast, their failures weaken them (Campbell & Hackett, 1986). The more mathematical successes experienced by a student, the better their self-efficacy. On the other hand, Thompson and Dinnel (2007) comment that, "Failure—and particularly failure that results in a conclusion of low ability—is particularly likely to give rise to negative self-evaluations and diminished expectations of further success" (p. 377). Shores and Shannon (2007) conducted research on 761 fifth and sixth grade mathematics students in which they assessed the relationship between "self regulated learning, motivation, anxiety, attributions, and achievement in mathematics." After surveying the research participants, their study reported that self-efficacy was shown to be significantly related to worry and failure.

Research shows that minorities have lower mathematics self-efficacy beliefs. In a study of 358 students in grades 9-10 enrolled in a public West Texas high school, Stevens, Olivarez, Jr., Lan, and Tallent-Runnels (2004) found that "Hispanic students reported significantly less confidence in their ability to use their skills and knowledge effectively to successfully complete mathematics problems than Caucasians did" (p. 218). Likewise, low self-efficacy has been reported to inhibit participation of African Americans in mathematics-related careers (Gainor & Lent, 1998). Mathematics students often judge their ability by evaluations and interactions with teachers. Educators often prejudge minority students making conjectures about their abilities and achievement (Berry, 2004; Holloway, 2004; Horn, 2004; Landsman, 2004). Minority students are seen as lacking in ability, motivation, and academic skills. Accordingly, many minority

students internalize these judgments and begin to doubt their academic abilities. Efforts to increase the achievement of African American students in the mathematics classroom will perhaps require that we find ways to increase their self-efficacy beliefs. Yet, African- American student populations are often overlooked in the self-efficacy research literature to date.

Studies show quite persuasively that females often perceive themselves as being less competent in mathematics (Stipek & Gralinski, 1991). Stipek and Gralinski (1991) published a study investigating achievement-related beliefs of students after a mathematics assessment. In this study of 194 third graders and 279 junior high school students, it was found that “girls rated their ability lower and expected to do less well on the examination than did boys” (p. 367). Similarly, in a recent study investigating the effects of motivation on performance in a tertiary preparatory mathematics course, Carmichael and Taylor (2005) once again asserted that females reported less confidence in their mathematical ability versus males. Also, findings reported by Chen and Zimmerman (2007) in their cross-national study regarding seventh and eighth grade mathematics students self-efficacy beliefs indicate that, “[A]merican girls reported exerting significantly more effort than did American boys, but American boys reported significantly higher self-evaluation judgments than did American girls” (pp. 241-242).

Mathematics Anxiety

Researchers define mathematics anxiety in several ways. Buckley and Ribordy (1982) defined math anxiety as an “inconceivable dread of mathematics that can interfere with manipulating numbers and solving mathematical problems within a variety of everyday life and academic situations” (p. 1). In another definition Zaslavsky (1994)

defined mathematics anxiety as “a state of mind that makes it difficult or even impossible for you to use the math skills that you already have” (p. 6). Some mathematics-anxious individuals have even gone as far as referencing mathematics anxiety as “sudden death” (Tobias, 1978) or “punishment” (Zaslavsky, 1994). Researchers studying mathematics anxiety have reported that during mathematics-related activities mathematics-anxious individuals experience: (1) feelings of tension, apprehension, dread (Ashcraft & Faust, 1994); (2) helplessness, disorganization (Hadfield, 1999; Richardson & Suinn, 1972; Tobias, 1978); (3) panic (Tobias & Weissbrod, 1980); (4) paralysis of thought (Perry, 2004); (5) loss of ability to concentrate (Cemen, 1987); (6) a debilitating state of mind (Hadfield, 1999); (7) fear, distress, shame, and inability to cope (Cemen, 1987; Posamentier & Stepelman, 1990). Also during mathematics related activities, mathematics-anxiety sufferers may exhibit a variety of physiological signs including: sweaty palms, nervous stomach, perspiration (Cemen, 1987); nausea, dizziness (Zaslavsky, 1994); “an increased and stronger heartbeat” (Sheffield & Hunt, 2006); and “desynchronization in cortical and subcortical brain waves” (Elliot, 1983, p. 781).

Mathematics anxiety has also been referred to as “Math phobia” (Dodd, 1992; Stodolsky, 1985; Zaslavsky, 1994), or “Mathophobia,” an “irrational and impeditive dread of mathematics” (Lazarus, 1974, p. 16). “Math phobia” is an exaggerated fear of mathematics and as with any phobia students may take excessive measures to avoid the mathematics. Pries and Biggs (2001) depicted a mathematics avoidance cycle that includes four phases: (phase 1) negative reactions to mathematics, (phase 2) avoidance of mathematical situations, (phase 3) poor mathematics preparation, and (phase 4) poor mathematics performance. Thus, mathematics anxiety impedes participation in

mathematics classes and will eventually lead to underrepresentation in advanced-level mathematics classes and mathematics related career fields. Some researchers contend that mathematics anxiety has been shown to impede the enrollment and participation of females in mathematics courses to a larger degree than males (Tobias, 1978).

Researchers have suggested that mathematics anxiety influences mathematics achievement and persistence. In general, the word “mathematics” creates anxiety for a large number of students and adults inside and outside of the classroom. Countless individuals hate and fear mathematics, and often they do not perform well at it. Consequently, many students struggle from year to year without learning or retaining important mathematics content. In this view, Shores and Shannon (2007) contend that, “[a]nxiety interferes with learning and with demonstration of understanding, and those students who are not well prepared or who expect to fail are more likely to have higher anxiety than those students who are well prepared and expect to succeed” (p. 233). Also, Greenwood (1984) claimed that, “women and minorities are usually identified as those who most suffer the pangs of math anxiety” (p. 662). Zaslavsky (1994) reported that the affects of mathematics anxiety (i.e. mathematics avoidance) causes minorities to be excluded “from the growing number of careers requiring some mathematical background, or, at the very least, an entry test on topics in mathematics” (p. 2). However, peer-reviewed research pertaining to how mathematics anxiety affects the mathematics achievement of minorities and limits their success in mathematics is limited and merits further investigation. Much of the previous research has been conducted in relation to Caucasians, or has not delineated race. Therefore, there is a need for more research on African American students and their feelings of anxiety in the mathematics classroom.

Mathematics anxiety experienced by students is a significant and growing problem that has important implications for their learning.

Research has revealed how mathematics anxiety undermines the confidence of students (Sheffield & Hunt, 2006; Stuart, 2000) thereby hindering their success in mathematics. This is not surprising given that researchers have identified confidence as a vital part of a “student’s internal belief system” (Fennema & Leder, 1990). As might be expected, if students are not confident in their mathematical ability, experiencing success becomes an immediate struggle. As Dodd (1992) stated “[lack] of confidence in oneself is perhaps the greatest obstacle to learning because beliefs govern action” (p. 296).

A variety of studies has demonstrated that students with high levels of mathematics anxiety generally perform poorly (Armstrong, 1985; Englehard, 1990; Green, 1990; Ma, 1999), obtain lower grades in mathematics, complete fewer mathematics classes (Betz, 1978; Felson & Trudeau, 1991; Meece, Wigfield, & Eccles, 1990; Sheffield & Hunt, 2006), are hesitant to enter careers requiring a sufficient amount of mathematics (Hadfield, 1999), receive lower standardized test results, enroll less in math-related college majors, and select fewer advanced level mathematics courses (Meece, Wigfield, & Eccles, 1990).

Evidence of mathematics anxiety starts very early in the educational process (Perry, 2004) and, if not treated or addressed, intensifies with each year of experience in mathematics, and follows many students throughout their careers and lives (Greenwood, 1984). For example, Hembree (1990) argued that generally mathematics anxiety increases at the junior high level, reaches its maximum level at grades nine and ten, and then levels off after grade ten. Researchers have shown that even after grade ten,

mathematics anxiety is prevalent, intense, and is relatively well established in many students (Jackson & Leffingwell, 1999; Perry, 2004).

The literature indicates that at least two distinct dimensions of mathematics anxiety exist (Hsiu-Zu Ho et al., 2000; Meece, Wigfield, & Eccles, 1990; Wigfield & Meece, 1988). The first is an affective dimension, and the second is a cognitive dimension. The affective dimension of mathematics anxiety is composed of emotion and attitudes, whereas, the cognitive aspect of the cognitive dimension is worry. These dimensions were derived from test anxiety research (Libert & Morris, 1967).

Speilberger (1972) explained mathematics anxiety in terms of a chain reaction that consists of a stressor, a perception of threat, a state reaction, cognitive reappraisal, and coping. An excessive amount of anxiety can affect brain activity by causing a “downshifting” in the brain (McKee, 2002). This downshifting causes higher mental activities to shut down and physical reactive functions to be enabled. High anxiety can narrow perceptions and inhibit short term memory (McKee, 2002). The narrowing of perceptions and the inhibiting of short term memory can potentially cause a mathematics-anxious individual to focus completely on the threat. This focus leads to paralysis of thought and panic. Thus, it seems unlikely that mathematics-anxious students who are paralyzed or in panic will be able to perform well in the mathematics classroom.

Though most mathematics students feel anxious sometimes, mathematics anxiety sufferers have persistent and overwhelming fear or worry. The frequency and intensity of these fears can be immobilizing, distressing, and disruptive to the educational process. Moreover, mathematics anxiety can negatively impact one’s attitude, self-efficacy, self-concept, motivation, and confidence in relation to doing mathematics.

As previously mentioned, researchers have repeatedly found that mathematics anxiety affects the mathematical performance of students. After conducting a meta-analysis of 26 studies on the relationship between mathematics anxiety and mathematics achievement at the elementary and secondary levels (grades 4 through 12), X. Ma (1999) found a significant negative correlation between anxiety and achievement and concluded that this relationship “is significant from grade 4 on” (p. 533). His results indicated that as students’ anxiety levels increase their levels of achievement tend to decrease (Englehard, 1990; Hembree, 1990; Meece, Wigfield, & Eccles, 1990; Ma, 1999). He also found that, “once mathematics anxiety takes shape, its relationship with mathematics achievement is consistent across grade levels” (p. 533). He emphasized that, during earlier stages of high school, a noticeable decline in mathematics achievement is probable for mathematics anxiety sufferers. He also noted that if students’ mathematics anxiety is reduced their mathematics achievement could possibly leap from the 50th to the 71st percentile. Hsiu-Zu Ho and others (2000), in their international research on how the dimensions of mathematics anxiety affect mathematics achievement amongst sixth graders, found that mathematics anxiety has a consistent negative relationship with mathematics achievement. Thus, increasing mathematics anxiety may result in lower mathematics achievement. This result was found for all three samples used including: China, Taiwan, and the United States. The cognitive factor, however, failed to yield significant results across the three samples. The investigators concluded that “affective, rather than cognitive, math anxiety is a debilitator to mathematics performance” (p. 375). Also, in a study of 48 undergraduate students between the ages of 18 and 25, Sheffield and Hunt (2006) found that mathematics anxiety was related to accuracy and that “high

math anxious participants responded correctly less frequently (mean (SD) =87.6% (6.0%) than medium anxious (90.9 % (4.3%)) or low anxious participants” (p. 20). Accuracy is vital to mathematics achievement, especially on standardized and college readiness assessments.

In contradiction to the previously cited researcher, Bush (1991) found a positive, significant relationship between mathematics anxiety and achievement. He found that students with high mathematics achievement were the most vulnerable to mathematics anxiety. Thus, the anxiety of the mathematically gifted and advanced students is more than likely high. It is reasonable to conclude that this finding therefore contradicts the earlier results of Meece, Wigfield, & Eccles (1990) that, “Importance ratings have a direct negative effect on math anxiety. Students who assigned more importance to achievement in mathematics reported less math anxiety” (p. 68).

A number of researchers have reported that mathematics anxiety has consistently been a contributing factor to performance differences among girls as compared with boys. Studies have suggested that mathematics anxiety is more common in females than males. In one study, Llabre and Suarez (1985) investigated gender dynamics in relation to mathematics anxiety. Their sample included 184 college students (112 female and 72 male) enrolled in an Introductory Algebra course. Using the shortened version of the Mathematics Anxiety Rating Scale (MARS; Richardson & Suinn, 1972) as the instrument, the researchers found that females reported higher levels of mathematics anxiety than males. These findings agree with other researchers who contend that “high school and college females generally rate themselves as more math anxious than men” (Meece, Wigfield, & Eccles, 1990, p. 61).

Academic Self-Concept

Self-concept has been defined as “the way in which a person evaluates his or her competence” (Chiu, Beru, Watley, Wubu, & Simson, 2008, p. 126) in learning academic subject matter (Marsh & Hau, 2004). A similar definition for academic self-concept may be found in Cokley (2000), Lent, Brown, and Gore (1997), and McCoach and Siegle (2002). Academic self-concept includes a comparison in competence from one subject domain to another (i.e., from reading to mathematics) and from one student to another (Cokley, 2000; Marsh, 1990; Rinn, McQueen, Clark, & Rumsey, 2008). In general, researchers report that students’ in elementary school exhibit a stronger self-concept than those in high school (Linver & Davis-Kean, 2005; Wilkins, 2004; Wilkins & Ma, 2003). This finding is consistent with mathematics education findings that support a drop in students’ beliefs about their mathematics capabilities during adolescence (Wigfield, Lutz, & Wagner, 2005).

Researchers also linked self-concept to self-efficacy (Lent, Brown, & Gore, Jr., 1997). As with self-efficacy, if students believe that they can achieve then they will more than likely try hard to make that belief a reality and persist even when they are challenged (Bandura, 1997; Okeke et al., 2009). Once students start to feel inadequate about their mathematical abilities, they struggle to reverse these feelings of inadequacy especially as mathematics content becomes more complex as they progress through the educational process.

In recent years, a number of researchers have suggested that the affective variable academic self-concept is positively and consistently related to academic achievement (Areepattamannil & Freeman, 2008; Cokley, 2002; Cokley & Chapman, 2008; Marsh,

1990; Okeke, Howard, Kurtz-Costes, & Rowley, 2009; Valentine, Dubois, & Cooper, 2004; Wilkins, 2004). Marsh and Hau (2004), in a cross-cultural study involving 55,577 participants from 26 countries and exploring “math and verbal self-concepts with math and verbal achievements” (p. 56), found a significant positive correlation between mathematics self-concept and mathematics achievement. This result was also obtained at the international level by Wilkins, Zembylas, and Travers (2002) in their study reviewing TIMSS data for 16 countries and by Wilkins (2004) in his study reviewing TIMSS data for 41 countries and 290,000 students. In a similar study, Rinn, McQueen, Clark, and Rumsey (2008) found a positive relationship between mathematics achievement and mathematics self-concept among 181 gifted students. Also, Plucker and Stocking (2001) corroborated these findings in their noteworthy study investigating the self-concept of high achieving students. All aforementioned studies clearly suggest that individuals who report a strong academic self-concept, on average, experience high levels of academic achievement (Marsh & Craven, 1997; Wilkins, 2004). Similarly, after conducting a study of 120 New Jersey students (63 boys and 57 girls) transitioning from elementary school to middle school, Chung, Elias, and Schneider (1998) reported that “self-concept was linked positively to academic achievement and negatively to psychological distress in both genders...” (p.89). Given considerable evidence from these studies, if a student lacks a strong academic self-concept in mathematics, achieving in mathematics is possible but will more than likely become a struggle. It is desirable, then, that we find ways to improve a student’s academic self-concept.

Studies which have investigated self-concept and its relationship to academic performance have suggested that a well-documented “reciprocal relationship” exists

between academic self-concept and academic achievement. When a student experiences high academic achievement, their self-concept is strengthened accordingly, and experiencing low academic achievement weakens a students' self-concept and vice versa. This reciprocal relationship has been repeatedly supported by research (Cokley, 2007; Cokley & Patel, 2007; Guay, Marsh, & Boivin, 2003; Marsh, Trautwein, Ludtke, Koller, & Baumert, 2005; Valentine, Dubois, & Cooper, 2004).

In addition to the relationship between academic self-concept and achievement, research also shows a strong and consistent relationship between academic self-concept and grade point average (Awad, 2007; Areepattamannil & Freeman, 2008; Cokley & Patel, 2007; Cokley & Moore, 2007; Linver & Davis-Kean, 2005) and academic self-concept and tracking (Chiu, Beru, Watley, Wubu, & Simson, 2008). In fact, Cokley (2000) conducted a study involving 206 African American college students and found that students' overall "academic self-concept increased as GPA increased" and that "GPA was by far the best predictor of academic self-concept" (p. 161). Also, Cokley and Moore (2007) provided further evidence of the relationship between academic self-concept and grade point average in their study involving 274 African American postsecondary students. They found a positive correlation between academic self-concept and grade point average. Another noteworthy study was conducted by Linver and Davis-Kean (2005) who examined data from the Michigan Study of Adolescent Life Traditions (MSALT) involving 1,651 youth from seventh to twelfth grade. They found that "for the high-ability girls, having a higher self-concept of mathematics ability acted as a protective factor against grade decline and contributed to the slowing of the grade decline throughout high school" (p. 61). Additionally, Chiu, Beru, Watley, Wubu, and

Simson (2008) found seventh grade higher-tracked students (i.e., Algebra) to have a greater self-concept than the lower tracked students (i.e., Pre-Algebra).

Some research reported no significant difference between the mathematics self-concepts of males and females (Simpkins & Davis-Kean, 2005). Other literature attests that mathematics self-concept is lower among females than it is among males (O'Connor & Miranda, 2002; Wilkins, 2004). In opposition, Cokley and Moore (2007) reported that African American males reported a lower academic self-concept in comparison to African American females and they were “more likely to devalue academic success than women...” (p. 176).

Many studies provided strong evidence that African American students often report a high academic self-concept. Okeke and others (2009) conducted two studies with 237 and 290 African American middle school students respectively and found for both groups that “[o]n average, students reported high levels of academic self-concept...” (p. 374). In this study Okeke and others (2009) hypothesized that students’ academic self-concept was negatively affected by their endorsement of academic race stereotypes. Consequently, their results showed that the students in these studies endorsed academic race stereotypes.

The research of Cokley and Moore (2007) indicated that ethnic identity and racial centrality were two important variables that had a positive relationship with African American females’ academic self-concepts. According to Harper and Tuckman (2006) racial centrality refers to “the extent to which one defines him or herself in terms of race” (p. 383). Their findings suggested that if an African American female student strongly

identified with and valued being African American, their academic self-concept will be affected positively.

Parental Involvement

Ample evidence that supports the contention that parental involvement positively and consistently impacts academic achievement exists. For example, Fan and Chen (2001) used meta-analysis to analyze empirical studies evaluating the relationship between parental involvement and student academic achievement. In total, 25 published studies were selected in this meta-analysis. Results showed that the average correlation coefficient between parental involvement and student academic achievement was equal to .30 which “represents a medium effect size in social sciences” (p. 16). The researchers argued that “the findings of this meta-analysis make a good case for the positive influence of parental involvement on students’ academic achievement” (p. 17). An interesting finding of this meta-analysis is that there were different meanings associated with the term “parental involvement;” therefore, the authors concluded that parental involvement is “multifaceted in nature” (p. 3), making the investigation of the relationship between parental involvement and student academic achievement more complex. For example, studies investigated in the meta-analysis showed that different types of parental involvement had a stronger relationship with different measures of academic achievement. Thus, to guide Fan and Chen’s (2001) data analysis of the studies, they identified four distinguishable categories of parental involvement including: (1) parental-child communication; (2) home supervision; (3) educational aspiration for child; and (4) school contact and participation (p. 7). An important finding of this study was that the “educational aspiration for the child” component of parental involvement

had the strongest correlation with academic achievement. It is reasonable, therefore, to believe that there are significant academic benefits to parents having high aspirations and expectations for their children's educational experiences (Marchant et al., 2001; Attaway & Bry, 2004). Similarly, in a study of underachieving high school ninth graders (with 61% of the participants being African American), Chen and Gregory (2009) emphasized the importance of parental expectations in relation to student academic achievement. They reported that perceived high parental expectations for academic success were significantly and positively linked to higher student grade point averages. Further, in a qualitative dissertation study investigating the lived experiences of eight mathematically successful middle school African American males, Berry (2002) found that high parental expectations played a critical role in contributing to the mathematical success of the participants. Berry (2002) found:

All of the parents stressed the importance of getting an education and doing well in school. The message the parents gave their sons was that not doing well in school was not an option. The parents constantly pushed their sons to achieve academically. They told their sons they could achieve and expected exemplary performance in school (p. 126).

Finally, findings from Brand, Glasson, and Green's (2006) study confirmed Berry's findings that strong parental support contributed to the success of African Americans in mathematics. Two of the four participants in this study attributed their success to a supportive parental environment. In fact, Lezly, a participating high school student, commented that the support of her family was the primary reason that she was assertive and confident in the mathematics classroom.

Some prior empirical research found that parental aspirations and expectations have a significant relationship with the academic achievement (i.e., grades and test

scores) of White students but not for African American, Hispanic, or economically disadvantaged students (Desimone, 1999). Clearly, the result of research by Yan (2005) does not support this finding. This researcher found that “[e]ducational expectations was associated positively with mathematics achievement, ranging from standardized coefficients of .08 for African American students to .15 for Asian and Hispanic American students, and .24 for Caucasian students” (p. 123).

Houtenville and Conway (2008), after analyzing data from the National Education Longitudinal Study (NELS), suggested that a significant positive association existed between parental effort and a student’s academic achievement. It is worth noting that parental effort as defined in this study is closely related to parent-student communication and school contact and participation as defined in the Fan and Chen study. The researchers also found that “the positive effect of school resources is diminished as the level of parental effort grows” (p. 448). It appears that, parental involvement decreases the disadvantages that come with limited school resources. The research of Hill and Craft (2003) also supported the positive relationship between parental involvement and student achievement. These researchers contrasted student and parental data of African American and Euro-American public school kindergartners with comparable levels of income. The work of these researchers suggested that “parents’ involvement at school, including volunteering in the classroom and sending materials to school, improved children’s academic skills, which in turn improved math performance for African American children” (p. 80). In more recent research, Strayhorn (2010) examined data from the National Center for Education Statistics’ National Education Longitudinal study: 1988/2000 and found a significant relationship between the mathematics

achievement of African American high school students “as measured by one’s score on the 10th grade standardized math exam” (p. 184) and parental involvement.

Classroom Culture

Many students are immersed into a classroom culture where mathematics is not taught in a nurturing way on a daily basis. As a result, student needs are not being met. What is the current culture in the mathematics classroom? Ball, Lubienski, and Mewborn (2001) emphasized that “[the] school mathematics experience of most Americans is and has been uninspiring at best, and intellectually and emotionally crushing at worse” (p. 434). They go on to argue that “[m]any pupils spend their time in mathematics classrooms where mathematics is no more than a set of arbitrary rules and procedures to be memorized” (p. 434). Ball (1988) referenced this culture as she described what she perceived to be the beliefs of her pre-service candidates:

Mathematics does not have much relationship to the real world and most mathematical ideas cannot be represented any way other than abstractly with symbols. Knowing mathematics means ‘knowing how to do it.’ Teaching mathematics involves telling (or showing) the students how to do different kinds of problems. Teachers ask questions to elicit right answers; if a teacher questions your answer, it means you have made a mistake. Learning mathematics is scary (p. 4).

The methods used to teach mathematics affect a student’s success and self-confidence (Stuart, 2000). Only about seven percent of mathematics students have had good experiences in the K-16 mathematics classroom (Jackson & Leffingwell, 1999). Given this statistic, it is not surprising that by the time students reach adulthood they both fear and loathe mathematics (Burns, 1998). Stodolsky (1985) asserted that, “[m]any adults feel incompetent mathematically and dread the idea of mathematics courses or chores”

(p.126). There have been almost endless discussions about this fear and dislike of mathematics.

Research also contends that females fail to enjoy learning mathematics; moreover, they are dissatisfied with the classroom culture in general. These factors also have been found to contribute to this gap. As girls are promoted from elementary to secondary school, this lack of enjoyment worsens (Geist & King, 2008). In rating the enjoyment of mathematics, Joffe and Foxman (1984) found that seven percent more girls do not enjoy engaging the mathematics. Moreover, Boaler (1997) commented that “[mathematics] as it is currently and widely taught is not equally accessible to girls and boys and this appears to relate to preferences of pedagogy” (p. 123). The general cultural value in the way mathematics is taught undermines the self-efficacy of females. As mentioned previously, a large number of mathematics teachers still employ the “drill, kill, and memorize” style of teaching (Geist & King, 2008). According to Arnot et al. (1998), “Boys show greater adaptability to more traditional approaches to learning which require memorizing abstract, unambiguous facts and rules that have to be acquired quickly. They also appear to be more willing to sacrifice deep understanding, which requires sustained effort, for correct answers achieved at speed” (p. 28). Females seek to learn mathematics with understanding; therefore, they do not adjust well to traditional pedagogy (Bevan, 2001). It is worth mentioning however that even though boys adapt to the use of traditional pedagogy, “traditional methods of teaching have a negative impact on both girls and boys” (Geist & King, 2008, p. 43). Mathematics is not about memorizing facts and formulas and recounting them quickly. These actions do not give credit to the

thoughtful constructive mathematical responses that are required in the mathematics classroom.

Instructional Practices and African American Students

Some educational researchers argue that the “quality of instructional delivery” (Tate, 2008, p. 956) contributes to the poor mathematical outcomes of African American students (Berry, 2003; Tate, 1997). Research suggests that the conventional mathematics instruction that these students receive is not serving their best interest (Berry, 2003). Vital issues have arisen in relation to the mathematics instruction of African American students including a resistance to change from traditional pedagogical practices to research-based methods and the pedagogical challenge of making the mathematics culturally relevant. Berry (2003) writes, “The NAEP data suggest that most African American students are not experiencing instructional practices in line with the recommendations suggested by the National Council of Teachers of Mathematics (NCTM), whereas more White students are experiencing NCTM standards-based instruction” (p. 245). He explained that when immersed into the classroom, a teacher is confronted with standard and rule oriented teaching strategies. Under the pressure of the demands of the job, most teachers of African American students tend to ignore research-based pedagogical strategies and succumb to traditional ones limiting these students exposure to research-based teaching practices. In recent years an increased emphasis on the critical importance of “constructivist” learning has emerged. The book, *How People Learn*, released by the National Research Council (NRC) provides a rich knowledge base about learners and learning. After reviewing and synthesizing mind and brain research, three fundamental principles related to the learning and teaching of mathematics from a

cognitive perspective emerged: 1) students come into the classroom with a pre-existing conceptual framework based on prior skills, knowledge, and beliefs; 2) the development of a deep and long lasting understanding requires thinking about academic material coherently and conceptually; and 3) students become autonomous learners through thinking deeply about, self-reflecting on, and self-directing their learning via meta-cognitive approaches and the monitoring of their own understanding (Bransford, 2000; Brook & Brooks, 1993). Current reform efforts in mathematics have been influenced by these three fundamental principles. Fox and Soller (2001) contended that “[r]ecent efforts to reform the teaching of mathematics endorse more hands-on approaches, thematic teaching, and cooperative learning” (p. 17). In this era of accountability, African American students are immersed into a classroom culture where mathematics is not taught in a nurturing way. Berry (2003) contends, “Fifty-eight percent of African American eighth grade students agreed that mathematics is mostly memorizing facts” (p. 245). African American students are traditionally taught repetition and practice which is a non-challenging, uninspiring, less thought-provoking way of learning and retaining information. As a result, students taught in this manner have spent a considerable amount of time memorizing procedures and internalizing rules. As a result, they transition to other mathematics courses without deeply understanding and seeing the underlying relationships of the mathematical concepts and they cannot recall or apply what they learned previously. According to constructivist theorist, instructional techniques involving traditional methods of teaching are less effective than independent investigative pedagogy. Researchers support the notion that the predominant style of teaching employed by the teachers of African American students limits African American students

thinking, creativity, problem-solving abilities, and the monitoring of their own comprehension, and causes them to resist the learning and doing of mathematics (Knapp, 1995). Evidence indicates that learning in this manner does not and has not worked. Teaching in this way goes contrary to the pedagogy suggested by the National Council of Teacher of Mathematics' Learning Principle which recommends a more discourse based approach to teaching (NCTM, 2000).

