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Experiences of African American Young Women in Science, Technology, Engineering, and Mathematics (STEM) Education

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Walden University
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Abstract

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by

Yovonda Ingram Kolo

M.Ed., Bowie State University, 2000

B.S., Virginia State University, 1994

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

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Abstract

African American women are underrepresented in science, technology, engineering, and mathematics (STEM) fields throughout the United States. As the need for STEM professionals in the United States increases, it is important to ensure that African American women are among those professionals making valuable contributions to society. The purpose of this phenomenological study was to describe the experiences of African American young women in relation to STEM education. The research question for this study examined how experiences with STEM in K-10 education influenced African American young women's academic choices in their final years in high school. The theory of multicontextuality was used to provide the conceptual framework. The primary data source was interviews. The sample was composed of 11 African American young women in their junior or senior year in high school. Data were analyzed through the process of open coding, categorizing, and identifying emerging themes. Ten themes emerged from the answers to research questions. The themes were (a) high teacher expectations, (b) participation in extra-curricular activities, (c) engagement in group-work, (d) learning from lectures, (e) strong parental involvement, (f) helping others, (g) self-efficacy, (h) gender empowerment, (i) race empowerment, and (j) strategic recruitment practices. This study may lead to positive social change by adding to the understanding of the experiences of African American young women in STEM. By doing so, these findings might motivate other African American young women to pursue advanced STEM classes. These findings may also provide guidance to parents and educators to help increase the number of African American women in STEM.

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Dedication

First, I dedicate this work to my daughter Naomi Kolo. You entered this world while I was on this dissertation journey and your presence has inspired me to complete this journey. Always know that you can be anything you want to be! Faith in God, hard work, perseverance, and endurance will get you there. Second, I dedicate this work to my mom, Dorothy Ingram Brooks. You were in this world when I started this journey, but you transitioned into eternal life before I finished this journey. Your smile, your voice, and your belief that I could be Dr. Kolo constantly inspired me to keep moving forward. Third, I dedicate this work to my father-in-law, Ambassador James Tsado Kolo (BaBa). BaBa, along with my mom, has transitioned to be with our Heavenly Father, but his words of wisdom have remained with me as a source of inspiration.

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Lastly, thank you to my “Diamond Club” girls. Your energy and thirst for learning about STEM inspire me to do what I do. I Shine Bright Like a Diamond!

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Chapter 1: Introduction to the Study

The intent of this study was to describe the experiences of African American young women in relation to science, technology, engineering, and mathematics (STEM) education. STEM education is an inquiry approach to acquiring scientific, technological, engineering, and mathematics knowledge to identify issues, acquire new knowledge, and apply that knowledge to STEM-related issues (Bybee, 2010). Research exists on the underrepresentation of all women in STEM, however, research on the experiences of African American women in STEM is limited. Malcom and Malcom (2011) found that the experiences of African American women in STEM are different from other female groups in STEM. Additionally, the absence of African American women in STEM represents untapped potential needed for growth in STEM fields (Leaper, Farkas, & Brown, 2011; Malcolm & Malcom, 2011; Ong, Wright, Espinosa, & Orfield, 2011). In Chapter 1, the focus of this study will be introduced including the problem statement, purpose, research questions, and a brief overview of the methodology. The theory of multicontextuality (Ibarra, 2001) will be highlighted as the conceptual framework and the significance of the study will be described.

Background

To help ensure economic growth and sustainability, the United States' economy depends on a citizenry that possesses scientific and technical skills within the STEM disciplines (Hill, Corbett, & Rose, 2010; McNally, 2012). In order to meet the needs of its workforce, the United States must examine ways to prepare all of its citizens for success in STEM careers. According to Koledoye, Joyner, and Slate (2011), it is of

paramount importance for students, the nation, and the world that diverse populations enter STEM fields. Having STEM professionals from a variety of backgrounds can increase the likelihood of new innovations and problem solving (Koledoye et al., 2011).

Improving recruitment and retention of women in the STEM fields is a critical challenge facing the nation (Malcolm & Malcom, 2011). In an increasingly globalized world, scientific advancement and innovation are important for maintaining national security, economic competitiveness, and quality of life for our citizens (Ong et al., 2011). The United States takes deserved pride in the vitality of its economy, which forms the foundation for a high quality of life, national security, and hope that American children and grandchildren will inherit greater opportunities (National Academy of Sciences, National Academy of Engineering, and Institute of Medicine, 2007). This vitality is derived in large part from the productivity of well-trained people and the steady stream of scientific and technical innovations they produce. Without high-quality, knowledge-intensive jobs and the innovative enterprises that lead to discovery and new technology, the U.S. economy will suffer and the people will face a lower standard of living (National Academy of Sciences et al., 2007).