The philosophy of constructivism was built upon the findings of cognitive science research. From a constructivist standpoint: (1) knowledge is not passively received; (2) learning should be more enduring understandings versus drill, skill, and kill; (3) knowing means being able to integrate knowledge, skills, and procedures in ways that are useful for interpreting situations inside and outside of the classroom and solving problems; (4) and learning should be student centered (Brewer & Daane, 2002; Inch, 2002). Shephard (2000) contended that, "learning is an active process of mental construction and sense making" (p. 6). This philosophy is in line with the vision of NCTM, provides the anchor for the direction of mathematics education, and is widely recognized (Jamar & Pitts, 2005). Through active learning, students are able to create new knowledge by observing relationships, recognizing patterns, making generalizations, and taking risk. Ideally, having students think, make connections and conjectures, problem-solve, invent their own strategies, collaborate with their peers, and monitor their own learning during mathematics class is a critical component of cognitive development and effective mathematics instruction. In this environment, students' thoughts and ideas are considered and valued. African American students are exposed to mathematics instruction that is taught as a sequence of memorization and algorithms that are

disconnected from their reality. If the mathematics is detached from a student's reality, it is hard for them to make sense of the concepts being taught and to actually see why the mathematics works. Thus, they are unmotivated to learn it. Greenwood (1984) referenced this particular instructional practice as the "explain-practice-memorize" teaching model. He argued that a great deal of mathematics anxiety is the result of this "impersonal, nongrowth, nonrational" (Greenwood, 1984, p. 663) method of teaching. In this environment students are seldom exposed to purposeful instructional activities. As a result, these students leave the mathematics classroom without seeing why mathematics is useful and how it relates to their career aspirations and lives. Students also develop negative beliefs and attitudes toward mathematics, and a lack of motivation to learn the content. Jamar and Pitts (2005) argue that, "[t]his shift from computational "basics" to a "body of knowledge" to be incorporated within mathematical tasks reflects a shift of seeing mathematics as ideas and not just procedures" (p. 128). This way of learning is particularly powerful. Perhaps if students see mathematics as ideas that can be applied to everyday situations, they will be more motivated to learn it and not remember the experience as painful. Since there is considerable interest in and much effort has been expended toward implementing the constructivist way of teaching and learning, further research needs to be conducted to understand the complexities of race and gender equity in relation to constructivist instructional practices and how instructional modes in general affect student performance. Lubienski (2002) in examining socio-cultural factors in relation to mathematics learning contended that "Researchers and educators should not assume that learning mathematics through problem solving and discussion is equally

natural for all students. Instead, we need to uncover the cultural assumptions of these particular discourses” (p. 120).

Stereotype Threat

Differences in gender performance in mathematics may result from “social and environmental factors” (Tsui, 2007, p. 2). Stipek (1998) contended that “[t]he reason for gender differences, no doubt, are embedded deeply in cultural stereotypes and the messages teachers and parents subtly convey to boys and girls” (p. 81). Females continuously experience the phenomenon “stereotype threat” (Spencer et al., 1999; Steele, 1997; Steele & Aronson, 1995; Steele, Spencer, & Aronson, 2002) inside and outside of the classroom that weakens their belief in themselves. In fact, females live in a society where they are seen as lacking mathematics ability (Quinn & Spencer, 2001; Spencer et al., 1999). They are expected by others to not excel or persist in mathematics or mathematics related careers, and these societal expectations greatly influence how they perceive their own ability and how they perform in mathematics. The stigma associated with being female and doing mathematics serves as a psychological barrier to females’ persistence and accomplishments in this field of study, and adds to growing doubts about their mathematical capabilities (Nosek et al., 2009; Quinn & Spencer, 2001; Schmader, Johns, & Barquissau, 2004). Stereotypes placed on females about not being mathematically oriented may influence the student’s academic and self-worth and potentially lead them to believe that they are mathematically inferior to their male peers. These stereotype beliefs subsequently undermine their confidence. Nosek and others (2009) reference the Implicit Association Test (IAT) and noted that most individuals have “the tendency to associate male with science (or math)” (p. 10594). In addition, Kiefer

and Sekaquaptewa (2007) investigated 138 female college students who were asked to complete a mathematics assessment and found that these females “associated men more than women with mathematics” (p. 828). Schmader, Johns, and Barquissau (2004) studied 86 female undergraduate students majoring in mathematics-related career fields and found that “the endorsement of gender stereotypes about math ability could play a significant role in undermining women’s confidence, thereby increasing the risk that many women who are in math related fields will leave their majors or avoid related careers” (p. 842). Stereotype threat is an area of research which has generated considerable attention in recent years.

Recent stereotype threat studies have pointed out that this phenomenon correlates negatively with students’ cognitive processes involved in understanding, remembering, and doing mathematics (Brown & Josephs, 1999; Kellow & Jones, 2008; Schmader, Johns & Forbes, 2008; Sekaquaptewa & Thompson, 2003; Spencer et al., 1999; Steele, 1997; Steele & Aronson, 1995). For example, in a study of 202 children from ages 6 to 10, McKown and Weinstein (2003) found that, “...when children from stigmatized groups become aware of broadly held stereotypes, indirectly activated stereotype threat can significantly hamper cognitive performance” (p. 510). That is, as stereotype threat increases, the cognitive operations of females, minorities, and/or other members of stigmatized groups decrease. Much of what is understood about stereotype threat is based upon research done in test-taking situations.

Evidence supports an association between stereotype threat and females’ performance on mathematics assessments. The underperformance of females on these assessments appears to be associated with an increased stereotype threat condition. In a

study conducted by Cadinu and others (2005), sixty females were given a mathematics assessment. Some of the participants were informed of a stereotype pertaining to gender differences and mathematical task and others were not. Participants who were exposed to the stereotype performed worse on the mathematics assessment than participants in the “no-threat condition”. Thus, participants in the “no-threat condition” were less likely to answer questions incorrectly on the mathematics assessment. Moreover, the researchers reported that “participants in the stereotype-threat condition showed a significantly higher number of negative math-related thoughts than participants in the control condition” (p. 575). This finding is also consistent with the research of Keller and Dauenheimer (2003). These researchers conducted a study in which seventy-four secondary students were given a mathematics assessment. Seventy-three percent of the questions on this assessment were taken from the mathematics portion of TIMSS and twenty-seven percent were taken from mathematics textbooks. Half of the participants were advised that “the test had been shown not to produce gender differences” (p. 373). The other participants were advised of the opposite. The results indicated that “female participants answered more questions correctly under no-threat conditions than under threat conditions” (p. 376). These findings lend support for the contention that the performance of females on mathematics assessments can improve by simply reducing or eliminating stereotype threat.

In addition to its effects on mathematics test performance, stereotype threat has been shown to hinder students’ problem solving abilities as they work to complete mathematics assessments. Quinn and Spencer (2001) studied 36 university undergraduates who as high school students scored between a 650 and 700 on the

mathematics portion of the SAT. These students were given an 18 question mathematics assessment constructed from older versions of the SAT-M. The complex, multi-step questions on the assessment required the research participants to exert great cognitive effort for problem completion and utilize their problem solving capabilities. The students were assigned to either a reduced or high stereotype threat condition. The researchers reported that “under conditions of high stereotype threat, women underperformed in comparison to men, and they were less likely to be able to formulate strategies” (p. 66). Additionally, females in the high stereotype condition performed less well in relation to problem solving than females in the reduced stereotype threat condition. There was no difference in problem solving abilities or the use of effective strategies in the “reduced-stereotype-threat” condition. Additionally, the researchers concluded that “the knowledge of cultural stereotypes changes the testing situation for women such that their performance is depressed” (p. 67).

The stereotypes that some people hold about certain individuals’ academic abilities are not only specific to gender but also to race. Many individuals hold negative views and stereotypes about the intelligence and academic abilities of African American students in comparison to other races (Bobo, 2001; Steele, 1997; Steele & Aronson, 1995). Research confirms that African Americans become aware of the negative stereotypes about their racial group by age six (McKown & Weinstein, 2003) and by high school age they are already fully knowledgeable about these stereotypes (Okeke et al., 2009). Also, Koppleman and Goodhart (2005) argue that these stereotypes “can be reinforced by images or information contained in such media as advertisements, textbooks, and films” (p. 38). The stigmatized African American female group

experiences “stereotype threat” as a result of the interplay of race and gender which poses extreme academic and psychological challenges. Surprisingly, even with all of the research literature pertaining to this phenomenon, there have been few studies examining African American females and the stereotype threat condition.

Stereotype threat can affect African American students’ performances in testing settings. In a study by McKay and others (2002) a group of eighty seven university students (52% African American) were given a “cognitive ability test.” Some of the participants were told that they were taking an “IQ test” and others were told that they were taking “a pattern completion test” (p. 770). Not only did the researchers find that the African American participants underperformed in comparison to the White participants on the test, but they also found that stereotype threat was negatively associated with “the IQ test performance of African Americans” (p. 780).

Findings also suggest that there is a relationship between stereotype threat and decreases in African American students’ mathematics test performances. Arbuthnot (2009) conducted a study of eighth grade students taking a mathematics exam created from questions from the 1999 Large Midwestern State Achievement Test (LMAT). A total of 416 students were in the sample, but the researcher only examined data for the 159 African American students that participated. The present research implemented the following two conditions: (1) high-stereotype-threat condition; (2) low-stereotype-threat condition (p. 456). The researcher found that “high-achieving Black students in the low-stereotype-threat condition outscored comparable Black students in the high-stereotype-threat condition by a margin that was very close to being statistically significant” (p. 459). After analyzing the results, the researcher concluded that “stereotype threat may

impede the performance of high-achieving Black students on mathematics test” (p. 459).

After a review of the stereotype literature Ryan and Ryan (2005) concluded that “because of the negative stereotypes about females’ and Blacks’ mathematics achievement that are widely circulated throughout society, mathematics test performance by moderate- and high-achieving females and by Blacks will be depressed anytime the stereotype threat is activated” (p. 55).

Research provides supportive evidence of an association between stereotype threat and anxiety. Osborne (2007), in a study examining the relationship between stereotype threat and anxiety found that females completing a mathematics assessment under high stereotype threat conditions showed an increase in skin conductance and diastolic blood pressure and a decrease in surface skin temperature. All of which are “physiological indicators of anxiety” (p. 140). In this study, the representative sample of 43 university students were given a mathematics assessment created from questions taking from the Graduate Record Examination (GRE). The fourteen female participants that were a part of the high stereotype threat condition were told that for this particular assessment created for the study “girls consistently do worse than boys” (p. 143). This study is of interest since anxiety has been shown to influence the academic performance of students. More research is needed to assess whether or not the effects of stereotype are long lasting.

Students’ Beliefs about Mathematics

Research confirms that students’ beliefs about the discipline of mathematics and mathematics teaching and learning within that discipline, directly influence a students’ mathematics anxiety and self-efficacy (Stodolsky, Salk, & Glaessner, 1991). Students

bring preconceived ideas, beliefs, feelings, and ways of thinking to the classroom based on their past experiences which impact their learning and achievement (Carter & Norwood, 1997; Stodolsky, Salk, & Glaesner, 1991). Failing to address these preconceptions could be detrimental to a student's future classroom experiences. Many of the beliefs that students hold about mathematics are negative and interfere with their motivation to learn. One such belief held by students is that mathematics is a subject that consists of incoherent facts, skills, and procedures to be memorized and used within the constraints of the classroom (Carter & Norwood, 1997) to solve problems that have definite answers. Students do not believe that learning mathematics requires a good conceptual understanding of the material (Stodolsky, Salk, & Glaessner, 1991). If students do not master the facts, skills, and procedures and get to an answer quickly, they feel like they are deficient in ability (Lampert, 1990). Students believe that taking notes, doing a plethora of problems from a textbook or worksheet, and taking tests is how mathematics is learned (Stodolsky, Salk, & Glaessner, 1991). Additionally, students believe that mathematics has no relevance to their lives beyond making a grade on an assessment and meeting graduation requirements. Mathematics instructors must include, as a desirable goal, the opportunity for students to reflect upon and address their "prior knowledge, skills, and beliefs" (Bransford, 2000). This will help bridge the gap between the mathematics taught in the classroom and the relevant mathematics that applies to students' lives.

Another commonly held student belief is that the role of the teacher is "information provider" as opposed to "facilitator of learning". The roles of the students then become "information absorbers". In the role of information absorber, students fail

to become autonomous learners connecting new knowledge to pre-existing knowledge. As a result, students have a difficult time transferring learned knowledge to different context. Therefore, students become dependent on the teacher and believe that they cannot be successful in mathematics without teacher assistance. In a qualitative study of sixty fifth-grade students, Stodolsky, Salk, and Glaessner (1991) reported that “only 7 students thought that they could learn mathematics on their own” (p. 105). It is essential that mathematics teachers cultivate environments that enhance the understanding of students by allowing them the freedom to explore, reflect, and collaborate (Lappan, 1998). This environment allows students to discover, retrieve, process, apply, analyze, and synthesize information. Indeed, there is a growing body of research that supports this type of learning environment.

Another belief commonly held by student is that mathematical ability is innate. They believe that some students are naturally good at mathematics and others are not. They also believe that it is alright for a person not to be good at mathematics. Students who believe that they do not have a “mathematical mind” will suffer from low self efficacy and will more than likely experience anxiety in the classroom.

Culture and Beliefs

Culture affects student’s mathematical beliefs. For instance, African Americans believe that working hard in school will not change how the larger society views them (Perry, 2003). They believe that no matter what they achieve, they will still be devalued. Additionally, African Americans feel that if they succeed in the mathematics classroom, they will be perceived as “acting White” (Fordham, 1996). Moreover, this success will entail overcoming numerous barriers and obstacles within the constraints of the

classroom. Nevertheless, most believe that education leads to a better life. All of the beliefs mentioned above, affect the achievement of African Americans in the classroom.

Peer Influence

As adolescents transition from elementary to middle school, social relationships become vital to their emotional and social well-being. Research shows that "...middle or junior high school transitions are often associated with increased psychological distress, a decline in academic performance, decreased motivation, and lowered self-esteem" (Chung, Elias, & Schneider, 1998, p. 84). In a study of 120 New Jersey students (63 boys and 57 girls) transitioning from elementary school to middle school, Chung, Elias, and Schneider (1998) reported a "significant decrease in academic achievement, $t(98)=-3.00$, $p<0.005$, and a significant increase in psychological distress, $t(98)=16.37$, $p<0.001$ for the full sample" (p. 86). They also reported that "students showing a high level of psychological distress during transition tended to have more adaptive difficulties in middle school than did their peers" (p. 98).

During this transition, adolescents have a psychological need of acceptance within schools. They find themselves turning away from adults toward peers for support, encouragement, intimacy, activities, and conversation. They find security in the presence of peers with their same interest and pursuits. These peer relationships assist adolescence in successfully negotiating the hardships and ease of the middle school experience and beyond. Additionally, these peer interactions can be helpful in the mathematical experience of students in the P-16 mathematics classroom. Powell-Mikle (2001) produced research findings that support the benefits of peer interactions. In the present study six African American students attending the same southern four-year university

were interviewed and identified peer interactions as having a positive influence on their success in mathematics. All six students benefited from working with other students in the mathematics classroom. Preliminary findings concluded that group settings enhanced the mathematics learning of African American students (Powell-Mikle, 2001).

Traditionally, research has shown a decline in African American students' academic achievement as they transition from elementary to middle school (Akos & Galassi, 2004). This decline may be due to Fordham's (1996) "acting White" phenomenon introduced as a result of her study of a predominantly Black high school located in Washington, D.C. Adolescents invented new identities that coincided with the identities of their peers. Wigfield, Lutz, and Wagner (2005) wrote, "[i]dentity formation involves the successful negotiation of a variety of activities and relationships during adolescence, including school achievement, social relations with others, and development of career interests and choices, along with a great deal of exploration of different activities and roles" (p. 3). Some African American students did not work to their full potential to avoid being stigmatized as "acting White." Being labeled in this way changed their identity. What is "acting White"? Fordham (1996) commented:

Within the African American community, "acting White" is generally used as an epithet to convey the response of African Americans to the institutionalization of norms that are generated and maintained by the larger, dominant community. As Capital students defined it "acting White" entailed representing the "Other" in the presence of Black people (p. 22).

Some African Americans either avoid achieving at high levels or try to camouflage their high academic achievement for fear of being alienated by their peers for their accomplishments. African Americans will not risk their sense of belongingness by being labeled as an "other." Years of injustices in the educational system is how "Black came

to be viewed as the antithesis of ‘being smart,’ and how ‘doing well in school’ and ‘being smart’ came to be associated with being and acting White” (Perry, 2003, p. 33). Avoiding the label of “acting White” can cause anxiety for the African American student.

Teachers

The actions, beliefs, and expectations of teachers either intentionally or unintentionally limit the success of African American students. Ferguson (2003) commented, “A major concern of African Americans is that teachers underestimate Black students’ potential, not necessarily their performance” (p. 467). Powell-Mikle (2001) reported that Jim—at the request of his teacher—was placed in a mathematics class for the learning disabled in middle school. Jim was not learning disabled, but he needed glasses so that he could see the board. As a result of being placed in the lower ability group, Jim was both discouraged and bored. Similarly, Berry (2005) reported on his dissertation findings pertaining to two successful African American male students—Phillip and Bilal-- in the eighth grade that Bilal’s father wanted to have him tested for the Academically Gifted program in the third grade. Bilal’s teacher failed to give him the recommendation needed to be tested. After administration was informed and intervened, Bilal was allowed to take the test and scored high enough to participate in the program. Further, Berry (2004) reported that a sixth-grade student Calvin exceeded all but one requirement—teacher recommendation—to gain admittance into an upper-level pre-algebra mathematics course. Although Calvin was initially denied access into the program due to teacher recommendation, he was later accepted after parental intervention. Student behavior was not a limiting factor in either study.

Teachers' perceptions and expectations of African American students have important implications for African American student achievement in the mathematics classroom. Specifically, teacher expectations can affect a student's mathematics performance (Wagner, Roy, Ecatoiu, & Rousseau, 200). Ferguson (2003) commented, "teacher's perceptions, expectations, and behaviors interact with students' beliefs, behaviors, and work habits in ways that help to perpetuate the Black-White test score gap" (p. 461). Ferguson (2003) commented about the difficulty in finding strong empirical evidence that shows how "teacher's perceptions, expectations, and behaviors are biased by racial stereotypes" (p. 461). Ferguson (2003) wrote, "[e]xpectations, perceptions, and behaviors that look biased if judged by one criterion often look unbiased if judged by another" (p. 462). Ferguson (2003) referenced a meta-analysis of studies (16 race related studies) examining teacher expectations done by Baron et al. (1985). Baron et al. (1985) reported that:

Teachers had higher expectations for White students in 9 of the studies and for Blacks in 1 of the studies. Six studies in which the differences were statistically insignificant did not report which group was favored. Of the 5 studies with statistically significant differences, all favored Whites (Ferguson, 2003, pp. 463-464).

Teachers hold different perceptions and expectations about African American achievement versus their White peers. This is unfortunate given that research shows that "teachers' expectations can and sometimes do affect teacher-student interaction and student outcomes..." (Good, 1987, p. 33). Learning under such circumstances can perhaps be a challenge. According to Ladson-Billings (1997):

When teachers believe in students' abilities, the students are likely to be successful. When teachers believe that because of their race, social class, or personal economic situations students may not be intellectually able, student performance (and how it is assessed) confirms those beliefs (p. 703).

A contributing factor to teachers' perceptions and expectations of African American students is the institutional racism found in schools. Perry (2003) tells a story of a high achieving African American male student by the name of Malcolm X. Even though Malcolm X was performing well in the classroom, he was not receiving the same encouragement as his White peers. Malcolm X confided in his teacher that he wanted to be a lawyer when he reached adulthood. His teacher responded "Malcolm, one of life's needs is for us to be realistic. Don't misunderstand me now, we are here like you, you know that...But you have to be realistic being a nigger" (Perry, 2003, p. 20). Perry (2003) tells another story about a woman by the name of Gwendolyn Parker who worked hard to turn in an English paper only to be told that she plagiarized the paper. Her academic ability was questioned because of the color of her skin. These are examples of how educators often prejudge minority students making conjectures about their achievement. Minority students are seen as lacking in ability, motivation, and academic skills. As a result of prejudgments made by educators, minority students are often offered a less challenging curriculum and limited achievement goals. Perry (2003) poses the following question as food for thought "Why should African American youth commit themselves to doing outstanding intellectual work if—because of the marker of skin color—this work is likely to be undervalued, evaluated differently from that of Whites, ignored?" (p. 19). Casteel (2001) indicated that this lack of encouragement and support for African American students is not uncommon in instructional settings. In a study of 417 seventh graders in southeastern Louisiana, Casteel (2001) reported, "African American students received more negative interactions from their Caucasian American

teachers than the Caucasian American students” (p. 119). Perry (2003) commented, “It was as if his achievement as one of the best students in the class were invisible” (p. 20).

According to Stinson (2006), teachers that buy into the “discourse of deficiency” attribute the low achievement of African American students to “higher rates of poverty, living in high crime communities, unstable single parenting, and minimal parental involvement, as well as suffering from the negative effects of slavery, segregation, racism, and discrimination” (p. 483). Conversely, in a study done by Ullenberg and Brown (2002) it was found that African American teachers perceived the substantive gap in achievement to be related to teachers and schools.

Moody (2004) and Brand, Glasson, & Green (2006) investigated the impact of social influences on African American student success in mathematics. The studies described the mental struggle that successful African American students had with negative stereotypes that teachers sometimes hold about African American culture and learning. Because of the often unpleasant picture that society paints of African American students, it is felt that the relationships that African American students have with their teachers are not deep-seated, caring relationships. Such relationships have the potential to prevent successful mathematics students from reaching their full potential. Moody (2004) found through her research that because of social factors, African American students felt like they had to work harder than their Caucasian peers to achieve the same result.

Teacher-Student Relationships

Although competence in mathematics is vital for African American economic access (Moses, 2001), an increasing number of African American students are not

experiencing success in the mathematics classroom. As previously mentioned, daily they are confronted with barriers that contribute to underachievement (e.g. low expectations, racism, unchallenging curriculum) and underrepresentation in mathematics daily.

Student achievement is at the heart of teachers' jobs. If students do not achieve in the classroom, teachers are somehow failing them. Klem and Connell (2004) reported that "Studies show students with caring and supportive interpersonal relationships in school report more positive academic attitudes and values, and more satisfaction with school" (p. 262). Klem and Connell (2004) conducted a study examining "longitudinal data sets collected by the Institute for Research Reform in Education to validate the Research Assessment Package for Schools (RAPS)" (p. 263). The longitudinal data were taken from six elementary schools and three middle schools. Klem and Connell (2004) reported, "students who perceive teachers as creating a caring, well-structured learning environment in which expectations are high, clear, and fair are more likely to report engagement in school" (p. 270). Additionally they found that "links between teacher support, student engagement, and academic performance and commitment hold for both elementary and middle school students, providing further support for an indirect link between student experience of support and academic performance through student engagement" (Klem & Connell, 2004, p. 270). If African American students are going to succeed academically, strong, sound, caring relationships must be formed with their teachers.

Summary

In Chapter II, literature related to potential factors contributing to the underachievement of the African American student was reviewed. The following factors

were discussed in the literature review: self-efficacy, mathematics anxiety, academic self-concept, parental involvement, classroom culture, instructional practices, stereotype threat, students' beliefs about mathematics, culture and beliefs, peer influence, teacher expectations, and teacher and student relationships. The next chapter will discuss the research methodology that was used for this study

CHAPTER III

METHODOLOGY

Phenomenology

In his book *Phenomenological Inquiry in Psychology*, Valle (1998) discusses the existential-phenomenological approach to qualitative research founded by Edmund H. Husserl (1859-1938). The existential-phenomenological methodology “seeks to understand a phenomenon in its pure essence, prior to any reflective interpretation, scientific, or other” (Valle, 1998, p. 311). Ashworth and Chung (2006) contend that phenomenology “aims to discover, articulate, and make explicit the participants’ lived psychological meanings” (p. 5). Phenomenology focuses on shared experiences and the research participants’ reflections on these experiences (Valle, 1998). The purpose of this study was to examine the mathematical experiences of seven African American females. The methodology chosen for this study is appropriate because there is a minimal amount of descriptive research in mathematics education describing the mathematical experiences of the African American female student. Phenomenology allows the researcher to use tape recorded, open-ended, intimate interviews and to do a qualitative inductive and descriptive analysis of personal narratives to get a comprehensive understanding of the lived experiences, feelings, and cultural significance of the experiences of African American females creating a “worldview” (Patton, 2002, p. 106) of the phenomena based solely on their full interpretations. The researcher sought to understand what hinders and contributes to the mathematical performance of African

American female students. This methodology allows research participants the freedom to provide detailed information about their personal mathematical interactions and experiences from their unique perspectives and gives the researcher the opportunity to without presuppositions highlight the distinct characteristics of each individual experience and the similarities among experiences synthesizing emerging and underlying categories, themes, and sub-themes. Moustakas (1994) specifies a distinctive feature of this approach which is to “determine what an experience means for the persons who have had the experience and are able to provide a comprehensive description of it” (p. 13). If this methodology is carried out appropriately, the researcher gets an accurate interpretation of the research participants’ experiences. In this section, the researcher discusses: the research site, gaining access to the research site and participants, choosing the participants for the study, the instrumentation used to collect the quantitative data, other data collection techniques, and possible limitations of the study.

Research Site

A Career Technical Education (CTE) center, with strong academic and career programs, was selected as the site for this study. This center is one of four career tech high schools belonging to a career and technical school district located in the Midwestern United States of America. This CTE is a coeducational center meaning that all classes are coeducational and all programs are open to both sexes. During the 2009-2010 academic school year, the center had an enrollment of approximately 818 students coming from 32 feeder schools. Of this number, the ethnic and racial makeup of the student population was as follows: 59% Caucasian, 37% African American, 2% Hispanic, and 2% Multiracial (State Department of Education, 2009). Moreover, fifty-two percent

of the total student population qualified for free and reduced lunches, and 26% were categorized as students with special needs (National Center for Education Statistics, 2009).

During the 2009-2010 school year, the center consisted of 29 full-time academic teachers. All 29 teachers were certified to teach grades 7-12, but the research site enrolled students in grades 11-12 only. Also, this center had a total of 27 full-time career and technical instructors who taught career related programs only (i.e., Automotive Technology, Culinary Arts and Hospitality). During the 2009-2010 school year, the research site offered 24 career and technical programs. Administrators at this center included the following: one head Dean, and two Assistant Deans. Students were required to take academic classes to meet both career and technical education standards and to satisfy the graduation requirement set forth by their home schools. Furthermore, students were required to pass all parts of the state graduation test before graduating. If students at the research site did not meet the graduation requirements by the end of their senior year of high school, they were able to participate in other programs offered through the district that served to assist them with meeting these requirements at a later date so that they could still obtain a high school diploma.

The center has articulation agreements with post-secondary institutions and businesses. As a result, they are able to offer Post-Secondary Education Options (PSEO) in academic classes through a two-year technical college. High school students at the center are offered the opportunity to earn transferable college credits free of charge to the student. During the 2009-2010 academic school year, 7% of the student population was enrolled in the PSEO courses. Of the students enrolled, 33% were African American.

During the 2009-2010 school year, the center offered a number of mathematics classes including: Mathematics Strategies, Geometry, Algebra I, Algebra II, Pre-Calculus, College Algebra, and Calculus. Pre-Calculus, College Algebra, and Calculus are considered upper-level mathematics courses. Students enrolled in the Mathematics Strategies courses had not passed the mathematics portion of the state's graduation test upon enrollment at the beginning of the 2009-2010 academic school year. Twelve percent of the student population was enrolled in the Mathematics Strategies classes. Of the students enrolled, 47% are African American. In the fall of 2009, 67 African American students from the research site took the state assessment test and only 32% passed. Out of the 37 African American female students that took the state assessment, only 30% passed. Eleven percent of students are enrolled in Pre-Calculus, 2.6% in College Algebra, and 1% in Calculus. Thirty-three percent of the Pre-Calculus students, 23.8% of the College Algebra students, and 22% of the Calculus students are African American.

Gaining Access

In 2008, the Vice President of Performance and Outcomes at the research site was contacted for permission to conduct the study with research participants at the research site. After the proposal was approved a meeting was held with the Vice President of Performance and Outcomes to discuss the purpose of the study, the timelines of the study, and how the participants would be selected. The Vice President of Performance and Outcomes granted the researcher permission contingent on Instructional Review Board (IRB) approval and excluding all students presently enrolled in her mathematics classes

from participating. The researcher only began conducting the research after the IRB at the University of Louisville approved the research study.

Participants

For this study, purposeful sampling was used to select the participants. Maxwell (2005) affirmed, "Selecting those times, settings, and individuals that can provide you with the information that you need in order to answer your research questions is the most important consideration in qualitative selection decisions" (p. 88). Since the intent of this research was to take an in-depth look at African American female high school students to examine what factors they attribute to their performance, the participants were seven African American female eleventh and twelfth grade students at the research site enrolled in the Pre-Calculus and Algebra II courses. Also, two mathematics instructors who have the research participants as students were interviewed for this research study. Both mathematics teachers were White males. One of the mathematics teachers taught all of the successful mathematics students in the research study and the other mathematics teacher taught all of the middle and low performing students in this research study.

Before students at the research site were enrolled in the Pre-Calculus courses, they had to have taken Algebra II, passed all portions of the state graduation test, and received a teacher and counselor recommendation. Students enrolled in the basic/remedial level Algebra II courses were placed in these courses as a result of scores received on a placement test that was created by all of the Algebra II teachers employed at the center and given to all Algebra II students at the beginning of the 2009-2010 academic school year. For the purpose of this study specific criteria were used to select successful, middle performing, and low performing students. A successful student was

defined as a student who: (a) was enrolled in a Pre-Calculus course; (b) had passed all parts of the state graduation test; (c) had completed or were enrolled in their last class for completing all required mathematics credits for graduation; and (d) had maintained a B cumulative average or higher in their last completed mathematics course. A middle performing student was defined as a student who: (a) was enrolled in Algebra II; (b) had passed all parts of the state graduation test; and (c) had maintained a B cumulative average or higher in their last completed mathematics course. A student who was not persisting and achieving was defined as a student who: (a) was enrolled in the remedial level Algebra II classes; (b) had not completed all of their required mathematics credits for graduation; and (c) received a C or lower cumulative average in their last completed mathematics course. The past and present educational records of all African American female students enrolled at the research site were reviewed to select the successful, middle performing, and low performing students for the research study. Upon reviewing the records potential candidates for the research study were identified and contacted. The potential candidates were verbally told the purpose of the study, the requirements for participation, and all other pertinent information pertaining to the study. Also, they were told that participation in this study was voluntary, that they would not be penalized in any way if they chose not to participate, and that they could withdraw from the study at any time if they chose to participate. They were then asked if they would be interested in participating in the study. Seven African American female high school students agreed to participate in this study. Because of the ages of the participants, parental consent was required. All of the research participants that agreed to participate were asked to sign a subject assent form and their parent(s)/guardian(s) were asked to sign a parent informed

consent document. The researcher spent time with each research participant explaining the subject assent form and allowing them to review the document asking any questions about the study. To build trust between the researcher and the participants, the researcher informed the participants that all of the data would be protected to ensure confidentiality. All of the research participants were interviewed separately in a private and quiet classroom. Pseudo-names were used throughout the study for all research participants as to protect their identity, and all research data was kept in a locked cabinet.

Instrumentation

A quantitative analysis of existing data was also examined for the research study. Earlier in the year, teachers at the research site administered a modified version of the Fennema-Sherman Mathematics Attitude Scale (1976) to all of their students in order to gather attitudinal data pertaining to their students learning of mathematics. This instrument is a 5 choice instrument ranging from “strongly agree” to “strongly disagree” with a score of 5 representing more favorable attitudes towards the learning of mathematics. Thirty questions from the following Fennema-Sherman Mathematics Attitude subscales were given by the teachers: the Confidence in Learning Mathematics Scale, the Mathematics Anxiety Scale, and the Mathematics Usefulness Scale. Demographic questions (i.e., race, sex) were added to the research instrument for analysis purposes. All students in College Algebra, Pre-Calculus, Calculus, Math Strategies, and the remedial level Algebra II classes present on the day was given the instrument by their mathematics teachers during their mathematics classes. The results of the surveys were given to the researcher for analysis purposes. Only the survey results of the African American female students were included in the data analysis.

Data Collection

The following techniques of data collection were used for this study: individual student interviews and mathematical autobiographies. Most of the data came from formal student interviews with an established protocol. Moustakas (1994) states that “[t]he phenomenological interview involves an informal, interactive process and utilizes open-ended comments and questions” (p. 114). Ashworth and Chung (2006) state that “the research always begins with a description of an experience from an everyday perspective that is to be understood psychologically” (p. 71). They go on to say that “the transcription of the interview then becomes the raw data of the research” (p. 71). Before conducting the interviews with the research participants, the interview questions were pilot-tested with two African American high schools students not affiliated whatsoever with the research site or the research participants. Two student interviews per participant were conducted. The interviews were approximately forty minutes in length and were tape recorded with permission from the interviewees. Data from the first interview was often used to drive the second interview leading to connected follow up questions asked during the second interview. The researcher also took notes during the interviewing process so that the data could be reconstructed accurately. The collected data consisted of: transcribed interviews, notes taking during interviews, and mathematical autobiographies. The participants were asked by their mathematics teachers earlier in the year to complete a mathematics autobiography as a regular mathematics assignment. Therefore, the mathematics autobiography was also existing data. The mathematics autobiography provided an overall written summary of the participants’ unique mathematical experiences from kindergarten through high school. The first interview

was designed around the mathematical autobiographies. The researcher read back the mathematical autobiographies to the research participants probing for them to reflect on what they wrote and to offer more detailed accounts of the experiences. According to Patton (2002), “[t]he experiences of different people are bracketed, analyzed, and compared to identify the essences of the phenomenon” (p. 106). The data analysis for this study was ongoing and inductive. All interviews and mathematical autobiographies were examined in a systematic and procedural way. Each individual student interview was transcribed by the researcher. The transcribed, individual interview responses were read thoroughly and the various themes that emerged from the data were organized and coded using category names. The codes were developed inductively while examining the data. The data yielded 13 major categories including: lack of confidence, perseverance, anxiety, mathematics usefulness, teacher dependence, teacher behaviors and characteristics, self-efficacy, success or failure in mathematics, parents and mathematics, stereotypes, other academic classes, peers and mathematics, and the ideal mathematics classroom. The interviews were then read line-by-line a second time and individual quotes were placed in the categories. Themes within the categories were also examined.

The method for analysis of this study will be adapted from Colaizzi (1978). According to Ron Valle (1998) the Colaizzi (1978) phenomenological method consists of the following steps: (a) the researcher reads the transcripts from the participants’ interviews getting a general feel for the data; (b) the researcher highlights meaningful words or phrases from the data and looks for overarching meanings; (c) the researcher examines the transcripts and highlights themes/categories and relationships that emerge; (d) the researcher provides a detailed description of the research participants experiences

as told by the participants as to accurately depict the participants' true perceptions of the phenomenon being studied.

Limitations

This study was subject to several concerns. One concern of the present study related to the lived experience of the African American female researcher who was successful in mathematics throughout her K-12 schooling experience. In order for the data analysis to be free from personal judgments and pre-conceived ideas, the researcher will have to bracket her feelings, beliefs, and understandings related to her prior experiences in the mathematics classroom. According to Giorgi (1981), "Bracketing means that one puts out of mind all that one knows about a phenomenon or event in order to describe precisely how one experiences it..." (p. 82). Also, using the Colaizzi method for data analysis calls for the researcher to bring "to awareness his or her preconceived notions and biases regarding the experience being investigated so that the researcher is less likely to impose these biases when interpreting the subjects' reports of their experience"(Valle, 1998, p. 162). Another limitation to the study was that the research participants were enrolled at the same school where the researcher is employed. As a result, students may have been less motivated to communicate freely and efficiently information pertaining to their mathematical learning experiences. One last limitation pertained to the multivariate analysis of variance. The multivariate analysis of variance (MANOVA) test was run to investigate between group differences among the three levels of mathematics classes (the independent variables), and the mean scores in the dependent variables: Confidence in Learning Mathematics, Mathematics Usefulness, and Mathematics Anxiety. Only the surveys from the African American female students at

the research site were examined. No inferences could be made that African American female experiences in mathematics were different from those of other gender/races because this study failed to examine other races/genders and run a comparative analysis.

CHAPTER IV

FINDINGS

This research study sought to provide insight into the mathematical experiences of seven female African American high school students in a career and technical school setting by examining factors that affect their learning and persistence. The purpose of this chapter is to report the research findings in detail. These seven students are on a continuum from struggling to succeeding in mathematics. Throughout the study, the researcher sought to get a true depiction of the participant's perceptions of their mathematical experiences. Several questions related to the participants' individual mathematical experiences were investigated. In accordance with phenomenological methodology and to achieve this goal, the main source of data for this study was provided through the voices of the seven research participants. The following techniques of data collection were used: mathematics autobiographies, survey data, semi-structured, in-depth interviews using a converging question strategy, and two individual teacher interviews using a teacher interview protocol from the dissertation of Berry (2002). Of the seven African American female research participants in grades 11-12 interviewed, three were successful, two were middle performing, and two were not persisting and achieving in the mathematics classroom. This chapter begins with an introduction of each of the research participants followed by an analysis of the qualitative research data. To conceal the identities of the research participants, pseudonyms were used to tell their stories. The successful students have been given names starting with the letter "S." Also,

the middle performing students have been given names that start with the letter “M.” Finally, the students who are not persisting and achieving in the mathematics classroom have been given names that start with the letter “L” (see Table 1). The following research questions were investigated for this study:

1. What factors do African American female high school students attribute to their performance in mathematics?
2. How do African American female high school students describe the factors that they deem important to their success in mathematics?
3. Why do African American female high school students think that other students fail in mathematics?
4. How does African American female high school students’ performance in mathematics compare to their performance in other subjects?
5. What barriers do African American female high school students perceive in being successful?

Table 1

The Seven Research Participants by Achievement Group

Research Participants	Group
Suzie	Successful Mathematics Student
Samantha	Successful Mathematics Student
Stacey	Successful Mathematics Student
Monica	Middle Performing Student
Maria	Middle Performing Student
Lynn	Low Performing Student
Lois	Low Performing Student

Suzie

I have to work hard at it, because math can be pretty complicated for me. When I get the math being taught, I feel good. Feels like I've accomplished something. It is very irritating when I don't understand what is being taught. When I realize my weakness, I try to overcome it and do my best work (Mathematics Autobiography).

The first research participant, Suzie, was a senior enrolled in Pre-Calculus at the research site. She was also a member of the Cosmetology program. Suzie generally thrived in mathematics, maintaining A's and B's in both her eleventh and twelfth grade years. Also, Suzie had a positive attitude about mathematics as confirmed by her interviews and had a somewhat strong belief in her mathematical capabilities. Also, Suzie noted that she holds high expectations for herself in relation to mathematics. At the time of the interview, Suzie had completed all of her required mathematics credits for graduation. Upon graduating from high school, Suzie planned to attend college pursuing a career in either business, nursing, or pre-law. Suzie conveyed that in college she intended to take higher level mathematics courses so that she could be challenged cognitively. She stated, "I am interested in taking a more challenging math class in college to challenge my brain and make me think" (Mathematics Autobiography). Her response confirmed her appreciation for the complexity of mathematics and how the subject requires students to think.

Suzie's first memories of mathematics were in an elementary school classroom where she learned addition and subtraction. As the mathematics became more rigorous in junior high and high school, she was drawn away from the subject. She articulated, "As things started to get complicated, it drew me away from math" (Mathematics Autobiography). However, she emphasized that she is better in mathematics than any

other academic subject. Suzie realized that she was good at mathematics when she could “actually comprehend the mathematical concepts that were being taught in high school” (Mathematics Autobiography).

Suzie believes that a successful mathematics student is “A student who works hard in mathematics even if their grades are not excellent” (Mathematics Autobiography). When asked why students fail in the mathematics classroom, Suzie listed the following reasons: they don’t pay attention in class, they don’t take notes, they don’t try, they don’t put effort into test, and they don’t study. In regard to why students succeed in the mathematics classroom, Suzie gave the following reasons: they take notes in class, they are focused, they study at home daily, they try to do their best, and they ask questions, and get their work done and in on time. When asked what advice she would give to future students Suzie offered, “Pay attention in math class when you are given material, and then go home and study it at least thirty minutes to an hour a day after school” (Student Interview 5/21/10).

The Teacher’s Perception of Suzie

Suzie’s mathematics teacher perceived her as a hardworking student who wanted to, “Do her best and be successful in mathematics.” He expressed that, “If Suzie is faced with a mathematics problem for the first time, she thinks critically about the problem and problem-solves before seeking help.” He expressed that “If Suzie makes a mistake or gets an incorrect answer, she wants to know where she went wrong.” More specifically, the teacher commented that, “If Suzie is taking a multiple choice test and her answer does not match up with one of the choices, she takes the initiative to find out where she made her mistake versus asking him for assistance.” He stated that, “Suzie is a partner in the

learning process.” Suzie’s teacher expressed that if Suzie is given a problem that will take 30 to 45 minutes to solve, she would do well. He remarked that “She would use the information that she knows or seek out other resources to assist her in solving the problem.” He expressed that, “He was confident in her mathematical capabilities and felt that she was ready to take complex level mathematics courses and/or pursue mathematics related careers at the university level.”

According to Suzie’s mathematics teacher, he held high expectations for all his students’ mathematics performances. Moreover, he expressed a willingness to assist all students in meeting his classroom goals for each student. His expectations for students included: wants to learn, willing to try, is not afraid to make mistakes, learns from making mistakes, and takes initiative to find their own mistakes and correct them. In response to whether Suzie met his expectations of a Pre-Calculus student, he answered “yes.” He stated, “Completing homework was never a problem for Suzie because she turned in all of her assignments and they were, nice, organized, and she showed all of her work.” When asked about Suzie’s weaknesses, the teacher commented, “Her attendance has dropped off drastically.”

When asked how Suzie is perceived by other students in her class, the teacher described Suzie as “somewhat of a loner.” He articulated that, “She is quiet and generally sits at a table by herself rarely socializing with her peers.” He went on to comment that, “Even when given the opportunity to work with her peers on a collaborative assignment, she often chose to work by herself.”

Samantha

When I really understand the mathematics being taught, I feel accomplished. It’s a good feeling. I feel it’s getting harder, and I feel it’s going to take more time. I

have to actually sit down and think about the stuff now, because it's not so simple anymore (Mathematics Autobiography).

The second research participant, Samantha, was also a senior enrolled in Pre-Calculus at the research site. Samantha was one of the top achieving students in the Early Childhood Education program. Like Suzie, Samantha also maintained A's and B's in mathematics both her eleventh and twelfth grade school years and possessed a strong desire to want to do her best in mathematics. From the interviews, Samantha was shown to be a student with a positive attitude who puts a lot of effort into the learning and doing of mathematics. Like Suzie, Samantha had a somewhat strong belief in her mathematical capabilities. At the time of the interview, Samantha had also completed all of her mathematics requirements for graduation. Samantha had a future goal of attending college after high school majoring in Early Childhood Education with a minor in Sociology. Samantha stressed an interest in taking more advanced level mathematics courses on the university level "to challenge her academically and to expand her thinking" (Mathematics Autobiography).

Samantha's first memories of learning mathematics were in elementary school when she "learned subtraction from the 100s place" (Mathematics Autobiography). Samantha pointed out that she is drawn towards mathematics because of the difficulty of the content. She commented, "As it is getting harder, I am more and more drawn into it and I'm on myself about learning it and remembering it and mastering how to do it" (Mathematics Autobiography). This statement showed that Samantha clearly valued the complexity and challenge of mathematics. Samantha realized that she was good in mathematics while doing multiplication and division, but began to struggle with the mathematical content when equations began to consist of "numbers and the alphabet"

(Mathematics Autobiography). As a result, Samantha had to complete Algebra I. twice. Samantha was really inspired and drawn to mathematics after being taught by what she described as “her effective ninth grade teacher who used different ways to help her understand the mathematics that was being presented” (Mathematics Autobiography). Samantha shared that this teacher also took time out for her, and was patient with her. Although Samantha has enjoyed doing mathematics for a long time, she noted that “English was her most successful subject” (Mathematics Autobiography).

In Samantha’s opinion, a successful mathematics student is someone who is motivated, really gets what they are learning, and they do the following: complete homework, seek help when needed, maintain good grades in mathematics, takes notes, find resources to assist with learning the content, pay attention, and try their best to comprehend what is being taught. In response to the question of why students fail in the mathematics classroom, Samantha stated that, “Students fail because they have given up on themselves or someone else has given up on them” (Mathematics Autobiography). Also, she offered that students fail because of the following: they lose focus, don’t want to do the work, they simply cannot comprehend the mathematics content being presented, and they don’t use other resources to assist them with learning the mathematics (e.g., family members, books, and internet). Samantha also attributed student failure to teacher behaviors. In her opinion, she felt that a teacher that was not willing to help students could be a major reason why students fail in mathematics. Samantha expressed that she feels that students succeed in the mathematics classroom because: they stay focused, they are motivated, and they work hard. Samantha stated the following about herself and why she is successful in mathematics:

I try to push myself with math, because you need math everywhere and I feel like if I don't know it then how am I going to live out in the real world. So, I push myself to remember it, and to learn how to do this stuff because I need it (Student Interview 5/19/10).

The Teacher's Perception of Samantha

Like Suzie, Samantha's mathematics teacher perceived her as a "hardworking mathematics student with a bright future." He expressed with excitement that Samantha was "one of his favorite students." He indicated that Samantha was deficient in some mathematical areas, but he observed that she works hard to overcome these deficiencies. Also, he recalled that Samantha has an inward desire to succeed and often persist when faced with various obstacles and struggles in the mathematics classroom. He observed that making mistakes undermines Samantha's confidence and often causes her to become anxious. He mentioned that even though he goes out of his way to assure her that making mistakes in mathematics is a part of the learning process, she still experiences various degrees of anxiety. He expressed that, "In Pre-Calculus, Samantha mastered the more complex mathematical content, but struggled with simple algebraic manipulation." When asked about Samantha's interaction with peers he shared that she has several friends in her Pre-Calculus class, and that she enjoys working collaboratively with her peers to successfully complete assignments.

Stacey

I loved math when I was younger. I loved numbers, calculations, and problem solving. I have strength in math, and it makes me feel good that I have it. I am confident that I have mathematical abilities. I have something in me that keeps me interested (Mathematics Autobiography).

The third research participant, Stacey, was also a senior enrolled in both Pre-Calculus and the Early Childhood Education program at the research site. Stacey had

also maintained A's and B's in mathematics in her eleventh and twelfth grade school years, and completed all of her required mathematics credits for graduation. As a student, Stacey was both confident and motivated in the mathematics classroom. Stacey also had a professional aspiration of going to college and becoming a Kindergarten teacher.

Stacey's first memories of learning mathematics were "drill and practice" in elementary school when she was required weekly to take "timed multiplication test" (Mathematics Autobiography). Stacey felt that she was drawn to mathematics at a very young age. Unfortunately, she was quickly drawn away from the subject when one of her favorite mathematics teachers took ill and was replaced by an ineffective, long-term substitute. Stacey shared the following about her original mathematics teacher, "I had an excellent mathematics teacher who taught us rhymes to memorize equations and information we needed to know" (Mathematics Autobiography). Although Stacey feels that she is a strong mathematics student, she expressed that she is most successful in Sociology because "she gets things done and understands it more than her other subjects" (Mathematics Autobiography). Additionally, she expressed that she enjoys English because she likes "writing essays" (Mathematics Autobiography).

When asked why students fail in the mathematics classroom, Stacey gave the following reasons: they lack focus, they do not understand the mathematical content being presented, and they feel like there is no point to learning mathematics. In answering the question of why students succeed in the mathematics classroom, Stacey stated the following: to maintain their grade point average, to graduate, and to prove something to themselves and their family, parents, teachers, and peers. She also stated

that, “A student’s mathematics teacher is a main source of their success” (Mathematics Autobiography). When asked to give advice to future students, Stacey responded:

I would tell them that stereotypes don’t matter and I would tell them that if they believe that they can make it, they can make it. Try their best. If they try, then that’s all that they can really do. Try by giving the question a chance. Like instead of looking at it and saying you can’t do it try the question and maybe you might even solve the whole thing wrong. But at least you tried it and like if you try and fail it’s better than not trying and failing (Student Interview 5/20/10).

The Teacher’s Perception of Stacey

According to Stacey’s teacher, she is “a hardworking student that wants to do well in mathematics.” As he put it, “She tries all of the given assignments; she shows and takes pride in her work; she’s a strong test taker; she has a strong work ethic; she ask for help when needed; and she’s neat and organized.” He acknowledged that Stacey has met his expectations as a Pre-Calculus student. Like Samantha, he indicated that Stacey has “some academic shortcomings.” Specifically, he stated that “Her deficiency in number sense and algebraic manipulation often limits her success in Pre-Calculus.” Stacey’s teacher indicated that at the university level she would “More than likely be prepared to take a College Algebra course, although gaps in her knowledge might cause her to still struggle with some of the mathematical concepts.” Additionally, he indicated that “She is prepared to pursue a mathematical related career if she so desires, and if she takes advantage of any extra help opportunities on campus.” He remarked, “It might not come as easy as others, but I think her desire is to be successful.” He observed that Stacey lacks patience and is anxious in the mathematics classroom when “she: becomes confused, makes mistakes, or cannot get the correct answer quickly.” In these situations he noted that, “Stacey gives up for about five minutes, gets down on herself, but then picks up her pencil and continues to problem-solve.” When asked about Stacey’s

interactions with her peers, her mathematics teacher stated that, “She socializes excessively which sometimes hinders her mathematical performance.” He also stated that, “Stacey’s peers see her as one of the better math students in the class.” In his opinion, “Stacey prefers to work with her peers.” He explained, “I think that she likes the confidence of knowing that somebody is there fighting it with her; at least coming up with the same answers or having the same problems that she’s having.” He expressed that, “She has no preference for collaborative learning instruction or lectures. She does equally well with both.”

Monica

Math is something that we will use for the rest of our lives and you can love it or hate it. Me, on the other hand, I’m in the middle about it. There’s times I like math and then there’s times when I don’t like it. With my abilities, I think I’m o.k. I know I’m not the best (Mathematics Autobiography).

The fourth research participant, Monica, was a junior enrolled in Algebra II at the research site. She was also a member of the Early Childhood Education program.

Monica’s grades in her sophomore year in Geometry remained at B or higher. Even though Monica generally maintained a C grade in Algebra II, at the time of the interview she stated that she had a D grade-type because of missing assignments. But, she expressed that she has set a goal for herself of maintaining good grades in mathematics and is striving to meet that goal. Monica believed strongly about her mathematical capabilities. She stated, “I am a good math student. I just need to try harder, and not be so lazy when I do my work in class” (Mathematics Autobiography). Since all of her mathematics requirements would be satisfied after Algebra II, Monica shared that she had no intention of taking further mathematics courses. Monica planned to attend college after high school, majoring in Early Childhood Education.

Monica's first memories of learning mathematics were in the first grade when she was caught cheating on a mathematics test. She also remembered "learning how to tell time and doing arithmetic with fractions" (Mathematics Autobiography). Monica reported that when she understands the mathematical content being taught she feels drawn to mathematics, but when she doesn't understand the concepts she becomes irritated and stops working. Monica expressed that throughout her K-12 schooling experience, her teachers have played a major part in supporting her and pushing her to do her best work in mathematics. She continuously expressed that this teacher encouragement and support positively influenced her attitude and was vital to her performance in mathematics for years to come. She stated, "A lot of my math teachers from junior high school and up has pushed me to do better in math. They let me know that I am a good math student and that I am good in math" (Mathematics Autobiography).

In Monica's opinion, a successful mathematics student is "one who is focused, motivated, wants to increase their conceptual understanding of the mathematics, and tries at everything that he/she does" (Mathematics Autobiography). The successful student "completes all of their assignments and hands them in on time" (Mathematics Autobiography). Also, the successful mathematics student "seeks out help if they fail to understand the material being presented and studies for thirty minutes to an hour outside of the mathematics classroom" (Mathematics Autobiography). When asked why students fail in the mathematics classroom, Monica gave the following reasons: they don't think that they can do it, they don't try, and they don't ask for help. When asked to give advice to future students, Monica had the following to say:

Make sure that they understand math, because it's not good if you don't understand something, just in general. So you should want to get that

understanding as a whole. You should want to do good in everything you do as far as school is concerned. Want to do good in math for themselves. They have to want it. You just can't assume that just being a good math person is just going to come to you. You have to want it, and work towards getting better at it (Student Interview 5/18/10).

The Teacher's Perception of Monica

According to Monica's teacher, "She wants to do well in mathematics and when she understands the mathematical concepts being taught, she works hard." At the time of the interview, Monica's teacher indicated that based on her ability level, he was concerned that she should not be in Algebra II even though she had already passed Algebra I and Geometry. He commented that "She has limited mathematical knowledge and should instead be in a Pre-Algebra class." Monica's teacher confidently shared that "she was deficient in mathematics." This comment corroborates the research findings of Berry (2004) who concluded that minority students are often seen as lacking in mathematics ability and effort. Speaking specifically about Monica's mathematical abilities, her teacher expressed that "She has gaps in her knowledge in relation to number sense and working with fractions." As a result of her deficiencies, he mentioned that "Algebra II has continuously presented a struggle for her." Providing feedback on some of her additional weaknesses, Monica's teacher listed the following: she is disorganized, she does not complete or turn in assignments/assessments on time, she is not confident in her mathematical abilities, and she doesn't pay attention. Specifically, he reflected:

I have to specifically talk to her about turning in her work. She'll come in, and I'll have to help her organize her materials. I was doing that just yesterday. She will even just take the quiz home with her as opposed to leaving it without even thinking about it, because she is disorganized or maybe she just feels hopeless that she can't do the work. So, instead of turning in a blank piece of paper, she would rather just take it home and put it off to another day.