African American women represent untapped human capital in the STEM fields. Increased participation of African American women in the STEM fields could increase economic vitality (Committee on Equal Opportunities in Science and Engineering [CEOSE], 2009). The underrepresentation of women is also a critical issue for the nation at large as the need to develop a globally competitive and diverse workforce increases (National Science Foundation [NSF], 2010). The underrepresentation of women and

minority groups in building and nurturing new talent pools of scientists and engineering continues to be a problem (CEOSE, 2009). Table 1 represents NSF and CEOSE data on the segmented attainment by race of STEM degrees at all levels of graduate study.

Table 1

Demographics of Students in Science and Engineering Graduate Programs, 2010

Total Enrollment	556,532
Male	57%
Female	43%
Caucasian	47.6%
African American	8.0%
Asian or Pacific Islander	6.2%
Hispanic	6.2%
American Indians	< 1%

The data demonstrate a noticeable gap between Caucasian and non-Caucasian women and the gap widens at the doctoral graduate level. The NSF (2010) reported that there were 20,560 doctoral degrees awarded in a science or engineering program in 2009. The overall female population made up 47% of the total graduates. The 47% represented a 7% increase from 1998. While the overall enrollment of women in STEM programs has increased, a large gap remains between Caucasian and non-Caucasian women (Leaper et al., 2011). Hispanics and African Americans combined accounted for 5% of STEM degrees in 2008 while American Indians accounted for only 0.6% (CEOSE, 2011).

Data show that women are underrepresented in the STEM fields (American Association for University Women, 2010; National Science Foundation, 2008). Perna,

Lundy-Wagner, Yoon, Bose, and Gray (2009) found that the barriers that contribute to the underrepresentation of African American women in STEM fields begin to arise during elementary and secondary school. The lack of role models has been identified as a barrier African American young women face when considering STEM classes and careers (Milgram, 2011). The lack of support from school or career counselors also acts as a barrier to increasing the number of African American women in STEM classes and careers (Morganson, Jones, & Major, 2010). Additionally, stereotyping is an obstacle that African American women face when expressing interest in STEM classes and careers (Shapiro & Williams, 2012).

Weber (2011) noted that role models have a positive impact on female students. Exposures to role models in the STEM fields have improved students' attitudes toward STEM. Additionally, Weber noted that female students who find female role models in the scientific community are more likely to pursue their interests in science. Milgram (2011) also emphasized the importance of female role models for STEM students and professionals. Milgram found that girls and women need to see other women in their academic and professional areas of interest in order for them to make personal connections to the STEM fields. Additionally, Milgram acknowledged that girls and women need to receive the message that they can be successful in the STEM fields while still having a personal life, and they need to receive that message repeatedly. Ensuring that African American young women are connected to role models throughout their schooling and professional careers will aid in increased participation and retention (Milgram, 2011; Weber, 2011).

Morganson, Jones, & Major (2010) noted that counselors play an important role in helping to increase the number of African American women entering STEM classes and careers. West-Olatunji and Shure (2010) stated that counselors are an untapped resource for increasing mathematics and science interest among African American young women. Counselors who provide young women with coping strategies to manage male-dominated STEM classes, connect STEM female students to STEM female mentors, help STEM female students form study groups, and encourage STEM female students to join STEM-specific female organizations provide needed encouragement for young women to remain in STEM classes (Morganson et al., 2010). Conversely, counselors who have negative stereotypes about girls in STEM classes and provide little support to them continue to build barriers (West-Olatunji & Shure, 2010). As stated by Appel, Kronberger, and Aronson (2011), negative stereotyping plays a role in the decision-making process for girls in STEM.

Stereotype threat is conceived as a state of psychological discomfort that, if sufficiently acute, can impact interest and performance (Appel et al., 2011). Girls in STEM classes and women in STEM careers have been stereotyped as low achievers (Gunderson, Ramirez, Levine, and Beilock, 2012). Gunderson et al. further stated that negative stereotypes about women's STEM abilities are transmitted to girls by their parents and teachers as early as preschool and elementary school. As a result, these negative stereotypes shape girls' attitudes and ultimately undermine their performance and interest in STEM classes and careers. Consequently, stereotype threat impacts the

academic and professional direction that African American women pursue and hinders their abilities to develop in the STEM areas (Appel et al. 2011).