He also commented that, “Monica needs a lot more assistance compared to the average student in my class, because of her low ability level.” He recommended placing her in a classroom of 20 students or less so that she can receive as much individual instruction as possible. In response to Monica’s work ethic, her teacher responded as follows:

Her work ethic at times is good but those are times when she understands the material and she just works, works, works. When she gets to something that she doesn’t know how to do, she generally does not want to ask for help in front of other people or doesn’t want to say come over here please. We have worked on that over the year, and she’s gotten better at it. But, she is easily able to just shut down and just stop working and that becomes her norm when she is lost. So, her work ethic is good if she knows what she is doing. It feels like if I were to help her with one problem she would know what she is doing. She likes that, but when I have to come back, and then come back, and then come back if we are doing the quadratic formula and she doesn’t know the order of operations, she’s just lost.

Monica’s teacher mentioned that “She gets along well with her peers, but she is not perceived by them as a leader.” He commented that “She would not be comfortable discussing mathematics with her peers because she does not want it to seem like her mathematical ability is low.” Moreover, he commented that, “Monica prefers whole class discussions versus collaboratively learning with her peers.” He provided the following:

She does well with whole class instruction. If we are going through something as a class and we are taking notes and we are doing an assignment together, she does very well with that. If someone goes to the board, she can write down what they did and follow along. Again, she is not doing the work herself, which has its plusses and minuses. So, she wants to be successful and that’s a way that she can be successful. Kids are doing them on the board, and she can follow along and I can facilitate when necessary. If it is an individual assignment, again she does struggle. If it is a small group assignment, she can do ok as long as she is definitely not the lead and someone in that group knows what they are doing. She is not going to be that person.

When her teacher described Monica's test-taking, it was clear that she was not confident during testing. He suggested that, "Monica needs to come in for extra help before or after school in order to prepare for assessments." He suggested once again that "She needs one-on-one attention." Monica's teacher offered little understanding of the underlying causes of Monica's low performance. Throughout the interview, Monica's teacher was quite passionate in emphasizing that she was in the wrong mathematics class like so many of his other students. Monica's teacher offered little understanding of the underlying causes of Monica's low performance or discussed meeting this student where she was and assisting her to move forward.

Maria

Math was always the class that I excelled in. It was always my A class; always my honors class. I always did good in math. It was the one thing that I always felt that I was good in. I was always one of the first kids done, and one of the only kids that understood it (Mathematics Autobiography).

The fifth research participant, Maria, was a junior enrolled in Algebra II at the research site. She was also a member of the Health Technology Program. Maria received a B or higher cumulative average in her Geometry class during the 2009-2010 school year. Maria perceived herself as a strong mathematics student who believed strongly in her mathematical capabilities. She commented, "I have put in a lot of studying time to improve my mathematics skills" (Student Interview 5/13/10). Although at the time of the interview Maria was enrolled in her last required mathematics course, she expressed a desire to take Pre-Calculus during the 2010-2011 school year. Upon graduating from high school in 2011, Maria had a future goal of attending college and majoring in nursing.

The first memory of learning mathematics that stood out in Maria's mind was at her home where her mother rewarded her with candy for placing numbers in the correct order. She also recalled in elementary school, working on adding numbers. Upon reflection Maria stated, "I remember adding small numbers and asking my teacher, why do we do this? She said, it's what big people do" (Mathematics Autobiography). Maria always felt like she was drawn to mathematics and stated that her teachers played a major role in this feeling. Maria reflected upon the support and encouragement of her eighth grade teacher and had this to say, "My eighth grade teacher showed me that I was really good with numbers and that I could remember sequences. I felt like I was good at it" (Mathematics Autobiography). Maria stated that she "really bonded with her eighth grade mathematics teacher. Additionally, she stated that along with inspiring herself, mathematics teachers have the most influence on her mathematics achievement. She further explained that a teacher's excitement about the subject matter and positive attitude is crucial to her performance. Although Maria enjoys mathematics, government is the class that she prefers to be in because she feels that she is good with dates and remembering historical facts.

In Maria's opinion, a successful mathematics student is "one that tries no matter how good or bad their performance is in mathematics" (Mathematics Autobiography). She also felt that a successful mathematics student maintains A's and B's, although she did acknowledge that some students try hard and seek assistance but still struggle to make above average grades. When asked why students fail in the mathematics classroom, Maria gave the following reasons: they lack the motivation to come to school, they have a hard time grasping the mathematical terms and concepts, they goof off, they don't

complete homework assignments, they sleep in class, and they don't ask the teacher for help. When asked why students succeed in the mathematics classroom, Maria gave the following reasons: they are focused, they seek assistance, they have energy, they exert the effort, they have a positive attitude, they are confident, they complete homework, and they are motivated. When asked to give advice to other students, Maria explicitly stated the following:

I think that most females need to learn that you can self-motivate yourself. For example, if you just wake up every morning and just look at yourself and say that I'm going to have a positive day and I'm going to do something nice for somebody. You'll feel like you are in a good mood. Every morning I wake up and look in the mirror and I say I'm pretty. Then, I do my hair and I feel good. The only time that I don't feel good is when it's raining outside, and I'm like man it's raining. So if you start off your day feeling kind of down you are going to feel down about everything that you do. So if you walk into your math class feeling like this isn't going to be fun, it probably won't be. For the most part you can actually have fun doing it. For example, I know that when I learn something new and I figure it out, I'm like it's easy to me now. As far as studying goes I think that you should just study hard but don't cram. So, if you are learning it, study it every night and work a little bit on it each day. If you don't understand it, ask the teacher questions but don't cram the day before the test because then you'll just forget it all. Then you'll be nervous going into the test, and you'll come to a complete blank of everything that you learned in class and you'll just be mad at yourself (Student Interview 5/13/10).

The Teacher's Perception of Maria

According to Maria's teacher, "She is a student with a high mathematical ability and confidence level who works hard to master the mathematical concepts in Algebra II." Unfortunately at the time of the interview, Maria's teacher had observed a change in her behavior. He had this to say, "She is failing and from the first three quarters to this quarter, she has completely shut down and changed. She has quit working, and her mindset is completely different." Also, he noted that "She often gets angry and frustrated in the mathematics classroom, and these emotions occasionally hinder her from

working.” When questioned about her completion of assignments, he stated that “Any of her Algebra II assignment given in the first three quarters were handed in on time and complete.” At the time of the interview, he stated that “She has failed to hand in any assignments for fourth quarter.” He added that “She is a very confident test taker, but has refused to take any test for fourth quarter.” He reflected that as part of the curriculum, Maria is required to do mathematics on the computer twice a week using a computer program called Cognitive Tutor. He stated that, “She prefers not to do the computer work and complains about it excessively.”

According to Maria’s teacher, he has high expectations for all of his Algebra II students. In describing the expectations for his students he included the following: students are expected to work hard daily; students are expected to have a willingness to learn; and students are expected to continuously work on expanding their mathematical content knowledge. In response to if Maria has met his expectations as an Algebra II student, he explicitly stated the following:

The first three quarters she performed well. She was hands on. She had it. She participated. She answered questions every day. She worked hard. She wanted that A, and she just could do it. She didn’t have to ask, ‘Do I have an A?’, because she knew that she had an A. She did everything well. This last quarter, she really does not care. There is not a deadline that she meets. I mean, she doesn’t turn anything in, and she is just failing. But again, that’s a whole personality thing too. It’s a different Maria and there is something there that is bothering her and she has not shared that with me. So this quarter no, but the first three quarters, man she was good.

He also noted that, “Her attendance in the fourth quarter had dropped drastically.” Once again, Maria’s teacher offered little understanding of the underlying causes of Maria’s low performance.

In relation to her peers, he noted that throughout the year she has frequently taken offense to students who are disruptive in the mathematics classroom and has tried several times to correct the students' behaviors. He reported that, "She thrives in a calmer learning environment." He commented that overall her peers like her. He stated, "She surrounds herself by female students that work hard and want to be successful in Algebra II." He commented that this quarter, her friends have continued to work and persist, but she just sits and observes. In his opinion, "Maria does not prefer to work collaboratively." He went on to say that she would much rather work on her own. He stated that if asked to work collaboratively, "She will participate and lead her group but she prefers individual learning." He stated, "She wants to do it on her own. She wants to go at her pace, and she can just tune everybody else out." He felt that based on her first three quarters of work, he was confident that she had the ability to pursue a mathematical related career at the university level. But, at the time of the interview he felt that this feat was questionable.

Lynn

"I am confident in my math abilities because I know if I apply myself like I should, then I'll do good. Math isn't really hard, if someone explains it to you" (Mathematics Autobiography).

The sixth research participant, Lynn, was a junior enrolled in the low-level remedial Algebra II course at the research site. She was also a member of the Health Technology program. During Lynn's sophomore year of high school she had been academically unsuccessful in mathematics receiving a C or lower cumulative average in Geometry. At the time of the interview, Lynn was enrolled in her last mathematics

course required for graduation and expressed no desire to take a mathematics course her senior year. Lynn planned to attend college after graduating in 2011, and aspired to become a pediatrician. While discussing future aspirations, Lynn conveyed the belief that only basic mathematics would be needed for her professional goal of becoming a pediatrician. Furthermore, she expressed no interest in taking higher level mathematics courses in the near future.

Lynn's first memories of learning mathematics were "multiplying numbers in elementary school" (Mathematics Autobiography). When the concept of multiplication was first introduced to Lynn, she reported that she had no confidence in her ability to do the multiplication. As she practiced more with the multiplication she experienced success, and this success "drew her towards mathematics" (Mathematics Autobiography). Unfortunately, Lynn was drawn away from mathematics when she experienced "failure with the concept of division" (Mathematics Autobiography). According to Lynn, by ninth grade she "hated mathematics" because of the level of difficulty of the mathematics at that point (Mathematics Autobiography). Although Lynn had grown to hate mathematics over the years, she expressed support related to her mathematics teachers and talked positively about how they assisted in making her mathematical journey a more pleasant one. Lynn made the following comment about her mathematics teachers:

All of my math teachers I have ever had have the most influence on my achievement in math. They really all helped me understand math, which is good, because I don't only use math in class, but also when I'm at the store or helping my little brother with homework (Mathematics Autobiography).

Lynn stated that she does not like when the mathematics teachers do all of the work for the students. She likes to explore the mathematical concepts on her own versus being

given the answer. Lynn did not see Algebra II as challenging. Moreover, she expressed that Health Technology was her most successful subject because she is interested in it.

In Lynn's opinion, a successful mathematics student is "One who puts effort into their work, applies themselves, wants to actually learn the mathematics, studies outside of the classroom, and is willing to learn new things" (Mathematics Autobiography). In response to why students fail in the mathematics classroom, Lynn gave the following reasons: nobody takes their time to explain it to them, no help from the teacher because the teacher is helping other students, and they don't ask for help. In response to advice for future students, Lynn had the following to say:

If you don't know how to do something, you should not give up. I kind of did that before and that didn't help me out at all. It just made me have to do more work. I thought that if I didn't do it, it was going to be cool. It made my grade drop, and I had to stay after school so many days just to get my grade back up. So, just keep on going, don't even stop (Student Interview 5/25/10).

The Teacher's Perception of Lynn

According to Lynn's teacher, "She is a pleasant student who wants to be successful and understand the mathematical concepts presented in Algebra II." He also stated that she: has potential, has a great personality, wants a high grade, attempts every problem, is studious, and is willing to work with and gets along well with others. He talked about how sometimes she has a strong work ethic and other times she socializes excessively. He noted that like Monica, Lynn is in the wrong mathematics class based on her skill level and should therefore be in a lower level mathematics class (e.g., Pre-Algebra). He commented that Lynn has unfortunately been bumped through the system and as a result of her skill level she is not a self-regulated learner. Frequently, Lynn's teacher stated that she has been encouraged by him to come in before or after school for

extra help sessions, but she has not taken him up on that offer. As a result, he has oftentimes felt “powerless in meeting her individual learning needs.” He remarked, “She needs time with an instructor or someone who knows their math, to teach it to her. She doesn’t get that on a personal level where she needs it.” Additionally, he commented that in order for Lynn to fulfill her career aspirations, extra help in the future will be needed.

When asked about Lynn’s deficiencies, he stated the following:

We definitely need to work on: positives and negatives without calculators and multiplication tables without calculators. You know, three minus seven. That is hard for her, as is for many students because they have just been given calculators and they don’t remember that type of material, so how can they combine like terms when you put an x in there when they don’t understand variables. So I would put her in a Pre-Algebra setting, and definitely work on fraction sense, number sense, and that type of thing.

Because of her mathematics placement, Lynn is very teacher dependent, gives up easily because of feeling hopeless, is easily distracted, and socializes excessively when the teacher cannot answer her questions quickly. He stated that, “Lynn doesn’t want her peers to know that she is deficient in mathematics.” He confirmed that, “When she understands the material being taught, she has a strong work ethic.” He acknowledged that, unfortunately, “Lynn does not have the ability to problem solve on her own in Algebra II and gets her work done more efficiently with his one-on-one assistance.” For example, when asked if Lynn could complete long, challenging mathematics problems, Lynn’s teacher explicitly stated the following:

Well, again it depends on at what level that math problem is. If it is at an Algebra II level, she can’t do it because she is not at an Algebra II level mathematically even though she has the credits. If it is at a level where she is at mathematically, she can: read through the problem, she can think about it, she can do an attempt, and she can write something down that has meaning. First, she has to: comprehend what she is reading, understand what math concepts she needs to know to solve it, and be able to critically think in that manner. In Algebra II, when you don’t know your Algebra I and you don’t know Pre-Algebra, it is hard

to even get to the first step of understanding what you are reading in the word problems.

He went on to say that, “Lynn also lacks confidence in mathematics and that it’s really hard to get her grade above a D or C because she frequently needs one-on-one attention.” Interestingly he stated that, “Although Lynn would love to have an A or B in Algebra II, she is satisfied with a grade of D.”

When asked about her interaction with peers, her mathematics teacher commented as follows:

She gets along very well with everybody. In fact, she is one of the better personalities in the class, if you were to rank them. She has a couple of really good friends that work together as much as they are allowed. She is very pleasant at all times; never upset; never angry; willing to work. I would say the biggest negative is that she has poor attendance and at times she just doesn’t come to school. Not sure why that is. But, when she is here, she is willing to try, and she is willing to sit with her friends and help them. Again, her confidence level is not always there.

When asked about how she prefers for the mathematics to be taught, her teacher acknowledged that Lynn enjoys whole-class instruction. He shared that Lynn follows along and takes notes but she will not participate in the classroom discussions unless she really knows what she is talking about. Specifically, he stated, “She has to make sure she knows what she is saying so that she can rehearse it first, because she has no confidence in it. If she knows what she is saying, she wants to do it”. Lynn’s mathematics teacher recommended her for a low-level remedial mathematics class for the 2010-2011 school year. He made the following comment:

I would not have her take Pre-Calculus at all. I mean, when you have trouble solving basic equations, understanding what a variable is, and how to set up an equation for a word problem; the critical thinking that comes with Pre-Calculus just would not make sense.

Lois

“Math is important for Culinary, so I guess to me it would be important to know as much math as I can” (Student Interview 5/24/10).

The seventh research participant, Lois, was also a junior enrolled in the low-level remedial level Algebra II class at the research site and a member of the Culinary Arts program. Like Lynn, Lois also received a C or lower cumulative average in Geometry during the 2009-2010 school year. Even though Lois was enrolled in her last required mathematics course for graduation, she expressed a desire to take a mathematics course her senior year. After graduating from high school in 2011, Lois shared that she had an educational goal of attending college, but she was unsure about her major. She did express a desire to take more advanced level mathematics courses in college, and stated that she is prepared to get assistance from professors if she finds herself struggling with the content.

When reflecting on her K-11 schooling experience, Lois recalled that her first memories of learning mathematics were “memorizing multiplication facts in either first or second grade” (Mathematics Autobiography). Memorizing these facts presented a challenge for Lois. She also recalled learning the Pythagorean Theorem in the seventh grade. Lois communicated that some things drew her towards mathematics, and others pushed her away from it. In this regard, some mathematical concepts like the Pythagorean Theorem and graphing functions drew Lois towards mathematics. Division and multiplication pushed Lois away from it. Lois admitted that she still often struggles with the multiplication and division of numbers. In evaluating her academic performance, Lois was quick to describe herself as a weak mathematics student. Lois did

not have a strong belief in her mathematical capabilities, indicating her poor self-concept about mathematics. She acknowledged that in high school the “mathematics became increasingly hard” and that she “struggled in Geometry” (Mathematics Autobiography). Even though Lois had a poor self-concept, she did not let it interfere with her pursuit of mathematical goals like taking a higher level mathematics course her senior year. Lois felt successful as a mathematics student when she was sitting in the front row, paying careful attention to the teacher, as the teacher presented the lesson. Lois felt that she has the greatest influence on her education but most of her mathematics teachers have supported and inspired her throughout her educational journey. Throughout her interview Lois talked about the necessity of having a supportive mathematics teacher and shared feelings about positive relationships and communication with her mathematics teachers. Lois offered that her most successful subject was English, because the English teacher often relates what she is teaching to real life situations.

Lois believes that a successful mathematics student is one who “gets all A’s in mathematics, studies, and can tutor other students” (Mathematics Autobiography). In response to reasons why students fail in the mathematics classroom, Lois gave the following reasons: they don’t pay attention, they don’t understand the mathematical concepts, and they give up on the learning. In response to why students succeed in mathematics, Lois gave the following reasons: they like the teacher, they are forced to do it, and they study a lot. When asked to give advice to future students, Lois responded:

Try your best. No matter what people tell you, just try your best. Really, that’s all that you can do is try your best and study. Sit in the front row closer to the teacher. Try to become friendly with the teacher, because you might need some help with some stuff, and if you are mean and stuff they probably won’t want to help you. So, that will help too (Student Interview 5/24/10).

Lois expressed that she positively impacts her own mathematics performance by doing the following: sitting in the front row, and paying attention to everything that her teacher does. However, she did comment that she never studies for mathematics because she does not know how.

The Teacher's Perception of Lois

Lois's mathematics teacher perceived her as "An intelligent student with a strong conceptual understanding of Algebra II." For example, he noted that she understands the basic algebraic concepts including: variables, substitution, graphing, and interpreting graphs. He added that when she decides to work, she gets through the material "fairly quickly." In relation to Lois's weaknesses, he listed the following: her classroom behavior is disruptive to the educational process, she is disorganized, and she has poor attendance. He also stated that, "Sometimes she comes in and she doesn't want to do anything. She just wants to play, and in that sense, it brings her grade down." He went on to say, "When she really gets her mind together she can really perform on a really good level." When asked about his expectations for a successful mathematics student and if Lois met them, he commented:

I like for my students to work really hard, and she wants to be a clown sometimes. She's not there. I have expectations that you are there, and you work in a professional manner. You try your best, and she doesn't necessarily do that. On behavior, no. On mathematics, she can at times. On some days, she is an excellent student and participates like a role model student would. She does very well; says yes sir and no sir. She just participates and answers all of the questions. The other days, she'll just come in and she wants nothing to do with me. She wants nothing to do with math. She either wants to just goof off and yell across the room to her friends, or maybe she is angry and if someone says something the wrong way she wants to go off or she just wants to be left alone. So it's a hit or miss. On the days that she comes in and she's on, she could lead the whole class. When asked to participate, she answers all of the questions and goes to the board to complete example problems. She'll also model what I do, and get the class to answer questions. She has a good personality when she is

participating and she is smiling and happy. If she is on, she can do that. On the other days, there is just no way.

When asked about how Lois is perceived by her peers, Lois's teacher reflected:

She is perceived as a student that is obviously one of the normal. Not the exceptional or the exception or anything like that. She gets along with everybody unless she is in one of her moods. She is a clown a lot of times and she likes that. She is funny when she is working. Everybody gets along with her except when she is in those moods.

Lois's teacher shared that she has the potential to be successful in a mathematics related career at the university level if she increases her focus and improves her attendance.

Although Lois's teacher spoke highly of her mathematical potential, he recommended that she be placed in a low-level remedial mathematics course for the 2010-2011 school year.

Research Question 1

When examining the research question "What factors do African American female high school students attribute to their performance in mathematics," an analysis of the data revealed common themes in relation to psychological, environmental, and socio-culture factors including: (a) self-efficacy, (b) mathematics teachers, (c) mathematics teachers' expectations, (d) mathematics usefulness, (e) peers and mathematics, (f) parental expectations, (g) parental involvement and (h) parental attitudes about mathematics.

Self-Efficacy

The first theme that emerged in relation to the factors that African American female high school students attribute to their performance in mathematics was self-efficacy. The majority of the research participants shared that they were confident in their ability to learn mathematics. Interestingly, Suzie was the only research participant

that shared that sometimes she is confident in her ability to learn mathematics and other times she is not. She rated her confidence in her ability to learn mathematics a five on a scale of one to ten, with ten being really confident. But, in her mathematics autobiography she wrote, "I am confident in my mathematics skills because I take notes, listen carefully, and pay attention. When I have a problem, I ask my teacher about it, so I can understand it better" (Mathematics Autobiography). As shown by the research of Stevens et al. (2004), high self-efficacy is linked to improved mathematical performance. When asked to respond to the question, "Do you usually think that you can learn the math even if the math is difficult," all seven of the research participants answered "yes". Also, when asked, "Are you confident in your mathematics ability," six of the seven participants responded "yes", while one of the research participants had no response to the research question. One research participant, Maria, stated the following about her perception of her mathematics ability, "I was just always good at it. It made sense to me" (Student Interview 5/13/10). This finding is consistent with researchers that find that students tend to often report high self-efficacy (Chen, 2003; Pajares & Kranzler, 1995) but inconsistent with prior research that reports that minorities (Stevens et al, 2004) and females (Bandalos, Yates, & Thorndike-Christ, 1995; Stipek & Gralinski, 1991) often have a low perception of their mathematical abilities. It is interesting to note that, despite the majority of the research participants reporting a high perception of their mathematical ability, they displayed characteristics of students with low self-efficacy including: giving up easily when faced with challenging tasks, exerting less effort on challenging tasks, the avoidance of taking future higher level mathematics courses, and experiencing anxiety (Bandalos, Yates, Thorndike-Christ, 1995). The research participants' responses to these

questions shows that there is a disconnect between what students perceive to be their ability in effectively doing and learning mathematics and their actual performance and in some cases the teachers perception of their actual performance. This study fails to examine the reasons surrounding these inconsistencies and the implications of such a disconnect.

Teacher Behaviors and Characteristics

The next theme that emerged from the data in relation to factors that African American high school students attribute to their performance was mathematics teachers. In analyzing the interviews of the research participants in relation to past and present mathematics teachers, it was clear that the research participants believe that having a good mathematics teacher is vital to their mathematics performance. All seven of the research participants responded to interview questions with overall positive perceptions of their past and present mathematics teachers. For example, as the participants discussed influential individuals who have served as a source of positive encouragement throughout their mathematics education, four of the seven reported that it was their past and present mathematics teachers. In discussing her present mathematics teacher Suzie stated, “He tries to help me and everything so it’s like he doesn’t like discourage me or anything he encourages me to do better, so it makes me feel better about myself” (Student Interview 5/21/10). Furthermore, a little over half of the participants (four of seven) responded that their past and present mathematics teachers have also served as sources of inspiration for them to improve their mathematics performance. Additionally, as the participants discussed their grades in mathematics, two of the seven research participants felt that their mathematics teacher positively contributed to their grade outcomes. In

discussing her past and present mathematics teachers Suzie commented, “They really helped me out a lot and my grades; they got my grades up in the math class, too’ (Student Interview 5/14/10).

In response to describing a good mathematics teacher, comments from the research participants expressed a wide range of additional themes in relation to teacher behaviors and characteristics including: provides one-on-one instruction (six of seven participants), explains the mathematics material in detail (four of seven participants) , provides positive encouragement (three of seven participants), provides extra help outside of classroom time (three of seven participants), has a good conceptual understanding of the mathematics (two of seven participants), is skilled at presenting the mathematics material (two of seven participants), teaches to different learning styles (two of seven participants), has a positive attitude/teacher disposition (two of seven participants), is a good classroom manager (one of seven participants), enjoys teaching mathematics (one of seven participants), and is confident (one of seven participants). Through responses to interview questions the research participants were able to identify specific teacher behaviors and characteristics that they perceived met their individual needs. For example, Monica offered the following description of a good mathematics teacher:

A good mathematics teacher is someone who encourages their students and they teach really well, meaning like they break the work down where everyone can understand it and try different approaches of teaching. You can’t just always teach at the board. There should be different ways because students learn differently. They make sure that they get around to all of their students because I always hear that a lot of teachers don’t get around to the students, so they don’t understand it (Student Interview 5/18/10).

Likewise, Lynn made the following comments in relation to a good mathematics teacher:

Takes time out with each of their students and answers all of their questions. They don’t pass them up if a student doesn’t know how to do something, and just

brush them off. They actually want to help them or figure something out to help them. They stay after school and take time out of their own day to help students. They explain each lesson that they go through. They don't rush through it. They explain it to the whole class. They make sure that everybody gets it and not just a couple of people (Student Interview 5/25/10).

Another participant, Stacey, talked about her perception of the behaviors and characteristics of a good mathematics teacher:

A good mathematics teacher is a teacher that can make everyone understand in a way that everybody gets it. They can make it easy, but not so easy to where everybody is like goodness, gracious. They can still make it challenging but not too challenging that nobody understands it (Student Interview 5/20/10).

Like Stacey, Maria, also articulated the following about her perception of a good mathematics teacher:

A good mathematics teacher is someone that is positive when they walk into the classroom and happy, but not overly happy to where they are irritating their students. Just happy enough to make everybody in the room feel like we are going to have fun in here. That we're going to have a good year and start it all off right and keep that attitude up constantly throughout and just be that type of person that someone can come to if they need something even if they just like need help. Don't constantly be like, I can't stay after school; not if it's important, but just because you want to get home. If they really have something that they really need to understand, they go into detail about the material. If they see one person that is lost, they'll ask the person if they are lost and if the person says yes, they'll go up to them and try to help them understand it, and see if another student understands, and they can explain it to them (Student Interview 5/13/10).

Also, Lois described her perception of a good mathematics teacher:

A teacher that wants to help and that would really want to see their students succeed and that's not really in it just for the money. They're really into it because they like to help kids and they like to teach math. So, a teacher that really knows what they are doing, too. All of my mathematics teachers have been real, real, real good at teaching. I don't think I've ever had a bad mathematics teacher (Student Interview 5/24/10).

One research participant, Suzie, talked about a "bad" mathematics teacher who she had her sophomore year of high school. It was evident from her comments that she felt this particular teacher lacked a strong conceptual understanding of the mathematics content.

She stated, “He didn’t know what he was doing in the math class, so he couldn’t teach the subject that we were on. It made it really hard (Student Interview 5/14/10). It is reasonable to conclude from her response, that having a teacher with a good conceptual understanding of the mathematics contributes positively to her mathematics performance.

Throughout the interviews, the research participants repeatedly mentioned the need for one-on-one teacher instruction and in-depth teacher explanations of the mathematics content in the mathematics classroom and how having these contributes to their mathematical performance. There were clear perceptions that the teacher’s role was one of information provider versus a facilitator of learning. Furthermore, when the research participants were asked to describe their ideal mathematics classroom, the interviews showed that they had a clear preference for teacher-centered approaches to instruction. Overwhelmingly, the data revealed that the research participants preferred and were comfortable with traditional, lectured-based pedagogical practices where the teacher is merely transmitting his/her knowledge of the mathematical material to the student and giving explicit directions to assignments. While describing their ideal mathematics classrooms, five of the seven research participants shared that they prefer being taught by the teacher delivering the content via teacher lectures. For example, Suzie shared what her teacher would be doing in her “perfect mathematics class,” It would be like a one on one class where he could explain everything to me and break it down, and if I needed help, he wouldn’t be distracted by other students” (Student Interview 5/14/10). Also, Monica commented about what the teacher would be doing in her ideal mathematics classroom. She posed, “We would have an overhead and he would break down the problem. You would have a teacher going through the problem breaking

everything down” (Student Interview 5/11/10). Like Monica, Stacey further summarized what the teacher in her ideal mathematics classroom would be doing:

The teacher would have everybody’s attention and they would explain each equation and what it is used for, and they would write the equation on the board and give an example of what the problem would look like or what the wording would be on the test. The wording is not always the same as what they say it is. The point-slope formula equals, you can write something right next to it that will help the students a little bit better during test time and they will look like ok, that’s where that goes and that’s what I’m going to use this for (Student Interview 5/14/10).

Additionally, Lois provided an example of the teacher behaviors in her ideal mathematics classroom. She stated that the teacher would, “teach it to where everybody understands. If somebody doesn’t get it then they will still try to help that person, and give us books so we can actually read it, take it home, and go over it “ (Student Interview 5/17/10).

Similarly, Samantha asserted that in her ideal mathematics classroom, the following would be taking place:

A teacher just teaching it and showing different ways, maybe like the long way to do it and then like a shorter way to do it. I could learn better like that, because I need to know all the steps on how to do it from the very last bit like when I first learn something new unless, I won’t grasp it as much as I should (Student Interview 5/19/10).

Based on the participants’ responses, it is reasonable to assume that they did not see mathematics learning as a constructive process requiring cognitive engagement. As mentioned earlier in this chapter, it is believed that this overwhelming focus on one-on-one instruction and in-depth teacher explanations has the potential to hinder the deep thought processing, and knowledge construction of the research participants. The research participants in this study provide evidence that they are teacher dependent and that they express a lack of motivation to engage in active inquiry, critical thinking, and the self-direction of their own learning. This finding corroborated the research findings

of Stodolsky, Salk, and Glaessner (1991) who found that students become dependent on the teacher and believe that they cannot be successful in mathematics without teacher assistance. According to one research participant, Samantha:

It all falls back on just them willing to help me out because if it's something hard and I don't get the help that I need then I'm probably not going to want to do it after a while because I'm going to get so frustrated with it (Student Interview 5/19/10).

Even though the majority of the research participants preferred traditional instructional practices where the teacher is the primary provider of information, recent research shows that these practices are not in line with the most effective ways of learning and therefore do not serve their best interest or foster student ownership of the mathematics learning (Bransford, 2000; Brewer & Daane, 2002; Inch, 2002; Huhn, Huhn, & Lamb, 2006; NCTM, 2000). Research has also found that African American students' mathematics performance improves when constructivist teaching methods are used for classroom instruction (Boaler & Staples, 2008). However, the preferred pedagogical strategies identified by the research participants centered on identifying the correct mathematical formulas and applying them quickly, memorizing facts and procedures, and internalizing rules. This finding is in line with the research of Berry (2003). The research participants' preferred classroom environments did not provide opportunities for cognitive engagement which requires higher level thinking or problem solving, even though problem solving is vital in the study of mathematics and in life. A constructivist learning environment in mathematics education enhances problem solving and independent thinking and gives students the opportunity to communicate and demonstrate what they know. Therefore, this preferred pedagogy has the potential to fail to prepare these students for future mathematics coursework requiring rigorous thought and

extensive problem solving putting them at a disadvantage. When the research participants were asked what the students would be doing in their ideal mathematics classrooms they gave the following wide range of responses: (a) working on problems (three of seven participants), (b) behaving (three of seven participants), (c) paying attention (one of seven participants), (d) asking for help (one of seven participants), (e) actively participating in the class (one of seven participants), and (f) keeping up with the pace of the class (one of seven). Samantha stated that the students in her ideal mathematics classroom would be “paying attention and taking notes and being quiet unless the teacher is telling them that they want you to do this problem with them on the board or something” (Student Interview 5/12/10). None of the research participants responded that students in their ideal mathematics classrooms would be developing, demonstrating or reflecting on their own mathematical understandings. Additionally, when asked about the resources and materials that the research participants would prefer to be used in their ideal mathematics classrooms, they stated: robots, overhead projectors, calculators, rulers, Whiteboards, paper, pencils, and textbooks.

Teacher Expectations

The next theme that emerged was the research participants’ perceptions of teacher expectations. Research has shown a relationship between teacher expectations and the mathematics performance of African American students and the importance of positive teacher expectations to this population of students (Tyler & Boelter, 2008). When the research participants discussed their perceptions of their teachers’ beliefs and expectations, it was apparent through the interviews and guided questions that most of the participants perceived that their mathematics’ teachers really believed that they could

learn and do mathematics. Moreover, they perceived that their teachers consistently held high expectations for their mathematics performance and reinforced these expectations throughout the course of a school year. For example, when the research participants were asked “Do you think that your mathematics teacher believes you can do the mathematics,” six of the seven research participants responded “yes”. The only research participant that had no response belonged to the successful mathematics student group. Additionally, the majority of the research participants (six of seven) consistently talked about how their mathematics teachers generally held high expectations for their academic performance. Only one of the middle performing mathematics students answered no to this question. When the research participants were asked about their teachers’ expectations for their mathematics performance, the responses included: to do my work (three of seven participants), to do well (two of seven participants), to try (one of seven participants), to ask for help (one of seven participants), to do my best (one of seven participants), to ask questions (one of seven participants), to keep being a good student (one of seven participants), to do well on assessments (one of seven participants), and to go above and beyond that which they are capable (one of seven participants). For example, Suzie shared her teacher’s expectations for her performance. She remarked:

He expects me to do well in the class. I have a loud classroom environment in math and he doesn’t put me in that group that doesn’t do their work. He expects me to do my work, or at least try to get it (Student Interview 5/21/10).

In addition, Monica mentioned what her teacher expects of her. She reflected, “To do my work and to ask for help if I don’t get it, but mainly to do all of my work because they have to grade it” (Student Interview 5/18/10). Further, Stacey reported the following:

My math teacher expects me to do my best and I can tell that he expects me to do my best, even though I don’t always do my best he expects me to and I appreciate

that. I appreciate when people know that I am not doing my best and they keep saying come on you can do your best; you can do better than this (Student Interview 5/20/10).

Also, Lois made the following comment when asked about her teacher's expectations of her, "Nothing but good. Just to succeed in math and get a good grade. That would be it, really" (Student Interview 5/24/10). Lastly in this regard, Maria provided the following information pertaining to her teacher's expectations:

Finish the work on time and hand it in when it needs to be turned in; all of the work and not just half of it. My teacher expects me to ask questions. My teacher expects me to go over and beyond to understand it, and then do very well on the test (Student Interview 5/13/10).

Based on the interview responses, there was no mention from any student that their teachers held high academic expectations for their mathematics performance in relation to: gaining a good conceptual understanding of the mathematics, constructing their own knowledge, implementing problem solving strategies, applying the learned mathematics, and mastering the course content.

When the research participants were asked if their teachers' expectations affected their actual achievement in the mathematics classroom, the majority of the research participants (five of seven) felt that it affected their achievement in a positive way. For example, Suzie shared her perspective regarding her teacher's expectations and the effect on her achievement. She reported, "It makes me think that if they think that I can do it, then I can" (Student Interview 5/21/10). Stacey supported Suzie's response by commenting:

I believe that if a teacher expects me to do really good and they show me that they want me to do really good, I would probably pay attention. I would probably get A's. If a teacher doesn't pay attention to the student, that won't go well. That's how students start failing in my opinion. If a teacher is not paying attention, neither will a student (Student Interview 5/20/10).

As previously mentioned a middle performing student, Maria, stated that her teacher's expectations do not affect her performance at all and one successful student, Samantha, stated that her teacher's expectations do indeed affect her performance but did not comment whether it was in a positive or negative way. The responses of the research participations regarding teacher expectations stressed the importance of positive and high teacher expectations. Teacher expectations, as identified by the research participants, were essential in positively impacting the motivation, achievement, and self-efficacy of the research participants.

When the research participants were asked if their mathematics teachers hold different expectations for different students five of the seven research participants felt that they did. For two of the three successful students that was not the case. Teacher expectations for different students as identified by the research participants included teachers hold different expectations for the students: that work hard (two of seven), who are well behaved (one of seven), and that do well (one of seven). The research participants also mentioned that teacher expectations are unique to the individual student (one of seven), and depend on the relationship the teacher has with the student (one of seven).

The perceptions of the research participants regarding whether their teachers held different expectations for different students based on race and gender were consistent. The majority of research participants felt that their teacher expectations' for different students were independent of race and gender. Only one of the seven research participants, Maria, felt that her teacher held higher expectations for female students versus male students.

Mathematics Usefulness

The next theme that emerged in relation to factors that African American female high school students attribute to their mathematics performance was mathematics usefulness. Responses from the research participants indicated that the participants' attitudes toward and their perceptions of the usefulness of mathematics influenced their mathematics performance. Specifically, most of the participants that perceived mathematics as useful or relevant to their career fields in some way were interested in learning the mathematics and were motivated to persevere. Interview data were examined in relation to mathematics usefulness and the research participants seemed to hold mixed belief systems. Given that the interviews were conducted at a career and technical high school the following programs of study were represented among the seven research participants: Cosmetology, Health Technology, Early Childhood Education, and Culinary Arts. Six of the seven research participants talked about the connections of mathematics to their career and technical programs. Some of these participants believed that mathematics contributed only minimally to their programs, while others believed that mathematics played a significant role in their career fields. Maria expressed a narrow perception of mathematics in relation to her Health Technology career program:

So far, we haven't really done much like mathematically. I think the most we've done is emptying a urinary drainage bag and adding up the cc's, or like adding up the food intake. So, it's pretty simple math in my field of study (Student Interview 5/6/10).

In addition to Maria's comments, Lynn made the following statement when asked about the connected usefulness of mathematics in her health program, "We measure volume and we do simple stuff like pulse multiplying by two and respiration multiplying by two. Everything is by two and it's like so easy" (Student Interview 5/25/10). Lynn failed to

see mathematics as a useful tool in the health field. Samantha echoed the same sentiment in relation to seeing the connected usefulness of higher level mathematics in her Early Childhood Education program. She responded, “When I was out on field experience, I helped adults with special needs with counting money and rounding numbers, and stuff like that. So, I kind of did math” (Student Interview 5/19/10). On the other hand, some research participants talked about the significant contribution of mathematics to their programs. For example, Lois commented about her Culinary Arts program, “We have to flip stuff and convert stuff to other things. Math is really all that we do; food math” (Student Interview 5/24/10). Similarly, Monica indicated, “My field is Early Childhood Education (ECE), so I would have to use a lot of what I learned to teach the kids as far as adding, subtracting, multiplying fractions, and stuff” (Student Interview 5/13/10). In contrast, one of the successful research participants, Suzie, reported that mathematics was not used in her program, but went on to say that her program incorporated a lot of chemistry. Interestingly, while writing her mathematics autobiography, Suzie recognized the critical relevant connections between chemistry and mathematics even though she failed to mention this connection in her interview. She stated that, “Mathematics comes in handy in my chemistry class. Math and chemistry are sometimes the same because they both use math equations and math logic” (Mathematics Autobiography). Surprisingly, none of the research participants mentioned doing any mathematics specifically related to their career fields in their actual mathematics classroom.

Disturbingly, the participants’ responses indicated that mathematics teachers are failing to communicate fully what mathematics is and the purpose associated with studying mathematical concepts. As a result, students are failing to make the connections

between mathematics and its usefulness outside of the mathematics classroom. All seven of the research participants had a narrow view of the usefulness of mathematics. For example, Stacey expressed, “The only things I’d use math for is to manage money, and to teach simple topics in Kindergarten” (Mathematics Autobiography). The research participants offered little understanding of mathematics as a powerful science that equips them with useful tools to understand their world and future occupations. Unfortunately, they only saw mathematics as procedure based computations that lead to one right answer versus thinking about mathematics as logic, thinking, and problem solving. They failed to see their classroom environments as safe places to explore the mathematics and to make mistakes without being ridiculed. Rather, they saw their classroom as environments of increased pressure to be correct.

Six of the seven research participants perceived that mathematics would be useful once they graduate from high school. Some of the participants believed that mathematics would be useful in their future career fields, while others felt that it would only be useful upon attending college. Suzie, a Cosmetology program participant, talked about the importance and utility of mathematics to the career aspiration of owning a hair salon. She commented:

If I go into business for myself, it would be really useful; and that’s what I was thinking about doing. I was thinking about owning my own salon, so this math will apply to what I do in my career. I would use the math for finances and when I go to pay bills, and when I have loans and everything like that (Student Interview 5/21/10).

In regard to mathematics usefulness, Samantha could not see the connected usefulness of mathematics either outside of the classroom or after high school graduation as it related

to anything else but college and careers. She shared her thoughts about using mathematics:

Only because I'm going to college. I don't really see how I can use like sine, cosine, logarithms, and stuff like that out in the real world unless I'm working or in college. Basically, just because I'm going to college I might need to know that stuff to excel (Student Interview 5/19/10).

Also, Maria made the following comment about the usefulness of mathematics after high school:

Well, it depends because like some of the simple math is useful but then some of the more complicated math isn't. Depending on what field you are going into. I can understand if you are a rocket scientist you're going to need a lot of math so I'm going to be taking Pre-Calculus next year, but I might not ever use it. A lot of people don't, and some people realize that early on and slack during school and some people don't. I might not ever use a lot of science but science goes into everything I do and math goes into everything I do. If the engineer behind my car didn't use the right math, my car might just break down while I'm out. So it's going to be used around me, but whether or not I will personally need it might be a no (Student Interview 5/6/10).

An analysis of the data revealed that those research participants who strongly connected the usefulness of mathematics to their career and technical programs expressed a desire to take more mathematics classes in the future. Even though it would seem that seeing mathematics as relevant and useful has a positive impact on mathematics performance, much more work is needed exploring this correlation before we can come to this conclusion. Only one of the seven participants, Lois who is a low performing student, failed to mention the usefulness of mathematics after high school. The research participants' statements point to the overwhelming need for more connections in the mathematics classroom to various career fields and to real life. Connecting the

mathematics to career fields in a career and technical setting can potentially have a positive effect upon mathematical outcomes.

After examining interview data, the most cited response for the use of mathematics in the “real-world” was shopping (three of the seven participants) and money (three of the seven participants). Both shopping and money were meaningful mathematics applications to the participants’ everyday lives. In relation to money, Stacey shared the following thoughts:

Yes, I do see people doing math in the real world. If you are at a bank and you have to cash your check, it’s all about money too and money is everywhere in life and you use it daily. You have to make sure that you understand how much you have. Money is a big thing in the world that people use so of course. it’s going to be all about math there and how much you have and if you give this away, how much will you have left and multiplying by every two weeks that you are going to be able to get paid from your job. I see that all of the time, especially since I just started a job, I have to figure out that now I’m getting paid minimum wage plus tips multiply by how many tips I get and how many days I’m working and how many tips I’m going to get per day or my minimum wage every two weeks, times that by the months see how much I can make by the end of the year. Math is everywhere just because of everybody trying to use money (Student Interview 5/14/10).

Similarly, Maria made the following comment about money and mathematics:

Money management; Adding up my bills; To pay bills; Adding up what I get from work for two weeks, before I get paid; Adding up what I need from the grocery store; Just a lot of money (Student Interview 5/6/10).

The research participants provided other diverse responses in relation to using mathematics in real world scenarios including: cutting cakes at birthday parties, problem solving, time management, traveling in a car, working a cash register, bills, taxes, and calculating gas mileage.

Additionally, the participants were asked about individuals in the real world doing mathematics. Their responses included: accountants, architects, bank tellers, cashiers,

construction workers, chemists, pediatricians, teachers, rocket scientists, weather forecasters, fashion designers, mechanics, and fast food restaurant workers. When Lynn a low achieving research participants was asked “Do you see people doing mathematics in the real world?” she responded, “No. Not really” (Student Interview 5/25/10). It is also interesting to note that, the research participants in the Health Technology career programs failed to see the significant use of mathematics by doctors and registered nurses. When Lynn was asked, “Do you think that being a pediatrician, you will need a lot of math,” she responded, “Probably not a lot, but I will probably need basic math like how to measure stuff. The basic stuff” (Student Interview 5/25/10). Also, when Maria was asked if she thinks that mathematics is used in the nursing field, she responded, “Not so much in the nursing field” (Student Interview 5/13/10). It appears that these students are not cognizant to the extensive amount of mathematics used and required for this career field.

Many of the participants realized the benefits to studying mathematics in high school. Maria discussed the following in relation to the benefit of studying mathematics, “It’s to teach us the structure and show us that we can go into a whole bunch of different job fields, and along the way give us something useful that we might use” (Student Interview 5/13/10). Moreover, Lois commented, “Math is an everyday thing. Math is everywhere, so I think that math should be pushed more than anything really. Math is everything” (Student Interview 5/24/10). Also, Monica responded:

Math is something that we all have to use at one point in time whether you like it or not. Then, depending on what you really want to do in life, you never know if that is going to contribute to what you have to do (Student Interview 5/13/10).

Also, Stacey commented:

I have a feeling that everything that I learn in math is going to be put back to use one day and it's just going to be like, hey I learned that, and hey I can use that. I know that when I have children, I'll probably use it then too because I'll have to help them you know. So I kind of feel like those tools are important, but at the same time I kind of feel like I might lose them before I need to use them (Student Interview 5/20/10).

Moreover, later in the interview she elaborated on her perceived benefits of studying mathematics:

I think that we are required to learn math first of all because it is going to occur in life, because adults know more than we do that you will use math sometime in life. Every type of math will be used again. I think that adults know that there is a deeper explanation than just math and whenever you're learning this, you are also learning about life at the same time. Also, things will occur that you are going to need to use math in; more than just mathematics situations. Problem solving, it makes you think. The word problems, you know how you have to read it over and over again. It's kind of like situations. You just have to think over and over again. Like ok, this is what happened here and this is what happened here, and how can I solve it.

Remarkably, the comment of this research participant alludes that mathematics is more than memorized, procedure based computations but it is a powerful problem solving tool used to understand the world around her. Some research participants saw no direct benefits to studying mathematics outside of the mathematics classroom. When asked about the usefulness of mathematics, Samantha responded, "I don't know besides him teaching it to us and like the work that we have to do, like the openers or the worksheets" (Student Interview 5/19/10).

Peers and Mathematics

When the participants were asked if their friends influence their learning in the mathematics classroom, three of the participants said "yes". Two of the three research participants who responded "yes" stated that their friends influence their mathematics learning in a positive way. The two participants who stated that their friends influence

their mathematics in a positive way were Stacey from the successful mathematics group and Lynn from the low performing group. For example, Stacey commented:

I don't really think about what my friends think, but like I said earlier Samantha is my main focus because she focuses hard. So, I was focusing hard. So, it was because of her that I really focused on it, because usually I don't care. But, this past year I was focusing on my math because Samantha was doing harder math. That's like the only positive influence from a friend. I don't take the negative ones (Student Interview 5/14/10).

Out of the three research participants that responded that their friends did indeed influence their mathematics learning, one participant from the low performing group expressed that her friends influence her mathematics learning in a negative way.

Specifically, Lois articulated the following:

If I'm sitting next to my friend like we've been friends for a long time, that would distract me because I use to sit next to someone in the class, and she use to distract me all the time and I never got my work done. Then, I moved to the front and now I get all of my work done" (Student Interview 5/17/10).

One of the middle performing research participants, Monica, answered "no" and "yes" in relation to her peers influence on her learning in the mathematics classroom. Later in the interview she had the following to say about her peers' negative influence on her performance, "Sometimes they are distracting when you try to focus in class, and they are all loud and doing dumb outbursts" (Student Interview 5/18/10).

The majority of the research participants (six of seven) expressed that their peers liked mathematics. For example, Maria shared the following:

I think most of them do, but you can't ever really be fully sure because everybody has their good and bad days and everybody has topics that they don't understand. So, it might seem like they don't like math but they probably do (Student Interview 5/6/10).

One research participant, Monica commented that her peers have made negative comments about mathematics. She stated that, “They are like this stuff is dumb, and I don’t get it” (Student Interview 5/11/10).

When the research participants were asked what their peers would say about them as mathematics students three of the seven research participants stated that their peers would make positive comments. For example, Stacey stated that, “My friends think that I’m smart. They think like, wow, you really get this. But sometimes, I do struggle. I struggle like anybody else” (Student Interview 5/14/10). Similarly, Lynn commented:

The people that I hang with now, they probably think that I’m smart in math because I know all of the stuff that Mr. H. has been doing, but that’s the only reason why they think I’m smart in math. I mean, I’m not stupid but...” (Student Interview 5/24/10).

One research participant, Lois, stated that her peers would have no comment about her as a mathematics student because “When I am with my friends we don’t really talk about classroom stuff because we want a break from that. So, I’m really not sure” (Student Interview 5/17/10).

Parental Expectations of Students

Another emergent theme revealed from the participant interviews as being essential to the participants’ performances in mathematics was parent/family expectations for mathematics performance and the continuation of their education after high school. The participants’ responses demonstrated that parental expectations played a vital role in participant attitude formations and goal setting and achievement in relation to mathematics. Overall, the research participants expressed that their parent/family members valued education and held high expectations for their mathematical achievement and performance. In all, a wide range of factors emerged in relation to

parent/family expectations for mathematical performance including: (a) to attend college after high school; (b) to do their best; (c) to seek help from instructors and others, (d) to maintain good grades; (e) to work hard; (f) to complete assignments; (g) to take mathematics courses in college; and (h) get a good conceptual understanding of the mathematical concepts. Six out of the seven research participants (all three successful research participants, both middle performing research participants, and one low performing participant) expressed that their parent/family members expected them to attend college after high school. Six out of the seven participants indicated that their parent/family members expected them to do their best in mathematics. These six research participants included all three successful research participants, one middle performing, and both of the low performing research participants. Additionally, four of the seven research participants expressed that their parent/family members expected them to: seek help from instructors and others when they find themselves struggling with the mathematical concepts (two successful and two middle performing students), and maintain good grades (one successful, two middle performing, and one low performing student). Also, three out of the seven participants commented that their parent/family members expected them to work hard (two successful and one middle performing student) and complete assignments (one successful student and two middle performing). Two out of the seven research participants stated that their parent/family members expected them to take mathematics courses in college (one successful and one low performing student). Also, two of the middle performing research participants expressed that her parent/family members expected her to get a good conceptual understanding of the mathematics. One successful research participant, Suzie, stated the following about

her parent/family members, “They expect me to do well in it and try my hardest, and if I need help to go and get help from someone that knows the subject well enough” (Student Interview 5/21/10).

The data revealed a continuous emphasis on maintaining good grades in mathematics. Four of the seven participants responded that their family members expected them to maintain good grades. The following quotation made by research participant Stacey acknowledges her parent/family members’ expectation of maintaining good grades in mathematics:

My family, they push me to do better. They are always like the people that are like you know that you can do better than this or this is a good grade but try to get a different grade this time you know. They help me to get those A’s and B’s that I am getting now. You have a C; try to get that to a B. You have a B, why don’t you try to make that an A (Student Interview 5/20/10).

Another middle achieving research participant, Monica, concurred with the idea of how parent/family members hold the expectations of good grades and stated the following about her parent/family members’ grade expectations, “They expect me to maintain my grades meaning like nothing below a C” (Student Interview 5/18/10). Lois pointed out the following about her parent/family members’ grade expectations, “She wants me to get all A’s” (Student Interview 5/24/10).

Only two of the research participants responded that their parent/family members expected them to get a good understanding of the mathematical concepts. Monica commented,

I guess just to be good at doing math and getting the understanding, I guess. Because it is something that you have to use so they would want me to be confident enough to do math problems and whatever, so they probably just want me to make sure I understand. Get that understanding, and what not (Student Interview 5/18/10).

Samantha also made the following comment pertaining to her parent/family members expectations of her getting an understanding of the mathematical concepts, “They want us the young generation to like pay attention and like get it because they didn’t so they want us to like excel in it. They want us to all do good in it” (Student Interview 5/19/10).

The majority of the participants (six out of seven) commented that their parent/family members expected them to attend college after high school. Stacey pointed out that her parent/family members expected her to go to college by stating,

We have been talking about college probably since high school started. Since our freshman year they were talking about, let’s see what you want to be. What kind of classes are you going to be taking in college because when students meet the first day and decide their classes in high school we went there and were like what classes will help you now? What classes will get you to where you need to be your senior year (Student Interview 5/20/10)?

Suzie concurred with the idea of parent/family members’ expectations of college for their student and stated, “They encourage me to go to college and they help me out in every way that they can” (Student Interview 5/21/10). However, one of the lower performing research participants, Lynn, stated that her parent/family members failed to talk to her about attending college after high school. Also, after reviewing the data none of the participants stated that their parent/family members expected them to pursue a mathematics related career field once enrolled in college. However, two of the research participants, a successful and low performing student, expressed that their parent/family members expected them to take mathematics courses in college.

Parental Involvement

Many of the research participants discussed their parent/family members’ involvement in their mathematics education through homework and how their involvement contributed to their performance in mathematics. Five of the seven

participants mentioned that their parent/family members play an active role in supporting their homework performance and supervising their homework completion. These research participants included all participants from the successful group and one participant from both the middle and low performing groups. Suzie indicated that her parent/family members “Always try to help me if I need help on my homework and everything. They always make sure that I get it done and everything. They play a very big role in it” (Student Interview 5/21/10). Stacey mentioned the following pertaining to her parent/family members’ assistance with the mathematical understanding of her homework:

My parents are really cool about helping if I need help. They’ll try to see, well let’s see do you have any papers that you can relate to this, to like look off of and maybe you’ll understand. Maybe it will come back to them. They’ll be like ok; I remember how to do this. You do it like this. Is this how you do it? They’ll ask me is this how you’re doing it now, because they might have done it a different way when they were in school (Student Interview 5/20/10).

One research participant, Lois, commented that her parent/family members never inquire about her homework. Moreover, she felt that even if she had homework her parent/family members lacked the skills to provide her with the necessary assistance to complete the homework at home. Lois made the following comment when asked about parent/family member assistance with homework:

I feel like I wouldn’t take it home because she wouldn’t know what she was doing because I would think that she hadn’t learned it because she said she’s been out of school for about twenty years because she graduated I don’t know how long ago. But, I would think that mathematics has grown over the time periods. So, I would think that she wouldn’t know what she was doing now (Student Interview 5/24/10).