Shapiro and Williams (2012) acknowledged that considering the phenomenon of stereotype threat can lead to an understanding of how stereotypes can undermine women's and girls' performance and interest in STEM classes and careers. Educating parents, teachers, and counselors on stereotyping and providing them with the needed skills to encourage African American women to enter STEM classes and careers can be beneficial as educators work to increase female interest in the STEM fields (Morganson et al., 2010; West-Olatunji & Shure, 2010). Additionally, connecting African American female students with female role models and ensuring that they have a strong support group will also aid in increased interest and retention of African American women in the STEM fields.

Morganson et al. (2010) stated that the lack of mentoring and coping support in the STEM environment has been particularly harmful to African American women. The STEM environment tends to be male-dominated, highly impersonal, and often hostile to women and minorities (Hanson, 2009; Morganson et al., 2010). Weber (2011) and Milgram (2011) found that women are drawn to environments in which they can build relationships and make interpersonal connections. West-Olatunji (2010) and Morganson et al. (2010) described the importance of counselors and how they impact young women's choices. Counselors tend to have lower expectations for African American women in STEM classes and careers resulting in lower recruitment in the STEM fields (West-Olatunji & Shure, 2010). African American women face a double stereotype of

race and gender that creates an even larger barrier when considering STEM classes and careers (Appel et al., 2011; Shapiro & Williams, 2012). The studies described above represent quantitative research. In this study, qualitative research will allow the voices of women to be heard.

Though recent research has examined barriers that all females face in the STEM fields, a gap in the research literature remains regarding African American women's experiences in STEM. Hanson (2009) stated that it is a mistake to think of women as an undifferentiated group and added that not all women have the same experiences in STEM education and occupations. Examining the gap in the research related to the experiences of African American women may provide valuable information needed to increase participation of African American women in STEM.

Milgram (2011) stated that society is enriched when women fully contribute to the advancement of science and technology noting that they bring different perspectives that shape and influence STEM disciplines. Having more women involved in STEM disciplines will not only help women themselves, it will also help society benefit from their expertise. For example, the presence of women will help ensure that women are included in clinical trials for medical research (Milgram, 2011). Improving the participation of women in STEM fields is necessary not only because of social justice goals but also to more fully tap the human resources that ensure America's economic competitiveness in a global society (Perna et al., 2009).

Ong et al. (2011) argued that the current underrepresentation of women of color in STEM fields represents an unconscionable underutilization of our nation's human capital.

Ong et al. also noted that the absence of women of color in the STEM fields raises concerns of equity in the American educational and employment systems. Failure to advance the education of women of color and move them into productive STEM careers represents a failure of the United States to maximize America's talent pool (Ong et al., 2011). In order to understand the true nature of obstacles faced by African American women in STEM, we must continue to examine information differentiated by race and by gender (CEOSE, 2011; Malcom & Malcom, 2011).

The CEOSE (2011) believe that there are students in every school district that have the potential to become STEM scholars. However, far too many of our most able students are neither discovered nor developed, have not been inspired to pursue STEM, or face numerous other barriers to achievement (CEOSE, 2011). African American women represent many of the underdeveloped STEM students and professionals. The United States has an untapped population of African American women that could be the scientists, engineers, and innovators of the future (CEOSE, 2011; Malcom & Malcom, 2011; Milgram, 2011).

Problem Statement

The problem that this qualitative phenomenological study addressed was a gap of scholarly knowledge examining the experiences of African American women in relation to STEM education. The societal problem addressed in this study was the underrepresentation of African American women in the STEM fields. As barriers are examined related to women in the STEM fields, attention must be given to the gap that exists between African American women compared to other groups of women in the

STEM discipline. Although the absence of all women in the STEM fields is worrisome, the absence of African American women in STEM fields presents itself as a greater concern. As efforts are made to increase female participation in the STEM fields, African American women's absence must be examined in isolation in order to identify barriers directly related to the experiences of African American women (Hanson, 2009; Malcolm & Malcom, 2011).