Outside of parental involvement through homework, one of the successful research participants, Stacey, made the following general comment about her parents’

involvement in her mathematics education through positive encouragement, “They kind of just complement me and say that I’m doing a really good job, and they raise my hopes. They raise my spirit. They congratulate me and it’s really good” (Student Interview 5/20/10).

Parental Attitudes about Mathematics

The final theme that emerged in relation to factors that African American high school students attribute to their performance was parental attitudes about mathematics. Many of the research participants discussed their parent/family members’ positive and negative attitudes about mathematics. The conversations with the research participants provided evidence that parental attitudes are vital to success and persistence in mathematics. Factors that emerged in relation to positive and negative parental attitudes about mathematics included: mathematics usefulness, academic ability in mathematics, an understanding of the mathematical content, and the perception of the difficulty of the mathematical subject matter. Most of the research participants indicated that their parent/family members held positive attitudes about the usefulness of mathematics. Four of the seven participants indicated that their parent/family members’ held the belief that mathematics is useful. Of these four research participants, two were successful and two were middle performing students. For example, Stacey stated that her parent/family member made the comment that mathematics is “a key factor of what you are going to have to use” (Student Interview 5/20/10). One of the low performing research participants reported that her parent/family member had a negative attitude toward the usefulness of mathematics. Lynn acknowledged that her parent/family members did not see mathematics as useful. She stated that her mother perceived that “the stuff that we do

now is so irrelevant” (Student Interview 5/24/10). Moreover, she expressed that “My mom is a nurse too, and I don’t really see her using math.”

Continuing with positive and negative parental attitudes about mathematics, two of the seven research participants indicated that their parent/family members were good in mathematics. These two research participants belonged to the successful and middle performing groups. Two of the seven research participants were forthcoming about their parent/family members’ negative attitudes about their perceived mathematical capabilities. These participants, one successful and one middle performing, pointed out that their parent/family members just simply did not understand mathematics. Moreover, one other successful participant, Samantha, stated that her parent/family member perceived mathematics as a difficult subject to learn.

Research Question 2

When examining the research question “How do African American female high school students describe the factors that they deem important to their success in mathematics,” common themes related to both internal and external attributions emerged. In examining the internal attributions, the majority of the participants (five of seven) perceived that studying mathematics was critical to their success in mathematics. These participants included two successful participants, both of the middle performing participants, and one of the low performing participants. For example, Suzie offered the following on how to be a successful mathematics student, “Sitting down and trying to learn the material, and studying it” (Student Interview 5/14/10). Similarly, Maria commented about her success in mathematics. She said, “I always spend a little extra time and study a little bit more when I don’t understand something” (Student Interview

5/6/10). Also, five of the seven research participants expressed that asking the teacher questions was important to their success in mathematics. These participants included all of the successful and middle performing research participants. Moreover, four of the seven research participants described the following factors as important to their success in mathematics: trying their best (all three of the successful research participants and one of the low performing), working hard at the mathematics (all three of the successful research participants and one middle performing participant), having a good conceptual understanding of the mathematics (two successful and both of the middle performing participants), focusing (all three of the successful research participants and one middle performing), and being motivated to do the mathematics (one successful, one low performing, and both of the middle performing research participants). For example, “Keep going and to do my best,” Stacey stated about her success in mathematics (Student Interview 5/14/10). Additionally, Monica remarked about factors critical to success in mathematics, “Focus, motivation. You would have to really want to be successful in math” (Student Interview 5/11/10). The same percentage of research participants, three of the seven, responded that paying attention in class (two successful and one low performing participant) and setting high expectations for oneself (one successful and both of the middle performing participants) is important to their success in mathematics. For example, Suzie noted, “I think that by me knowing that I can get the material if I work harder. So, I have higher expectations for myself to do good in the math class” (Student Interview 5/14/10). Additionally, the same percentage of research participants, two of the seven, commented that the following factors are critical to their success in mathematics: taking notes (two successful research participants), not giving up easily

(two successful research participants), maintaining good grades (one successful and one middle performing participant), and completing work and turning it in on time (all of the middle performing participants). For example, one participant, Monica, provided feedback on what to do to be a successful mathematics student. She remarked, “Do your work and turn it in on time. If you don’t understand something ask questions” (Student Interview 5/11/10). Some other responses given by the research participants as factors that are important to their success included: coming to school prepared (one of seven), having ambition (one of seven), having confidence (one of seven), and having a good relationship with their mathematics teachers (one of seven).

Data in relation to the second research question also revealed external attributions in relation to the common themes of mathematics teachers and general external causes. The same percentage of research participants, two of the seven, commented that the following teacher behaviors and characteristics were critical to their success: teachers that have good conceptual understandings of the subject matter (one successful and one low performing participant), teachers that provide extra help (one successful and one middle performing), teachers that believe in their students (two successful research participants), teachers that explain the mathematics to their students (two successful research participants), and teachers that meet the learning needs of individual students by using multiple strategies to teach them (two successful research participants). The research revealed general external causes of African American female high school students’ success including: the class behaving (five of seven including all three successful and both middle performing participants), family support (five of seven including all three successful, one middle performing, and one low performing student), the class size (two

of seven including one middle performing and one low performing participant), and finding supplemental resources (one of seven including a successful research participant).

Research Question 3

When investigating the research question “Why do African American female high school students think that other students fail in mathematics” the research participants unanimously indicated that individual students are responsible for their own failure. Common themes related to students’ attitudes, behaviors, and characteristics emerged. For example, four of the seven research participants (two successful, one middle performing, and one low performing) expressed that students fail because they do not understand the mathematics material. Also, three of the seven research participants (two middle performing and one low performing participant) stated that students fail in the mathematics classroom because they do not ask questions). Additionally, in relation to students’ attitudes, behaviors, and characteristics, two of the seven research participants stated that students fail because: they do not try (one successful participant and one middle performing participant), they lack focus (two successful participants), and they do not pay attention (one successful participant and one low performing participant). Also, a small percentage of the research participants (one of seven) gave the following reasons why students fail in the mathematics classroom: they do not study (a successful participant), they do not attempt assessments (a successful participant), they do not work hard (a successful participant), they do not put any effort into their assessments/assignments (a successful participant), they do not think they can do it (a middle performing participant), they cannot see the usefulness of the mathematics (a successful participant), they have given up on themselves (a successful participant), they

do not want to do the work (a successful participant), they do not utilize the resources (a successful participant), they lack the motivation to come to school (a middle performing participant), they goof off (a middle performing participant), they do not complete their homework (a middle performing participant), they sleep in class (a middle performing participant), and they give up easily (a low performing participant). The research participants gave only two reasons why students fail in relation to teacher behaviors including: the teachers are not willing to help (one successful and one middle performing participant) and they do not take the time to explain the mathematics (a low performing participant).

Research Question 4

When investigating the research question “How does African American female high school students’ performance in mathematics compare to their performance in other subjects,” four of the seven research participants shared that they perform better in the social sciences including: Social Studies, Government, and Sociology. Also, two out of the seven research participants noted that they perform better in English. Only one of the seven research participants commented that she performs better in her career and technical program classes. The classes that the participants identified as performing best in, seemed to be classes that they enjoyed. When one of the research participants, Maria, was asked to “Describe how she feels when you are in the mathematics classroom compared to other classes” she expressed her feelings as follows:

Well, I still feel excited about the math class, but dependent on what I am doing. I can be frustrated, and I can feel so many different emotions in math. I might not feel that in English because we’re always writing a paper, and I can do that pretty easily. I might not feel that when I’m just reading and then when I’m in my lab the only time I’m frustrated is if a resident is moving or kicking me” (Student Interview 5/6/10).

Another research participant, Lois, preferred to be in English versus mathematics because her English teacher made it a point to make the English relevant to her life. Also, Suzie preferred to be in English because mathematics is harder and requires more time and effort. Additionally, Lynn reported that she prefers to be in lab because, “that’s something that I actually got to know how to do and want to do. And in math, I’m not really going to use that; we just use basic math” (Student Interview 5/24/10).

When Stacey was asked “If she feels different in the mathematics classroom compared to her other classes, she described:

Yes, actually I do because math is different from the other subjects only because there is a way that you can explain math that is different than the other subjects. Every subject has to do with solving problems but math takes it step by step but with other subjects you really can’t take a problem step by step. You really can’t show it like you can show math (Student Interview 5/14/10).

Research Question 5

When investigating the research question “What barriers do African-American female high school students perceive in being successful?” An analysis of the data from the interviews once again revealed common themes in relation to psychological and environmental factors including: (a) lack of confidence, (b) mathematics anxiety, (c) test anxiety, and (d) stereotypes.

Lack of Confidence

Interview data were examined to see if the research participants lacked confidence in the mathematics classroom, and, if so, what factors contributed to this lack of confidence. One of the successful research participants, Suzie, elaborated on her lack of confidence in the mathematics classroom:

Sometimes I don’t give myself enough credit that I should. I am actually doing good in math, but I don’t give myself that amount of credit. I always think that I

am doing badly in that subject. So I'm not that confident in math (Student Interview 5/14/10).

It was clear from the interviews that all research participants, independent of mathematics ability level, experienced confidence issues at one point or another in the mathematics classroom. Moreover, all seven of the research participants addressed this theme of confidence. After analyzing the interviews, the following words emerged as words that were used by the participants to describe how their lack of confidence in the mathematics classroom made them feel: nervous, frustrated, worried, shy, bad, overwhelmed, embarrassed, stupid, and stressed.

In the research participants' descriptions of their lack of confidence, the following factors emerged: (a) discussing their mathematical thinking in the mathematics classroom during whole-class discussions, (b) the fear of answering mathematics questions incorrectly in front of their peers, (c) the lack of understanding of the mathematical concepts being presented in the mathematics classroom, and (d) solving long and complex mathematical problems. The second most cited response (six of the seven participants) was the lack of confidence pertaining to communicating mathematical thinking in front of peers during whole class discussions. Across all students from high performing to low performing, there is evidence that they are concerned about public performance in talking about mathematics problems in front of their peers. Specifically, the research participants preferred not to discuss their mathematical thinking in front of their peers. The following statement demonstrates a successful mathematics research participant, Suzie's, lack of confidence in relation to discussing her mathematical thinking:

I get shy and my voice gets lower because I might feel like what if I get the answer wrong or what if my idea is wrong or something like that. So, I get a little nervous about answering the question and I hesitate a lot too, and second guess myself (Student Interview 5/14/10).

Another successful mathematics research participant, Samantha, shared a similar thought about her lack of confidence in relation to discussing her mathematical thinking in front of her peers:

I don't like discussing it like off the bat. I like to think it through first. I like to think through all of the steps and solve it, and then I'm like ok I think that it should go like this because I don't want to just like hurry up and think about something. I want to try to test it out. Test it out, think about it, and then talk about it. So I would probably like be quiet while everybody else is discussing it (Student Interview 5/12/10).

In addition, one of the struggling research participants, Lois, articulated the following about her hesitation to contribute during whole-class discussions, "I probably wouldn't want to do it because I wouldn't want to feel stupid" (Student Interview 5/17/10). The responses revealed that due to confidence issues, most of the African American female research participants, would rather not take part in whole-group mathematics discussions. The only research participant that did not mind discussing her mathematical thinking in front of her peers was a successful research participant.

Unanimously, all of the research participants expressed that if asked to discuss their mathematical thinking in whole-group discussions, they feared responding incorrectly in the presence of their peers. This was the most cited response for the lack of confidence theme. This fear of being wrong, caused the research participants to experience anxiety in the mathematics classroom. For example, one of the middle performing students, Monica, responded:

I would probably be hesitant because if I'm not very sure if I understand the problem, I don't want to like try to go up there and answer it and get it wrong

because then I'll be like all types of frustrated. If I am not confident enough that I know the problem I would probably be hesitant because I don't want to get the answer wrong in front of like the class or whatever (Student Interview 5/11/10).

In addition to Monica's comments, another one of the middle performing students, Maria, stated the following in relation to her lack of confidence when it comes to discussing her mathematical thinking amongst her peers and getting the answer incorrect:

I would probably be like nervous and slump down in my chair and be like no that's ok, I'll get the next one. I think it's just like me not wanting to be embarrassed in front of the entire class when I get the answer wrong and the one person that knows it will be like ha, ha that was an easy one and me be like, oh well (Student Interview 5/6/10).

Also, one of the lower performing students, Lynn, shared a similar response to Maria's response. She expressed:

I wouldn't really talk because I don't want to feel like stupid if it is like wrong or anything like that. So, I just wouldn't really talk. The only time that I would speak up is if I actually know for a fact that, that's what the answer is or something like that (Student Interview 5/17/10).

Similarly, Suzie responded, "When I am asked to answer a question during math class, I feel kind of nervous about speaking in front of people or giving my answer in front of the other classmates because I might be wrong" (Student Interview 5/14/10). Also,

Samantha gave the following justification pertaining to her hesitation to answer questions during mathematics class:

It is a confidence issue just because if I told them to do the wrong thing and then we'll all be doing the wrong thing and it's not like I'm just doing the wrong thing it's like me and everybody else. Then I'll be the cause of it, so I would feel bad. So, I would much rather like have it wrong with myself and me keep trying it over and over again than to have it wrong with me and everybody else (Student Interview 5/12/10).

After examining interview data, the research participants also expressed confidence issues related to their depth of understanding of the mathematical concepts

being taught. Comments from four of the seven research participants (three successful and one middle performing) showed that they experienced confidence issues when they lacked understanding of the mathematical concepts. For instance, Stacey made the following comment:

When it is something that doesn't come easy to me and I have to keep on working at it. The longer that it takes for me to get it, my confidence just keeps going down. It's not like fast, but it like slowly starts going down. If it is something that I believe I can solve, I feel like more confident in solving it, but if it is something that they want me to try and figure out and I don't know, I'll probably feel a little more stressed because I wouldn't know how to solve it or we really didn't get to different topics (Student Interview 5/14/10).

Additionally, the research participant, Suzie, simply described her lack of confidence in relation to her not understanding the mathematics being taught:

It's like certain topics that we are on and if I don't get it, I think I won't pass that one or that section so I just get down about it and not really confident about the subject. Sometimes I'll just give up (Student Interview 5/14/10).

Suzie goes on to make the following comment:

Sometimes my confidence level is not high in it because I don't have the knowledge that I think I should have on that problem or something on that subject. Sometimes I don't get the material that we are doing and it's kind of hard for me to get, and it kind of takes a while for me to get it. It makes it kind of hard for me to feel good about doing it, if I can't get it. My pace is not as fast as someone else's pace, so I don't understand it as well as they do in the beginning (Student Interview 5/14/10).

Also, Samantha expressed her anxiety and lack of confidence in relation to not understanding the mathematics being taught:

I feel frustrated and I feel worried because I'm like I never know how long a teacher is going to stay on a subject because if I'm the only person that don't get it, and like the majority of the class gets it, I don't know if he is going to go back and try to help me with it. So, I feel worried about that and I feel frustrated because I feel like it's my fault that I don't get it (Student Interview 5/12/10).

Later in the interview, Samantha also expressed confidence issues related to being asked to do investigative learning assignments in a group with her peers. She explained:

If it was like something that I didn't know anything about and I was in a group, I wouldn't like that because if I don't know it, I would much rather want to figure it out on my own first. If he did it like you do this paper individually and then later we come together as groups and we share our answers and how we got it, which would be better for me. I would probably feel a little uncomfortable with just him giving us a group assignment and I don't know anything about it.

In the same manner, a middle performing student, Monica, made the following comment when she was asked to describe times when she didn't feel confident in the mathematics classroom, "I'm probably like frustrated because I should understand it but I don't. I feel frustrated and nervous because everybody else is getting it but me. So what am I doing to not understand it" (Student Interview 5/11/10). The responses of the research participants showed that confidence levels decrease and the articulation of pertinent information is hindered when one is not knowledgeable of the skills and operations needed to complete mathematics problems.

All of the research participants lacked confidence in their ability to solve complex mathematical problems that generally take a lot of time and energy to complete. For example, Stacey discussed more in detail about her lack of confidence pertaining to solving complex problems:

I'm not confident with long problems only because I'll start off doing something way different, and then look back like "What am I even doing on this problem?" Like, "Where did I even get this answer from?" It would probably be a little stressful, because I would have to recheck everything that I just did and make sure that I didn't make little mistakes. You might be starting off doing the right thing, and then you accidentally added two and then the whole problem is thrown off. I can write down as much as I can, but I never really understand where I get the answer from until I actually have to rethink and rethink. My mind just hurts and it's a lot to go through (Student Interview 5/14/10).

Throughout the discussion of the lack of confidence of the research participants due to solving long, complex mathematical problems, it was clear that the research participants had an overwhelming need to do the mathematics quickly and to answer correctly. One research participant, Lois, expressed that it should only take five minutes to solve a mathematics problem and if she cannot solve the problem in five minutes, she quits. These students lacked the desire to wrestle with the mathematical content via problem solving. However, Monica encouraged other students not “to brush it off right away; to give it time so that you can try to understand it” (Student Interview 5/11/10).

Only one of the research participants, Suzie, commented about not always being correct in the mathematics classroom. But, in those situations she still commented about receiving assistance from the mathematics teacher. She expressed:

I don't think it is bad to be wrong in math, because if you are wrong you can get help. So, it's better to like put everything out there because the teacher can help you better if he knows that you are having trouble (Student Interview 5/21/10).

Responses for the lack of confidence theme included: being asked to give an instantaneous response to a question (two of seven participants), taking higher level mathematics courses (one of seven participants), the pace of the class (one of seven participants), having to lead peers (one of seven participants), the behavior of other students in the class such as students shouting out answers (two of seven participants), and the time it takes to complete a problem (two of seven participants).

Advanced Pre-Calculus students have significantly higher levels of confidence

African American female mathematics students were given three subscales from the Fennema-Sherman Mathematics Attitude Scales (Fennema & Sherman, 1976): (1) Confidence in Learning Mathematics; (2) Mathematics Usefulness; and (3) Mathematics

Anxiety. One item from an additional subscale, Mathematics as a Male Domain, was also included on the survey but was omitted from the analysis because a single item has been shown to not provide reliable or valid information about the latent factor (Stevens, 2002). Each item was measured on a five-point Likert-type scale (1 = *Strongly disagree*, 5 = *Strongly agree*). All statistical analyses were performed using PASW 18.0. Internal consistency reliability was measured using Cronbach's alpha for each subscale and for the instrument overall. A scale is generally considered to have strong internal consistency with alpha values greater than 0.70 (Urbina, 2004), but the alpha statistic has also been shown to be dependent on the number of items in the scale (Voss, Stem, & Fotopoulos, 2000), so more items automatically leads to a higher alpha measurement, controlling for all other influences. For the present study, the observed alpha values were compared to the reported values to see if the scale behaved similarly across samples. The Confidence in Learning Mathematics subscale consisted of 13 items ($\alpha = .919$), the Mathematics Usefulness subscale consisted of 12 items ($\alpha = .889$), and the Mathematics Anxiety subscale consisted of 4 items ($\alpha = .656$). The Cronbach's alpha coefficient for the full 30-item instrument was $\alpha=0.931$. Therefore, this instrument was found to have acceptable reliability.

A total of 61, 11th-12th grade African-American female students from three levels of mathematics classes at the research site completed the scale and were included in the sample. Twelve were enrolled in Advanced Pre-Calculus, while 22 were in enrolled in Basic Mathematics, and 27 in Remedial Mathematics. The instrument was administered to each mathematics class at the site separately, and every student was given the option to either participate or to decline participation. Only data from the African-American

female students who completed the scale were included in this analysis. Every student that was present on the day that the instrument was administered at the research site agreed to and completed the instrument. Therefore, there was equal participation by all possible groupings.

MANOVA

The multivariate analysis of variance (MANOVA) test was run to investigate between group differences among the three levels of mathematics classes (the independent variables), and the mean scores in the dependent variables: Confidence in Learning Mathematics, Mathematics Usefulness, and Mathematics Anxiety. The MANOVA test was chosen because it allowed for the examination of group differences simultaneously when more than one dependent variable was involved, thereby minimizing the potential for a Type I error (Stamatis, 2003; Stevens, 2002; Tabachnick & Fidell, 2007).

The statistical software program, SPSS, outputs four multivariate test of significance. All four tests were compared to analyze differences between groups. Also, all four tests simplified to the F-statistic. Three of the four tests of multivariate significance indicated near significance (Pillai's Trace, Wilk's Lambda, and Hotelling's Trace with p-values ranging from 0.074 to 0.082). The fourth test, Roy's Largest Root ($F(3, 56) = 3.721, p = .016$) indicated statistical significance at the 0.05 level.

After running test of between-subject effects, the data revealed that there were statistically significant differences between the sample mean scores in Confidence in Learning Mathematics ($F[2, 58] = 5.317, p = .008$) among the Advanced Pre-Calculus, Basic, and Remedial mathematics students. There were, nevertheless, no statistically significant differences noted in the average responses for the Advanced Pre-Calculus,

Basic, and Remedial mathematics students in relation to mathematics usefulness and anxiety. These findings suggested that, African-American female students appear to view mathematics with the same perspective on its usefulness and with the same degree of anxiety regardless of proficiency levels.

Because differences were found for Confidence in Mathematics, Tukey's HSD post hoc tests were conducted to determine which pairwise comparisons were significantly different. Because the confidence level of multivariate statistical significance was above 0.90 for all four tests, and one was greater than 0.95, the risk of Type I error for the post hoc test was deemed low. The Advanced Pre-Calculus students seem to have a statistically significant higher confidence level in relation to learning mathematics than either other group ($MD=0.998$, $p=.005$), but there doesn't seem to be any significant difference between Basic and Remedial mathematics students on any measure. It is interesting to note that, the mean differences between Advanced Pre-Calculus and Remedial students in confidence in learning mathematics is only significant at the 92% level of confidence.

Mathematics Anxiety

When discussing the times in the mathematics classroom that made the research participants feel anxious, several causes were mentioned including: (a) solving complex mathematical problems that take a long time to solve (seven of seven participants); (b) taking higher level mathematics courses (one participant from the successful group); (c) getting problems incorrect (six participants across all three ability groups); (d) facing mathematics problems for the first time (one participant from the successful group); (e) discussing mathematical thinking in front of peers (five participants from all three ability

groups); and (f) taking mathematics test (seven of seven participants). Similar responses came from the research participants when asked questions pertaining to their lack of confidence. As mentioned in the research literature, if mathematics anxiety is not addressed it can perhaps limit a student's success in mathematics courses from kindergarten through the collegiate level (Ma, 1999) by adversely affecting mathematics performance. Without exception, all of the research participants experienced anxiety when asked to complete complex mathematical problems that generally take a long time to solve. Based on the data, it is probable that being asked to solve long, complex problems, had both an emotional and cognitive effect on the research participants causing them to lose focus and shut down. Further, the anxiety they may have experienced interfered with the students' motivation to persist in the mathematics classroom. These students often became disengaged once the anxiety began. The research participants talked in detail about the anxiety experienced from the length of and the perceived time it takes to solve some mathematics problems. Moreover, they talked about how being asked to solve these problems hinders their perseverance in the mathematics classroom. Stacey shared the following:

I don't like doing long problems. If I was asked to do a long problem that takes a really long time to do, it would probably be a little more stressful just because I would have to recheck everything that I just did and make sure I didn't make little mistakes in the middle of the problem. You might be starting off doing the right thing, and then you accidentally added two and then the whole problem is thrown off. I really don't like doing long ones, especially in front of people. I know that I would probably make a mistake, and I don't like making mistakes in front of people. If it something hard and I don't get the help that I need then I'm probably not going to want to do it after a while because I'm going to get so frustrated with it (Student Interview 5/14/10).

In addition to Stacey's comment, Suzie responded:

Sometimes it kind of frustrates me because it takes me a long time to get it and if I keep doing it over and over again, I know that I am doing something wrong but I can't figure it out and that kind of frustrates me so sometimes I just take a break from it and I'll go in the next day and ask the teacher about it (Student Interview 5/14/10).

Similarly, Monica elaborated on how solving long problems caused her to feel anxious and give up. She commented:

I would be frustrated. I would be like forget it, if it's been a long time. Because, I think if you get frustrated, then you just want to quit. I would be tired, and frustrated. I would probably be like what the heck is this mess, and why am I still doing it? You want to try and do it the right way and not take that much time in doing it (Student Interview 5/11/10).

Further, Lynn shared similar sentiments. She stated the following:

Oh my gosh, I'm not going to finish it, if I had to do it by myself and not get any help. If I don't know how to do it, and I don't get help then I'm just going to quit. But if I'm doing it and I got help, I'm going to keep on doing it (Student Interview 5/24/10).

Interestingly, only one out of the seven research participants who belonged to the successful mathematics student group stated that she would persist if asked to solve long, complex mathematical problems. Samantha reported:

I would probably feel lazy, like man, I have to do this long problem. But I would still do it. I would just feel a little lazy at first because I really don't like long problems. An hour is a long time, but I would still do them. Even though I wouldn't feel up for it at first, when I finished I would feel accomplished about it (Student Interview 5/12/10).

The presented data is evidence that the research participants have a preference for quick and simple mathematics problems, and experience anxiety when asked to work through difficult ones.

Throughout the discussion of anxiety in the mathematics classroom, it was clear that the research participants often looked for the support of their teachers to decrease anxiety. The student interviews continuously stressed how the research participants

frequently sought out teacher assistance during anxious situations. This theme of teacher dependence surfaced many times throughout the interviews. It is reasonable to conclude from the participants' comments that this overwhelming need for teacher support when feeling anxious, once again illustrates a lack of them being willing to self-assess, problem solve, and construct their own knowledge. As mentioned in the research literature, the lack of thinking coherently and conceptually about the mathematics material and self-reflecting makes it hard for the mathematics student to be able to recall or apply the mathematics later in their schooling experiences or careers (Bransford, 2000). Six of the seven research participants commented on seeking help from teachers after becoming anxious in the mathematics classroom. For example, Monica had this to say about her teacher dependence due to experiencing anxiety when solving long, complex mathematical problems:

I would probably be frustrated, but then I would probably see where I went wrong on it. So, I would ask the teacher what I did wrong because then if you ask they will go through the problem and then like break it down for you (Student Interview 5/11/10).

Also, one research participant, Lynn, discussed how she often became disengaged when her mathematics teacher could not get to her immediately when she didn't understand the content. As a result, she tended to socialize excessively with her peers while waiting for him to assist her. It would appear that in such instances this research participant fails to rely on her own competence and problem solving abilities.

Only one of the seven research participants, a successful mathematics student, shared techniques that she uses to cope with mathematics anxiety versus immediately asking the mathematics teacher for assistance. Samantha offered the following explanation:

I would just stop for a little bit and probably take two to five minutes just to sit there and just relax a little bit. It was one time and I was really frustrated. I was so mad that I was red and I started tearing up and it was like I need to just chill. It's only math (Student Interview 5/12/10).

Test Anxiety

Unanimously, all seven of the research participants provided responses that discussed their anxiety in relation to taking assessments. Suzie shared her anxiety for timed tests:

I have a nervous feeling right before the test and I'm not a good test taker. So, it takes me longer to do the test, because I take my time. The night before the test, I have like an anxiety feeling. I get really nervous. Then, when I get to the test, my mind goes blank so I kind of forget everything. But, once I start doing it, I just take my time and that makes it easier for me to get through. But, I don't work well under pressure when I am taking a timed test, so my mind goes blank. I don't like timed test (Student Interview 5/14/10).

Another research participant, Samantha, had this to say in regards to mathematics assessments:

I feel nervous because I feel like I just try to do everything right. In the end, I'm still nervous and anxious to see the test score to see if I got it right. For some reason though, when I think I did badly on a test, I did good. When I think I did good, then I didn't do as well as I thought (Student Interview 5/12/10).

Throughout the discussion of test anxiety, the following key phrases were used to express how taking mathematics test made the research participants feel: nervous, tense, scared, overwhelmed, bad, stressed, and anxious.

Participants (four of seven) also mentioned anxiety on mathematics test due to a lack of confidence. The four research participants that lacked confidence in relation to mathematics testing were all three of the successful mathematics participants and one low performing participant. Samantha shared, "I'm not that confident with taking test because I never know what's going to happen. I might think I get it, but I don't get it

when I get the test back (Student Interview 5/12/10). One research participant, Stacey, made the following comment in regards to mathematics test:

I don't like taking tests at all, because I'm just not good at them. I don't have that much confidence only because I struggle with knowing what equation goes with each problem. I can read the problem over and over again, but then if I don't know what equation goes with that problem, I'll probably mix up the equation and get the whole thing wrong even though I might have been on the right track, just had a different equation. But, that only happens with test and whenever they can't give you help and you're sitting there and you can't figure out what equation goes with this problem. You even look in your packet and you just don't know it. I don't have that much confidence for tests (Student Interview 5/14/10).

Interestingly, two of the seven (a low and middle performing student) research participants indicated that they were confident during mathematics tests only if the teacher offered assistance throughout the test. So, once again the teacher dependence theme emerged as a result of the research participants feeling anxious.

Stereotypes

The research participants were asked if they were aware of any race stereotypes related to students that do well in mathematics and students that do not. Three of the seven research participants (one middle performing and two low performing) were aware of academic race stereotypes in the mathematics classroom. Two of the three research participants (one middle performing and one low performing) acknowledged academic race stereotypes in relation to Asian Americans. These participants perceived that Asian American students achieved higher in the mathematics classroom in comparison to other races. Lois revealed her stereotypical thinking about whom she perceived was the most successful, high achieving race in the mathematics classroom. She commented, "An Asian because I know that if they are not from here and are from another country, they really push the education harder than America does. So, I would think the Asian"

(Student Interview 5/24/10). Lois was also asked if she was with all Asians in her class would that intimidate her in any way. She responded, “Yes, because I would feel like I was the non-smart person in the classroom and that would intimidate me a lot.”

Similarly, Monica had this to say about the perceived high ability level of Asian American students in mathematics:

I’ve always heard that Asian people are smart in math. I really don’t know for a fact. I would assume that because they are in school all year round, too, and we have two months in the summer. So, they have the math always processing in their heads (Student Interview 5/18/10).

The other research participant that was aware of race stereotypes, Lynn, perceived that White students perform better in the mathematics classroom.

Four of the seven research participants reported that they were not aware of any race stereotypes in relation to mathematics. It is interesting to note that none of the three successful research participants were aware of any race stereotypes. For example, one of the research participants, Stacey, who was not aware of any race stereotypes, articulated the following profound statement when asked, “Are you aware of any stereotypes about who does well in mathematics and who does not”:

I really haven’t. I don’t really care about that stuff. To me, it doesn’t matter what you are to be a good math student. It really depends on if you are trying or not, because if you are Asian and you are trying you can be a good mathematics student. If you are African American and you are trying, you are a good math student. I don’t get how people make stereotypes on what your race is or your ethnic background or anything. Anybody can be a mathematician (Student Interview 5/20/10).

Another research participant who was not aware of any race stereotypes, Suzie, agreed with Stacey’s sentiments and stated clearly that race does not matter, “It’s how hard they work at it and how much knowledge they have of the subject” (Student Interview 5/21/10). It is also interesting to note that none of the seven research participants

endorsed racial or ethnic stereotypes in relation to being African American and doing mathematics.

Additionally, the research participants were asked if they were aware of math-ability gender stereotypes. Four of the seven research participants were aware of gender stereotypes in the mathematics classroom. The four research participants who were aware of math-ability gender stereotypes were all of the three successful students and one middle performing student. Two of the four research participants who were aware of gender stereotypes, heard that males had more mathematics ability than females. These two research participants belonged to the successful and middle performing research participant groups. The other two, on the other hand, heard that females had more mathematics ability than males. These two research participants were successful mathematics students. Suzie, for example, made the following comment about her awareness of math-ability stereotypes favorable to males, “I hear people say that boys are better at math than girls, but I don’t think that that’s true. Some girls can be smarter at math than guys” (Student Interview 5/12/10). Stacey made the following comment about her awareness of math-ability stereotypes favorable to females:

I heard that women are smarter than men and I’ve heard that Black men have the least amount of, I can’t really say smartness because that’s not really a word, perform at a lower level. That they are not that smart. Those are just stereotypes of course, but that is what I’ve heard (Student Interview 5/20/10).

One of the middle performing research participants, Maria, talked about how being exposed to gender stereotypes affected her mathematics performance. She was asked “Do you think that the gender stereotype that you heard about has influenced your success in learning math at all” and responded:

Maybe somewhere in the back of my mind it has. Maybe I can do better just to show them up but I don't know. Sometimes I feel like it probably has because I want to be like we can prove you wrong. We have proved you wrong in other things and we can prove you wrong in this one too (Student Interview 5/13/10).

Maria does not acknowledge her exposure to this gender stereotype as a barrier to her success, instead she talks about how it causes her to work harder in mathematics.

To get a further understanding of stereotypes in the mathematics classroom, some of the research participants were asked what a mathematician looks like. All three research participants that were asked this question said that a mathematician would be male. These research participants stereotyped mathematics as a male's field of study. Two of the three research participants that responded to this question were part of the low performing group whereas the other was a successful research participant. This finding is consistent with research that states that females (versus males) are perceived as lacking mathematics ability (Quinn & Spencer, 2001; Spencer et al., 1999). It is clear from the research participants' responses that they associate being a mathematician with being male. Two of the research participants stated that a mathematician would be a White male, while one of the research participants said that the male could potentially be either African American or Caucasian.

Summary

In this chapter, each research participant was introduced and the survey data and all five research questions were discussed. All of the research participants, regardless of ability level, had similar responses to the research questions. Also, more research is needed to see if the mathematical experiences of African American students in a career and technical setting are different than those in a traditional school setting. In Chapter 5 the conclusions and the directions for future research will be discussed.

CHAPTER V

DISCUSSION

The United States is calling for an increase in the mathematics competency of all students. Presently, African American students are falling behind. As a group, they are consistently the lowest performing mathematics students in the United States (College Entrance Examination Board 2008). Furthermore, they are failing to enroll in higher level mathematics courses (NCES, 2008a) or pursue STEM related careers (Fox & Soller, 2001; Tortolani, 2007; Tyson et al., 2007). The results of this study contributes to mathematics education research on race and gender equity by describing the mathematical experiences of seven African American female high school students who are on a continuum from succeeding at high levels to struggling in mathematics. These particular African American females were enrolled at a career and technical high school. As a goal of this study, the researcher examined the participants' perceptions of barriers that they encounter or factors that enhance their mathematics learning and achievement. The research participants completed two individual interviews about their mathematical experiences. Also, the teachers of the research participants were interviewed once separately to triangulate the data. Additionally, mathematics autobiographies (Berry, 2002) that had been completed earlier in the school year by the participants and the Fennema-Sherman Mathematics Attitude subscales (1976) which had also been completed earlier in the school year were examined. The previous chapter discussed in detail the research findings. This final chapter begins with a summary of the results from

the five overarching research questions driving this study, and ends with a discussion of areas for future research.

Factors Affecting the Research Participants' Performances in Mathematics

The research participants reported that the following eight factors contribute to their performance in mathematics: self-efficacy, teacher behaviors and characteristics, teacher expectations, mathematics usefulness, peers and mathematics, parental expectations, parental involvement, and parental attitudes toward mathematics.

Self-efficacy

The majority of the participants stated that they had strong perceptions of their ability to learn and do mathematics regardless of their ability group. Only one research participant, a high performing student Suzie, revealed poor self-efficacy pertaining to her ability to learn mathematics even though she did perceive that she could do the mathematics even when the mathematics content was difficult. Data revealed a discrepancy between the participants' self-efficacy beliefs and their capabilities in the mathematics classroom. This finding was unexpected. In the mathematics classroom, most of the research participants displayed characteristics of students with low self-efficacy. For example, according to the research of Zimmerman and Schunk (2008) highly efficacious students persevere when the mathematical task become more complex. The responses to the interview questions revealed that four of the seven research participants often gave up quickly without exerting much effort when the mathematics became challenging. Only the three successful research participants stated that they would continue to work when faced with difficult mathematics problems. Also, according to the research of Stevens, Olivarez, Jr., Lan, Tallent-Runnels (2004), highly

efficacious students utilize problem-solving strategies when faced with difficult mathematical tasks. The data revealed that the research participants often looked for support from their teachers rather than utilizing their own problem-solving techniques when faced with challenging mathematics problems. Furthermore, one of the mathematics teachers interviewed went as far as to specifically say that his student, Lynn, lacked the ability to problem solve on her own in Algebra II. Five of the seven research participants revealed that they ask the teacher questions when faced with challenging mathematical task instead of tackling the problem solving on their own. Three of the seven research participants also mentioned becoming disengaged and giving up on the task when the teachers could not respond to their questions quickly. Only two of the research participants, both successful, mentioned utilizing problem solving strategies when faced with difficult mathematics problems. These two high-achieving research participants never mentioned in their interviews giving up or asking their teacher for assistance when faced with a difficult mathematical task. Furthermore, as mentioned in the literature review, the research of Pajares and Urdan (2006) and Multon, Brown, and Lent (1991) found that students who have high self-efficacy perform at high levels in the mathematics classroom. Data from this research study contradicted this finding. According to the teacher interviews only the three successful research participants were performing at high levels at the time of the interview. This is solely based on the teachers' assessment of student performance.

Also, as mentioned in the literature review, the research of Lent, Brown, and Larkin (1984) showed that students with high self-efficacy go on to take more complex mathematics courses and participate in mathematics related career fields. Only four of

the seven research participants were interested in taking more advanced level mathematics courses in the future. Moreover, none of the participants expressed that they were interested in pursuing a mathematics related career field even though some of their future careers required a significant amount of mathematics (i.e., pediatrician, nurse). All of these findings suggest that more research needs to be conducted to investigate why these students perceive themselves as having high self-efficacy but behave more like students that the research describes as having low self-efficacy.

Teacher Behaviors and Characteristics

Teacher behaviors and characteristics, was also found as a factor that African American female high school students attribute to their performance in mathematics. Results showed that all of the research participants perceived that their mathematics teachers contributed positively to their mathematics learning and achievement. For example, Stacey wrote, “I believe that the teacher is the main source of a student’s success” (Mathematics Autobiography). The research participants felt that their instructors were approachable and readily available to support and encourage their mathematics performance. Four out of seven research participants from all three ability groups reported that their mathematics teachers have served as a source of positive encouragement throughout their experiences in school. Specifically, interview data indicated that the research participants’ mathematics teachers encouraged them to improve their mathematics performances (four of seven) and improve their grades (two of seven). It is important to note, that the majority of the research participants (six of seven) shared that their mathematics teachers influenced their attitudes about mathematics. Five of the seven research participants, who discussed their teachers’ influences on their

attitudes, felt that their mathematics teachers influenced their attitudes in a positive way. However, one of the low-achieving research participants mentioned that the negative attitude of one of her past mathematics teachers negatively influenced her attitude towards mathematics. But, at the time of the interview she reported her attitude had improved.

The research participants identified several teacher behaviors and characteristics that met their individual needs. For example, the majority of the research participants felt that mathematics teachers should provide one-on-one instruction (six of seven participants) and thoroughly explain the mathematical content (four of seven participants). All of the research participants felt important and valued by their teachers in the mathematics classroom.

As also mentioned in Chapter 4, the research participants' descriptions of a "good mathematics teacher" revealed a prevalent theme that all participants viewed a traditional, lecture-based pedagogy as the best approach to teaching mathematics. The research participants' expectations of a good mathematics teacher included the teacher: (a) presenting the material via lectures; (b) giving thorough examples; and (c) assigning work and being immediately available when questions arose. The teaching pedagogy with a heavy emphasis on memorizing and quickly recalling mathematical facts was considered by the research participants as the best teaching approach. Also, it involved internalizing rules instead of: (a) mentally constructing mathematical concepts; (b) developing effective problem solving skills; (c) thinking thoroughly about the mathematical concepts; and (d) engaging in significant learning. The research participants' conceptions of mathematics teaching mainly involved the teacher

transmitting teacher knowledge to the students rather than the teacher teaching and encouraging his/her students to experiment with the mathematics, think independently, and reflect on the mathematical concepts. This finding is not surprising because research indicates that African American students are generally immersed into a classroom culture where mathematics is taught using traditional teaching methods (Berry, 2003). Also, according to Geist and King (2008) most teachers are still teaching mathematics in this traditional way. Therefore, there is a possibility that these students have not been exposed to any other type of teacher pedagogy outside of the traditional, lecture based teacher pedagogy. Moreover, they may need to be taught how to think, learn, and problem solve independently. The data from this research study contradicted the findings of Bevan (2001) who found that females do not prefer this traditional pedagogy because they have a desire for a good conceptual understanding of the mathematics. One possible explanation for this is that these students may not have had any other experience. Therefore, they expect only what they have experienced. Some do not know or understand that there is another way. The data revealed that the research participants' preferred pedagogy can be detrimental because it fails to empower them to be autonomous learners, but rather contributes to their dependency on the teacher. Berry (2003) also found that the traditional teaching method is not meeting the best interest of these African American students. Some research claims that African American student achievement is positively affected by instructional practices that are non-traditional. For example, in a study of 933 Black middle school students, Woolley, Strutchens, Gilbert, and Martin (2010) found that "...some teacher beliefs and practices, namely teacher expectations and use of reform practices, directly influenced students' mathematics

standardized test scores” (p. 55). The researchers found that the standardized test scores of African American students were positively related to their teachers’ use of instructional practices aligned with mathematics reform standards. The researchers for this study looked at both SAT-10 mathematics scores and survey data. The African American students in this study who were taught using reform practices performed significantly better than those African American students who were not taught using these methods, in other words, traditionally taught. Also, Boaler and Staples (2008) reported similar findings. After conducting a “five-year longitudinal study of approximately 700 students as they progressed through three high schools” (p. 609), they found that the mathematics performance of African American students who attended Railside high school and experienced instructional practices aligned with mathematics reform standards at this school improved, and performance “differences between White, Black, and Latino students disappeared” (p. 622). According to Goldsmith, Mark, and Kantrov (2000) instructional practices aligned with NCTM reform standards, “...shifts the focus away from memorization and rote application of procedures toward standards for performance that are based on conceptual understanding and reasoning” (p. 9). These findings indicate that teaching aligned with mathematics reform standards perhaps improves the mathematical outcomes of African American students. Dethlefs (2002) conducted a dissertation study investigating the relationship between learning using constructivist approaches and high school mathematics and science students’ attitudes and achievement. In this study of 804 high school Algebra and Biology students it was found that a positive relationship exists between a constructivist learning environment

and student attitudes (i.e., self-efficacy). But, no clear relationship was found between learning using constructivist approaches and student achievement.

It is probable that the normal behavior of the research participants' -in their classroom environment-is when you cannot figure out a mathematics problem quickly, immediately ask the teacher for assistance. This reliance on teacher lectures and instantaneous assistance limits research participants' grasp of the mathematical concepts and inhibits their development of responsibility for their own learning.

A probable cause for the research participants' behaviors could be the phenomenon "learned helplessness." This phenomenon has a long history, with earlier research studies conducted with dogs in which the dogs were exposed to unavoidable shock treatments and became helpless (Overmier & Seligman, 1967). According to Seligman (1991), "learned helplessness is the giving-up reaction, the quitting response that follows from the belief that whatever you do doesn't matter" (p. 15). The researchers Cemalcilar, Canbeyli, and Sunar (2003) have studied the construct of learned helplessness, emphasizing that learned helplessness can potentially disrupt "motivation, emotion, and learning" in humans (p. 65). According to these researchers, learned helplessness is evidenced by several factors including: passivity, giving up, procrastination, decreased problem-solving ability, frustration, and lowered self-esteem (p. 66). Instead of taking learning risk when the mathematics content became challenging, the research participants became helpless looking to their teachers for assistance.

This behavior becomes problematic when these students are not able to transfer or effectively communicate mathematical knowledge from one situation to the next because

they have not actually learned it. It also becomes problematic when these students go on to higher education where the professors expect and demand independent thinking and learning. In order to develop into effective problem solvers who can transfer learned knowledge to other areas of their life and education, it is imperative that these students begin to take risks and become actively engaged in constructing their own mathematics knowledge. Having students take charge of their learning while the instructors guide instruction is critical to developing successful mathematics students.

Teacher Expectations

Participants discussed the factor of teacher expectations. The research of Tyler and Boelter (2008) confirms a relationship between teacher expectations for performance and the actual mathematics performance of African American students. The data from this research study suggested that the majority of the research participants (six of seven) perceived that their mathematics teachers clearly communicated their learning expectations for academic achievement and believed that they could adequately meet these expectations. For example, the research participants perceived that their mathematics teachers expected them to: (a) do the assigned work; (b) perform well; (c) to try; (d) request help when needed; (e) to do their best work; and (f) to keep pushing themselves. It is noteworthy that none of the research participants mentioned higher order expectations such as: comprehension, constructing knowledge, making connections, and problem solving strategies.

The majority of the research participants felt that their teachers' high expectations positively affected their mathematics performance. The research participants' positive views of their teachers' expectations were surprising giving that the teacher interviews

revealed that the mathematics teachers held low expectations for most of the research participants' academic performance regardless if they were successful or not. For example, interviews of the mathematics teachers for the middle and low performing students Monica and Lynn revealed that their teachers held low expectations for their academic performance by stating that they were in the wrong mathematics class based on their skill levels. Also, high performing Stacey's mathematics teacher stated that Stacey has met his expectations as a Pre-Calculus student but that she should be placed in a remedial College Algebra class once she goes to college. The mathematics teacher of the middle performing student Maria initially stated that her mathematics ability was strong and that she was very capable of performing in Algebra II, but once she started to fall off later in the school year, he was quick to judge her incapable of performing well. Her teacher had the following to say about her mathematics recommendation for her senior year:

I honestly don't remember if she got a recommendation for College Algebra or not, but if she did I am going to have to resend that because this quarter she is failing and from the first three quarters to this quarter, she has completely shut down and changed. She has quit working and her complete mindset is different (Teacher Interview 5/28/10).

College Algebra is considered an upper-level mathematics course at the research site. The students enrolled in this course earn transferable college credits free of charge. Also, they must have a teacher and counselor recommendation before being enrolled. This mathematics instructor is going to withhold a recommendation for College Algebra for this student without any effort to establish what might have gone array, after this student performed well for three quarters.

Similar to Maria, a low performing student Lois' mathematics teacher initially stated that her mathematics ability was strong but later recommended that she be placed in a remedial level mathematics course for her senior year of high school. The teachers interviewed for this research study only had high expectations for two of the seven of the research participants. This finding is not surprising given that the research of Baron et al. (1985) found that teachers hold different perceptions and expectations about African American achievement than their White peers in favor of White students.

As mentioned in Chapter IV, the research participants perceived that their mathematics teachers held different expectations for different students independent of race and gender but based on their: (a) work ethic; (b) classroom behavior; and (c) classroom performance. Clearly, the research participants did not perceive that their mathematics teachers held high expectations for mathematics performance for all students. Instead, they perceived that their mathematics teachers only held high expectations for those students that worked hard, were well behaved in class, and who were performing well. NCTM's Equity Principle, "demands that high expectations for mathematics learning be communicated in words and deed to all students" (NCTM, 2000, p. 13). Unfortunately, this was not the case at the research site. Woolley et al. (2010) found that holding African American students to high expectations improves their mathematics performance.

Mathematics Usefulness

The research participants discussed their belief systems about mathematics usefulness and revealed a variety of opinions. Although the majority of the research participants (six of seven) mentioned that there is a connection between mathematics and

their career and technical programs some held the misguided belief that only lower level mathematical concepts were used in their present and future career fields. For example, Lynn was enrolled in the Health Technology program at the research site and failed to see how competence in advanced level mathematical concepts is needed for the nursing profession. Moreover, Lynn discussed future plans of becoming a pediatrician, but did not feel the need to enroll in mathematics during her senior year of high school. Similarly, Maria and Samantha mentioned that only lower level mathematics was used in their nursing and Early Childhood Education fields respectively. Even though some of the research participants saw mathematics as an important contributor to their future careers they still only recognized the use of lower level mathematical concepts in their occupations.

All of the research participants failed to mention the integration of applications from their career and technical programs into the mathematics curriculum by their mathematics teachers. The data revealed that a discontinuity exist between the mathematics that the students learn in their career and technical labs and what they learn in their mathematics classes. As a result, it was hard for the research participants to see the practical relevance of the mathematics to their careers. Therefore, teachers should perhaps attempt to connect the mathematics to the research participants' career fields. Making the mathematics relevant in this way could potentially reinvigorate the students' motivation to learn the mathematics, increase their mathematics performance, pique their mathematics interest, and better prepare them to use mathematics in their future professions and daily lives. The findings in this study suggest that more work needs to be

done to make the mathematics meaningful and relevant. Making the mathematics meaningful and relevant should be a high priority.

Peers and Mathematics

The research participants discussed the role that their peers played in their mathematics performance. In discussing interactions with their peers in the mathematics classroom, participants felt that their peers impacted their mathematics performance in both positive and negative ways. Participants commented that their peers impacted their performance in the following positive ways: (a) encouraging them to do well; (b) helping them stay focused; and (c) assisting one another with the completion of assignments. One research participant mentioned that her peers impact her mathematics performance in a negative way by acting as a distraction and prohibiting her from getting her work finished. It is interesting to note that, the majority of the participants noted that their peers like mathematics. There were no notable differences in responses pertaining to peer influence in mathematics between the high, middle, and low performing students.

Parental Expectations

The research participants discussed the importance of the factor, parental expectations, to their mathematics performance. Specifically, parental expectations were shown to have positive effects on their child's mathematics performance. The majority of the participants felt that their parent(s)/family member(s) held high expectations for their mathematics performance and persistence. For example, the participants commented that their parent(s)/family member(s) expected them to: (a) to attend college after high school; (b) to do their best; (c) to seek help from instructors and others, (d) to maintain good grades; (e) to work hard; (f) to complete assignments; (g) to take

mathematics courses in college; and (h) get a good conceptual understanding of the mathematical concepts. The majority of the research participants (six of the seven), across all students from high performing to low performing, discussed how their parent(s)/family member(s)' expectations positively affected their mathematics performance. Also, the majority of the research participants (six of seven), across all students from high performing to low performing, spoke about how their parent(s)/family member(s) expected them to attend college after high school, but pursuing a mathematics related course of study at the university level was not emphasized in these conversations. Additionally, six of the seven research participants, across all ability groups, expressed that their parent/family members expected them to do their best in the mathematics classroom. Interestingly, all three of the successful research participants and all two of the low performing research participants were included in the six. Most of the participants (four of seven), across all students from high performing to low performing, discussed how their parent(s)/family member(s) held high expectations for their grades. Also, four of the seven research participants commented that their parent(s)/family member(s) expected them to seek help from their instructors or others when they experienced difficulty in the mathematics classroom. These four participants included two from the high performing and two from the middle performing groups. Three out of the seven participants, all from the successful and middle performing groups, noted that their parent(s)/family member(s) expected them to work hard and complete assignments. Interestingly, only two of the seven research participants (both middle performing) felt that their parent(s)/family member(s) wanted them to have a good conceptual understanding of the mathematics that they were learning. Also, only two of the seven

research participants from the successful and low performing groups commented that their parents expected them to take mathematics courses in college. Only one of the low performing research participants expressed that her parent/family member failed to talk to her about attending college after high school.

Parental Involvement

Five of the seven research participants from all of the ability groups noted that their parent(s)/family member(s)' were actively involved in their mathematics learning process through the assistance with and the monitoring of their mathematics homework. These research participants perceived that their parent(s)/family member(s) were interested in what they were doing in the mathematics classroom and wanted to help. These research participants failed to share whether or not this involvement positively affected their grades, attitudes, attendance, and aspirations. More research is needed to explore these relationships.

Parental Attitudes about Mathematics

The research participants discussed their parent(s)/family member(s) attitudes about mathematics. Parental attitudes included attitudes about: (a) mathematics usefulness; (b) academic ability in mathematics; (c) an understanding of the mathematical content; and (d) the perception of the difficulty of the mathematical subject matter. The majority of the participants (six of seven) across all ability groups reported that their parent(s)/family member(s) saw mathematics as useful. Only one of the seven research participants, a low performing research participant, noted that her parent did not see the mathematics content that she was presently learning as useful. In fact, she stated that her parent thought that the mathematics she was learning was completely irrelevant.

Participants also noted that: (a) their parents were good in mathematics (one from the successful and one from the middle performing groups); (b) did not understand mathematics (one from the successful and one from the middle performing groups); and (c) that mathematics was a difficult subject to learn (one from the successful performing group).

Factors the Research Participants' Deem Important to their Success in Mathematics

The research participants spoke about both internal and external factors that they deemed important to their success in mathematics. The seven most frequently reported internal factors that the research participants deemed important to their success in mathematics were: studying mathematics (five participants from all three ability groups), asking the teacher questions (five participants which included all of the successful and middle performing participants), trying their best (four participants including all of the successful and one low performing participant), working hard at the mathematics (four participants including all three of the successful and one middle performing participant), having a good conceptual understanding of the mathematics (four participants including two successful and both middle performing participants), focusing (four participants including all three of the successful and one middle performing participant), and being motivated to do the mathematics (four participants from all three ability groups). Other internal factors mentioned by the research participants as being important to their success included: coming to school prepared (one of seven), having ambition (one of seven), having confidence (one of seven), and having a good relationship with their mathematics teachers (one of seven). The two most frequently reported external factors that the research participants deemed important to their success in mathematics were good

classroom behavior (five participants from the successful and middle performing groups) and family support (five participants from all three ability groups). Other external factors mentioned by the research participants included teachers who: have a good conceptual understanding of the subject matter (two of seven), provide extra help (two of seven), believe in their students (two of seven), explain the mathematics to their students (two of seven), and meet the learning needs of individual students by using multiple strategies to teach them (two of seven). The research participants also mentioned class size (two of seven) and finding supplemental resources related to the mathematics that they were learning (one of seven) as important to their success in mathematics.

Factors the Research Participants' Attribute to Failure in Mathematics

The research participants discussed factors that they perceived to cause failure in the mathematics classroom. The research participants attributed failure to internal causes. For example, over half of the participants (four participants from all three ability groups) expressed that students fail because they do not understand the mathematics content. Also, less than the majority of the research participants reported that students fail because they do not: ask questions (three of seven), try (two of seven), focus (two of seven), pay attention (two of seven). study (one of seven), attempt assessments (one of seven), work hard (one of seven), put any effort into their assessments/assignments (one of seven), think they can do it (one of seven), see the usefulness of the mathematics (one of the seven), want to do the work (one of seven), utilize the resources that are provided to them (one of seven), complete their homework (one of seven), stay awake in class (one of seven), and persevere (one of seven). They also reported that students fail because they give up on themselves (one of seven) and they goof off in class (one of seven). Less

than the majority of the research participants only mentioned two external factors related to student failure including: the teachers are not willing to help (two of seven) and the teachers do not take the time to explain the mathematics (one of seven).

Performance in Mathematics as Compared to Other Academic Areas

The majority of the research participants reported that they perform better in their social science and English classes in comparison to their mathematics classes. None of the research participants reported that they perform better in their mathematics classes. The research participants gave the following reasons why they fail to perform best in mathematics: (a) mathematics takes more time; (b) they will not use the mathematics that they are learning; and (c) they are just better at the other subjects. One research participant, Maria, stated that she feels excited about mathematics for the most part, but sometimes learning mathematics frustrates her. She expressed that she does not feel that same frustration in her other academic classes. These findings that the research participants preferred other academic subjects over mathematics were not surprising given that the research participants' responses to other research questions throughout the study showed a lack of enjoyment and the lack of engagement in the learning and doing of mathematics. The data revealed that research participants failed to give any indication that they really like mathematics or that they view the learning of mathematics as relevant or fun. One of the low performing research participants, Lynn, was asked, "Are you enjoying some of the stuff that you are learning?" She responded, "It's cool because we have to learn it, but if I didn't have to learn it I wouldn't waste my time" (Student Interview 5/25/10). Future mathematics education research focused on females in mathematics in general, and African American females specifically should consider their

enjoyment of mathematics. X. Ma (2001) studied 1200 high school seniors in mathematics and found that “students who experienced more enjoyment learning mathematics achieved higher scores in that subject” (p. 288). Students’ attitudes and love of mathematics will perhaps change when learning mathematics becomes enjoyable.

Barriers to Participants’ Mathematics Performance

The research participants noted that the following four factors served as barriers to their performance in mathematics: lack of confidence, mathematics anxiety, test anxiety, and stereotypes.

Lack of Confidence

The research participants’ lack of confidence served as a barrier to their mathematics performances. The research participants experienced confidence issues in the mathematics classroom in relation to: the fear of discussing their mathematical thinking in the mathematics classroom during whole-class discussions (six participants across all ability groups), fear of answering questions incorrectly in front of their peers (seven of seven), lack of understanding of the mathematical concepts being presented (four participants from the successful and middle performing groups), and difficulty solving long and complex mathematical problems (seven of seven). The confidence issues related to discussing their mathematical thinking or answering questions in front of their peers were described as a fear of being wrong or being viewed as stupid. The lack of confidence associated with the lack of understanding of mathematical concepts related to the participants’ fear of struggling with concepts and problem solving; and the fear of being left behind because they were taking a long time to comprehend the mathematics. The confidence issues related to solving long and complex mathematical problems

surfaced due to a fear of making mistakes and also the desire to solve mathematics problems quickly.

Mathematics Anxiety

In this study, the psychological condition mathematics anxiety was found to limit the mathematics performance of the research participants. The research of Sheffield and Hunt (2006) discussed how mathematics anxiety undermines the confidence of students. All participants interviewed had experienced some degree of mathematics anxiety. The research participants perceived the following factors contributed to their mathematics anxiety: (a) taking a long time to solve complex mathematical problems (seven of seven); (b) considering taking higher level mathematics courses (one participant from the successful participant group); (c) answering questions incorrectly (six participants across all three ability groups); (d) facing mathematics problems for the first time (one participant from the successful group); (e) discussing mathematical thinking in front of peers (five participants across all three ability groups); and (f) taking mathematics tests (seven of seven). The data revealed that mathematics anxiety tended to depress the research participants' performances in mathematics by causing them to lose focus, become disengaged, and shut down. To cope with mathematics anxiety, the research participants once again frequently looked to their teachers for assistance.

Test Anxiety

Test anxiety was also identified as a barrier to the research participants' mathematics performance. All seven participants regardless of ability level experienced some test anxiety due to: inability to complete timed tests (one of seven), fear of making a mistake which leads to second guessing oneself (two of seven), lack of confidence (four

of seven which included all of the successful research participants and one low performing), concern over the length of the test (one of seven), and lack of preparation for tests (one of seven). Two of the seven research participants (a low participant and a middle performing participant) mentioned not feeling anxious if teacher assistance was offered during the test.

Race and Gender Stereotypes

The research participants discussed stereotypes in mathematics in relation to race and gender. Three of the seven research participants were aware of racial stereotypes pertaining to mathematics achievement. Of these three, two of the research participants discussed stereotypes related to students of Asian descent. These participants felt that students of Asian descent perform better academically in mathematics than other races. The other research participant felt that Caucasian students have higher mathematics achievement. It is notable that four of the seven research participants were not aware of any race stereotypes related to mathematics achievement. These four research participants included all of the successful and one of the middle performing research participants. Although one of the research participants included in this percentage verbally acknowledged not being aware of any race stereotypes, she later contradicted that statement when she talked about a stereotype related to African American males and mathematics. Four of the seven research participants were aware of gender stereotypes in the mathematics classroom. The research participants who were not aware of any race stereotypes related to mathematics achievement were all a part of the middle performing and successful groups. Two of the research participants had heard that females perform better in mathematics and two had heard that males perform better in mathematics.

Interestingly, the participants perceived that students of Asian descent and White students are the highest performing students in the mathematics classroom, but all but one failed to mention stereotypes related to whether or not African American students are high-performing or low-performing in the mathematics classroom. One major finding was that none of the participants mentioned stereotypes in relation to being African American females and performing in mathematics.

Recommendations for Practice

As mentioned in Chapter I, African American students continue to be the lowest performing racial and ethnic group in mathematics in the United States. Moreover, in 2008 African American females were the lowest performing gender group on the SAT-M. To improve the mathematical outcomes of these students we must examine and improve how African American female students are taught. The findings of this study lead to recommendations for practice for female African American students. In order for the students to become less teacher dependent, less anxious, more confident, and see the mathematics as relevant and useful, teachers of African American female students have to examine the way that they teach. The results of this study highlighted a need for mathematics teachers to place a greater emphasis on African American female students becoming autonomous learners constructing their own knowledge rather than teachers transferring their knowledge to their students. In a study of 76 six grade mathematics students, Kim (2005) found that “constructivist teaching is more effective in terms of academic achievement of students” (p. 18). Furthermore, when Dart, Burnett, Boulton-Lewis, et al. (1999) conducted a study of 484 secondary students across the four main academic areas including mathematics, they found a positive relationship between self-

concept and “deep approaches to learning” which are defined to be constructivist approaches to learning. Also, Dorman (2001) conducted a study of 1055 mathematics students at the secondary level and found a positive correlation between constructivist learning classroom environments and academic self-efficacy. The present study found that even though the research participants perceived that they possessed a strong sense of efficacy, their behaviors showed that their efficacy was indeed low. Furthermore, Anderson (2005) conducted a case study of seven high school females of different races and ethnicities taking part in a summer mathematics program. Guided by the research literature on feminist and constructivist theories, she gathered information about the mathematical experiences of these seven female students. To gather information she used interviews and classroom observations. The instructors at this summer mathematics program implemented constructivist methodologies. The instructors, “created a supportive environment where the girls were expected to struggle with the mathematics” (p. 178). Also, the instructors “allowed the girls to experience frustration and encouraged them to work through these feelings of struggle” (p. 178). At the end of the summer program which lasted four weeks Anderson (2005) expressed:

All the participants claimed that they would neither want to eliminate the struggling nor want to be rescued from the discomfort that came with it. Instead, they ultimately viewed it as a way to gain authorship or to improve confidence, patience, or persistence as a learner of mathematics (p. 186).

The research participants in this study provided evidence that they were not independent learners, but that they were very teacher dependent. When faced with any difficulty in the mathematics classroom, they discussed either giving up immediately, asking their teachers for assistance, or both. Also, the research participants believed that having a good mathematics teacher was vital to their mathematics performance. As

previously mentioned, the research participants' expectations of a good mathematics teacher included the teacher: (a) presenting the material via lectures; (b) giving thorough examples; and (c) assigning work and being immediately available when questions arose while completing the given assignments. The research participants failed to mention that a good mathematics teacher teaches them effective problem solving strategies or how to engage the mathematics constructively when problems arise.

Having students construct their own knowledge holds students to high standards and expectations and helps them to obtain a more complex understanding of the mathematical concepts being presented. Teachers of African American students must change from being solely information providers to facilitators of mathematics learning. These teachers should continue to offer tutoring and one-on-one instruction, but to a lesser degree. A teacher's guidance and support is necessary in helping to develop students who are strong problem solvers and who think independently. Embracing this pedagogy will move African American female students away from repetition, memorizing rules, recall, and practicing problems and towards thinking deeply about the mathematics, communicating effectively, and gaining proficiency in relation to problem solving so that the learning can be long lasting and transferrable from one mathematical situation to the next. Moreover, embracing this pedagogy will perhaps improve the learning outcomes of these students and improve their sense of self-efficacy. Pushing students to think is critical for success in mathematics rather than the teacher thinking for the students. Although the research participants did not explicitly say that mathematics was repetition, memorizing rules, and recall, they implied it throughout their interviews. Their attitudes towards mathematics was that in order to be successful, you have to work

hard, pay attention, focus, complete work, turn work in on time, pay attention, etc. Once again, these students failed to mention problem solving or figuring the mathematics out on their own. The implication is that these students viewed learning mathematics as a mechanical process, in other words, a memory process.

If African American female students are required to be autonomous learners they will not be satisfied with giving up easily when presented with challenges in the mathematics classroom or exerting little to no effort on test and assignments. Moreover, they will be forced to wrestle with the mathematical material overcoming personal struggles in the process. Allowing African American female students to construct their own knowledge will perhaps assist these students in reaching high learning levels in mathematics and increase their interest in enrolling in future higher level mathematics courses. Furthermore, they will be better prepared to tackle these courses and they will feel more confident pursuing mathematics related careers.

This study found that even though most of the participants mentioned the relevance of mathematics to their career and technical programs, they saw only minimal connections of basic mathematical concepts to their career and technical fields. Another recommendation for teachers in a career and technical setting is for mathematics teachers at these schools to connect the mathematics being taught to the mathematics involved in the students' career and technical programs. Moreover, the colleagues teaching the career and technical areas should highlight the importance of mathematics to their various career fields. This connection will perhaps make the mathematics that the students are learning relevant to something that they are interested in and improve students' attitudes, beliefs, and motivations in relation to the learning and doing of mathematics. This may

perhaps enable the students to see mathematics as valuable and purposeful and better prepare them to tackle the mathematics required for their fields of study at the university level or in their workplaces. As mentioned in Chapter IV, none of the research participants mentioned that their mathematics teachers integrate applications from their career and technical programs into their mathematical instruction.

This study found that African American female students lack confidence in relation to whole class discussions and public performance. Another recommendation for mathematics teachers is to create a mathematics classroom that is not competitive. Mathematics teachers should attempt to find ways to reward students in the mathematics classroom independent of correct answers. Also, they should attempt to create a classroom environment that is exploratory, nurturing, and places the responsibility of the class to come to solutions rather than directly trying to guide the students immediately to the correct answer.

One last recommendation for teachers is that they should perhaps find ways to increase parent participation in their child's education. One way to increase parent participation is to offer joint mathematics tutoring for parents and their children. This may perhaps, change parents' negative attitudes about mathematics.

Future Research

This study provided an in-depth examination of the mathematical experiences of seven African American female students from their perspectives. The findings of this study included factors that they perceived either as being important to or barriers to their performance in mathematics. The findings of this study have the potential to improve the performance of the African American female student in mathematics. The research

participants for this study were African American female students from different ability groups enrolled at a career and technical school. One recommendation is that future studies compare the perceived mathematical experiences of African American female students from different ability groups at a career and technical school with the perceived mathematical experiences of African American female students from different ability groups at a traditional high school to see if their experiences are similar. Also, another recommendation would involve Latina students. Since Latina students are also a low performing racial/ethnic group a researcher could interview seven Hispanic females about their perceived mathematics experiences and compare their experiences to the experiences of the seven African American female students included in this study to see if the same themes emerge (i.e., teacher dependency, lack of confidence, attitudes towards mathematics usefulness). Research of this sort would provide data related to how race and gender affect the mathematical experiences of students from different races and ethnicities. A study of this sort will add to the mathematics education literature pertaining to how race and gender affects the mathematical experiences of students. Additionally, another recommendation is to examine the perceived experiences of African American female high school students in single-sex classes to see if the same themes emerge. Also, another recommendation for a future study would involve interviewing African American female students whose teachers are utilizing constructivist teaching methods and examining their attitudes, confidence, anxiety and belief systems in relation to mathematics. Additionally, another recommendation for a future study would involve investigating the culture of the African American student. The following question should be investigated: Are some African American students

teacher dependent because of factors directly related to their cultural background?

Furthermore, another recommendation for a future study is to increase the overall sample size of the study in general and each ability group specifically. Thus, additional research needs to be considered with a larger sample size to produce more data in relation to the mathematics experiences of African American females and to increase the confidence of the results in this study. Another recommendation is to do a follow up study with the research participants two years after the research study to see if their perceptions of their mathematical experiences changed through the years or to see if they: continued on to postsecondary education, enrolled in higher level mathematics courses while participating in postsecondary education, or pursued their desired career.

Limitations

There were various limitations to this research study. This study was limited to the mathematical experiences of African American female high school students at a career and technical school. Only including students from a career and technical school limits the generalizability of the research findings to other high schools that are not career and technical schools. As mentioned in the future study section of this chapter, it is desirable that a similar study of African American female students at a regular high school be conducted to investigate their mathematical experiences, and verify the results found in this study. Also, since this study only involved African American females, the research findings were unique to the mathematical experiences of African American female students. Additionally, a second limitation was that out of 23 career and technical programs offered at the research site only the following four career and technical programs of study were represented among the seven research participants: Cosmetology,

Health Technology, Early Childhood Education, and Culinary Arts. One of the career and technical programs linked to STEM fields and offered at the research site, Engineering Technologies and Robotics, was not represented by any of the research participants. A third limitation of the present study was that although none of the research participants were students of the researcher, the researcher was an African American female teacher at the research site. As a result, the students could have been cautious or not forthcoming about their answers to some of the interview questions as might the teachers. A fourth limitation of the research study was the small sample size of seven African America females. As mentioned previously increasing the sample size of the study will make the results more generalizable. A fifth limitation of the present study was that all of the mathematics students at the site were asked to complete mathematics autobiographies by their mathematics teachers earlier in the year. The students were required to put their names on their mathematics autobiographies before turning them in; therefore, the students' mathematics autobiographies were not anonymous. Failure to make these mathematics autobiographies anonymous could have resulted in false or bias responses. One recommendation is to find ways to make the mathematics autobiographies anonymous. Lastly, this study was limited because even though the teachers of the research participants were interviewed to cross reference the data, the students were not observed in their classroom settings. Observing the research participants in their mathematics classrooms could have given the researcher the opportunity to observe how the participants interacted with the teacher and their peers which would have been another way to validate the research findings by triangulating the data.

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APPENDIX A: STUDENT INTERVIEW PROTOCOLS

Interview Protocol 1

1. What mathematics course will you take next year? How do you feel about taking that course?
2. Describe how you feel when you are asked to solve mathematics problems in your career and technical program. In your daily life.
3. Describe how you feel when you have to discuss your mathematical thinking in a group of your classmates.
4. Describe how you feel when you are asked to do a hard mathematics problem that will take a long time to solve.
5. Do you usually think you can learn the mathematics even if the mathematics content is difficult?
6. Are you confident learning mathematics?
7. Describe how you feel when you are in the mathematics classroom compared to English, social studies, science and career technical.
8. Which class do you prefer to be in? Why?
9. Describe how you feel when you are taking a mathematics test.
10. Describe times when you don't feel confident in the mathematics classroom?
11. Describe the ideal mathematics classroom.
12. Do you believe that the mathematics that you are learning will be useful once you graduate from high school? Explain.
13. What does it take to be a good mathematics student?
14. Do your friends influence how you feel about mathematics?
15. Does your teacher influence how you feel about mathematics?
16. Do your friends influence your learning in the mathematics classroom?
17. Do your friends like mathematics?
18. Do you see people doing math in the real world? Where?
19. Are you aware of any stereotypes about your gender and mathematical ability?
20. How do your family members feel about math?
21. What do your family members say about math?

Interview Protocol 2

1. Describe how you feel when you are asked to answer a question during mathematics class.
2. Describe your family's role in your education?
3. What expectations do your parents/family members have of you in relation to mathematics?
4. How do your parent's/family react when you do well in mathematics?
5. How do they react when you don't do well in mathematics?
6. Did you have a person who inspired you to do well in mathematics?
7. Are you aware of any stereotypes about who does well in mathematics and who does not?

8. Do you think these stereotypes influence your success or your difficulties in learning mathematics? Explain.
9. Is the mathematics that you are learning in high school useful outside of the classroom?
10. Why do you think you are required to learn mathematics?
11. What lessons can other African American female students learn from you to help them do well in mathematics?
12. What do you think your friends think of you as a mathematics student? Do your friends encourage you to do well in mathematics?
13. What does your mathematics teacher expect of you?
14. Do you think that your mathematics teacher believes you can do mathematics?
15. Does what the teacher expects of you academically affect your actual performance or lack thereof in the mathematics classroom? If so, how?
16. Do you feel that your mathematics teacher holds different expectations for different students?
17. Do you see people on TV, in the movies and in the news doing math? Tell me about that.
18. Describe your past and present mathematics teachers' roles in your education?
19. Describe a good mathematics teacher.
20. What do you think makes a good mathematics teacher?
21. Do you feel that your mathematics teacher understands your culture? Explain.
22. Do you feel that your mathematics teacher understands you?
23. How have you impacted your own math performance?
24. How have others impacted your math performance?

APPENDIX B: TEACHER INTERVIEW

Teacher Interview Protocol (Berry, 2002)

This research will provide descriptive information about the mathematical experiences of a select few African-American female high school students who are succeeding and struggling in mathematics by examining the factors that affect their learning and persistence. You do not have to answer a question if you do not want to. I will assure your confidentiality. Your name will not appear on the interview protocol. If you decide you do not want to participate, please let me know. You can withdraw or discontinue your participation at any time without further obligation. The interview should take about 45-60 minutes to complete. Is it O.K. if I ask you some questions now?

1. How do you see your role in your student's education?
2. What is a successful mathematics student?
3. Describe student's name as a mathematics student.
 - a. What are her strengths
 - b. What are her weaknesses
4. Describe student's name mathematics performance in regards to his mathematics abilities.
5. Describe student's name mathematics placement in regards to his abilities.
 - a. Do you think student's name has the potential to do well in mathematics related career fields.
 - b. Do you think student's name has the potential to do well as she goes on to take more advanced mathematics classes?
6. What expectations do you have of your students in mathematics?
 - a. Does student's name meet your expectations?
7. Describe student's name interactions (w/teacher and other students) in mathematics class.
 - a. How is student's name perceived by other students in his class?
 - b. Are student's name friends' good mathematics students?
8. In mathematics class, how does student's name prefer to work?
9. Has student's name reacted more positively to a particular teaching method (whole class, instruction, cooperative learning, or individual seat work)?

APPENDIX C: MATHEMATICS AUTOBIOGRAPHY

The following mathematics autobiography protocol was adapted from Berry (2002).

1. Recall and describe in detail specific personal experiences you have had in the mathematics classroom from elementary to high school. Write about experiences when you were successful in the classroom and also experiences when you were unsuccessful. All experiences can be either positive or negative experiences. Describe completely how you felt during each experience.
 - a. What are your first memories of learning math?
 - b. What was it that drew you towards mathematics or pushed you away?
 - c. Describe how you feel when you really understand the mathematics being taught.
 - d. Describe how you feel when you don't understand the mathematics being taught.
 - e. When you face a mathematics problem for the first time what are you thinking? How are you feeling?
2. When did you first realize that you were "good at math" or that "math wasn't your best subject"?
 - a. Describe in detail how you came to believe this.
 - b. How did you feel when you came to realize your strengths and/or weaknesses in mathematics?
 - c. Who was involved in helping you know that you were either "good in math" or that "math wasn't your best subject."
 - d. Are you confident in your mathematical abilities? Why or why not?
 - e. What is a successful mathematics student?
 - f. Are you interested in taking more challenging mathematics courses?
3. Who currently has the most influence on your achievement in the mathematics classroom?
4. Describe ways where you find mathematics useful in or out of the mathematics classroom?
5. Compare your mathematics experiences with your experiences in other subjects (i.e., English, social studies, science).
6. What subject area would you say you are the most successful? Why do you feel that way?
7. Give three reasons why you think students fail in the mathematics classroom. Expand on your reasons.
8. Give three reasons why you think students succeed in the mathematics classroom.
9. What are your future career aspirations?
10. Why do you think that other students fail in mathematics?

APPENDIX D: FENNEMA-SHERMAN MATHEMATICS ATTITUDE SCALE (1976)

Please read the following items and rate what **YOU** feel about mathematics. Circle one and only one number based on your feelings. The number **1** means that you **Strongly Disagree** and **5** means that you **Strongly Agree**. Answer honestly. You will not be penalized. All responses are completely confidential.

SD-Strongly Disagree

N-Neutral

SA-Strongly Agree

	SD		N		SA
1. Generally I have felt secure about attempting mathematics	1	2	3	4	5
2. I am sure I could do advanced work in mathematics	1	2	3	4	5
3. I am sure that I can learn mathematics	1	2	3	4	5
4. I think I could handle more difficult mathematics	1	2	3	4	5
5. I can get good grades in mathematics	1	2	3	4	5
6. I have a lot of self-confidence when it comes to math	1	2	3	4	5
7. I'm no good in math	1	2	3	4	5
8. I don't think I could do advanced mathematics	1	2	3	4	5
9. I'm not the type to do well in math	1	2	3	4	5
10. For some reason even though I study, math seems unusually hard to me	1	2	3	4	5
11. Most subjects I can handle o.k., but I have a knack for flubbing up math.	1	2	3	4	5
12. Math has been my worst subject	1	2	3	4	5
13. I'll need mathematics for my future work	1	2	3	4	5
14. I study mathematics because I know how useful it is	1	2	3	4	5

15. Knowing mathematics will help me earn a living	1	2	3	4	5
16. Mathematics is a worthwhile and necessary subject	1	2	3	4	5
17. I'll need a firm mastery of mathematics for my future work	1	2	3	4	5
18. I will use mathematics in many ways as an adult	1	2	3	4	5
19. Mathematics is of no relevance to my life	1	2	3	4	5
20. Mathematics will not be important to me in my life's work	1	2	3	4	5
21. I see mathematics as a subject I will rarely use in my daily life as an adult	1	2	3	4	5
22. Taking mathematics is a waste of my time	1	2	3	4	5
23. In terms of my adult life it is not important for me to do well in mathematics in high school	1	2	3	4	5
24. I expect to have little use for mathematics when I get out of school	1	2	3	4	5
25. Studying mathematics is just as appropriate for women as for men	1	2	3	4	5
26. It wouldn't bother me at all to take more mathematics classes	1	2	3	4	5
27. Mathematics makes me feel uncomfortable, restless, irritable, and impatient	1	2	3	4	5
28. I have a lot of self-confidence when it comes to math	1	2	3	4	5
29. I get a sinking feeling when I think of trying hard math problems	1	2	3	4	5
30. My mind goes blank and I am unable to think clearly when working mathematics	1	2	3	4	5

CURRICULUM VITAE

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ACADEMIC BACKGROUND

2004 – 2011	Ph.D., University of Louisville
Major: Curriculum & Instruction – Secondary Mathematics Education
Dissertation: <i>Yes We Can Achieve in Mathematics and Why We Don't: African American Female Eleventh and Twelfth Grade Students In A Career and Technical Setting</i>
Advisor: Dr. Karen Karp
Graduation Date: December 2011
2000	M.A., University of Kentucky
Major: Secondary Mathematics Education
1998	B.A., University of Kentucky
Major: Secondary Mathematics Education
Minor: Statistics

PROFESSIONAL EXPERIENCE

2001 – Present	Secondary Mathematics Instructor
Great Oaks Institute of Technology and Career Development
Scarlet Campus
Teach: Algebra I, Algebra II, Geometry, Pre-Calculus, College Algebra, and Statistics.
2004 – Present	Adjunct Faculty
Hocking College
Department of Mathematics

Teach: College Algebra

2000 – 2001 Secondary Mathematics Instructor
Holmes Junior High School
Taught: Pre-Algebra, Algebra I, and Geometry

RESEARCH INTEREST

African American students and their barriers to achievement in mathematics.

Battling the needs of a diverse population in mathematics education.

Mathematics and Test Anxiety

PRESENTATIONS AND PUBLICATIONS

Mayes, C. (2007, January). A review: Rooted in place: Family and belonging in a southern black community. *Rural Mathematics Educator*, 5(3).

Mayes, C., Granade, S., Schlesinger, P., Waggoner, D. (2006, April). *Mathematics Anxiety Perceptions of College Students*. Presented at the National Council of Teachers of Mathematics. St. Louis, Missouri.

Mayes, C., Brown, E. L. (2007, June). *Understanding and Reducing Mathematics Anxiety in 9th Graders: Influencing Perceptions and Behaviors toward Mathematics*. Accepted for presentation at the Annual Learning Conference. Johannesburg, South Africa.

Brown, E. L., Johnson, V., Lewis, B., Morgan, C., **Mayes, C.** (2002, November). *Affecting student perceptions through photography, mentoring, and immersion: a cultural perspective in black and white*. Presented at the Twenty Second Annual Lilly Conference on College Teaching. Oxford, Ohio.

Brown, E. L., **Mayes, C.**, Martin, M. (2000, June). *Effectively transmitting multicultural precepts and fostering cultural diversity sensitivity in an increasingly restrictive environment*. Presented at National Conference on Race & Ethnicity in American Higher Education. Santa Fe, NM.

Brown, E. L., **Mayes, C.** (2000, November). *Future Teachers, "Picture This": Whose Culture? Whose Community?* Presented at the Twentieth Annual Lilly Conference on College Teaching. Oxford, Ohio.

Articles in Progress:

Mayes, C., Brown, E.L. Reducing Mathematics Anxiety in 9th Grade Students:
Culturally relevant instructional practices.

HONORS AND AWARDS

Graduate Dean's Citation Award, December 2011

Southern Regional Education Board Doctoral Fellowship, 2010

Applause Magazine's "African American Leader of the Future," 2005

ACTIVITIES

Scarlet Oaks Associate Equity Council

Co-sponsor of the One Community (inclusion for all students)

Scarlet Oaks' Leadership Team

African American Professional Development Symposium Panelist

Mathematics Department Chair

Co-Sponsor of the National Technical Honor Society

Appalachian Collaborative Center for Learning, Assessment and Instruction in
Mathematics (ACCLAIM) Leadership Institute.

Youth Advisory Council Member

Member of Technology Integration in the Classroom—Teachers Applying
Concepts.