Purpose

The purpose of this qualitative phenomenological study was to describe the lived experiences of African American young women in relation to STEM education. The study will help to ensure that the voices of African American young women are heard as educators strive to make informed decisions on strategies to increase female participation in STEM classes, clubs, and careers. Developing an understanding of African American young women's experiences related to STEM may identify effective counseling and role modeling processes that will aid educators in making needed adjustments to ensure participation of African American young women in the STEM fields. Additionally, understanding external variables that impact African American young women as they encounter STEM education will help educators, parents, and organizations identify institutional practices that may be acting as barriers to the success of young women in STEM classes.

Research Questions

The central question for this research study is: How do STEM experiences in K-10 education influence African American young women's academic choices in their

final years of high school?

The following subsidiary questions are designed to elicit responses that describe the lived experiences of African Americans young women related to STEM education:

1. What are the formative K-10 educational experiences and perceptions of African American young women in their junior or senior year of high school in relation to STEM experiences?
2. How does the distinction between high and low context illuminate the experiences of the participants?
3. How have participants' STEM experiences influenced decisions related to future career options?
4. What recommendations from African American female students will help improve recruitment practices in STEM classes?

Conceptual Framework

This study was based on the conceptual framework of Hall (1977) and Ibarra (2001). Hall stated that patterns within cultures frame the context of interactions and relationships. High context cultures are identified as predominantly ethnic minorities and females. Low context cultures are predominately northern European ethnic groups and majority males (Ibarra, 2001). Cultures toward the high end of the continuum tend to look at the big picture and look for meaning. Conversely, cultures on the low end of the continuum focus on words and facts. Ibarra used Hall's high and low cultural context work to develop the theory of *multicontextuality*.

The theory of multicontextuality is a collection of cultural context and cognitive models (Ibarra, 2001). Ibarra stated that multicontextuality is a person's ability to think and perform in different contexts in response to varying situations. Ibarra proposed the high and low context as a way of understanding different cultural orientations. Ibarra asserted that individuals who are successful in education display characteristics that are interchangeable with models of cultural context and bicognition. In Chapter 2, the characteristics of high context cultures will be examined as connections are made to African American young women in the STEM fields.

Nature of the Study

The purpose of this study was to describe the lived experiences of African American young women in relationship to STEM education. Creswell (2013) stated "a phenomenological study describes the common meaning for several individuals of their lived experiences of concept or a phenomenon" (p. 76). For the purposes of this study, phenomenology was the approach that was used to understand the experiences of African American young women related to science education.

The phenomenological approach was the most appropriate approach to use in order to capture the voices and experiences of African American young women related to STEM education. The data generated from this study will provide a foundation to initiate changes that will support participation of African American young women in STEM classes, clubs, and careers.

Definitions

In order to facilitate clarity of thought throughout this research, the following terms and definitions are provided.

Multicontextuality: A person's ability to think and perform in different contexts in response to varying situations (Ibarra, 2001).

Role Model: People who exemplify success and achievement in a field (Rosenthal, Levy, London, Lobel, & Bazile, 2013).

STEM: The acronym used to describe Science, Technology, Engineering, or Mathematics classes or careers (National Academy of Sciences et al., 2007).

STEM education: An inquiry approach to acquiring scientific, technological, engineering, and mathematics knowledge to identify issues, acquire new knowledge, and apply the knowledge to STEM-related issues (Bybee, 2010).

Stereotype threat: Stereotype threat is a concern or anxiety that one's performance or actions can be seen through the lens of a negative stereotype (Steele, Spencer, & Aronson, 2002).

Assumptions

I assumed that the participants in this study would participate willingly and share their experiences about STEM education honestly. I assumed that the purposeful sampling strategy and voluntary nature will identify participants who would be able to reflect and articulate their experiences. I also assumed that the interviews would provide a useful database of information upon which interpretations and conclusions can be drawn.

Scope and Delimitations

The study was confined to interviewing African American young women in their junior or senior year of high school about their experiences related to STEM education. There was no attempt to include perceptions of young women other than those who are purposefully selected participants for this study. The omission of other ethnic groups as well as teachers and parents delimit this study. Additional perceptions about the experiences related to STEM education could provide important sources of data that are not within that scope of this study.

Data collected and analyzed from African American young women through the interview process was transferrable to educators and parents. The information can be used by educators in kindergarten through Grade 12 to develop programs that will promote interest and achievement for girls in the STEM areas. The information can also be used by parents to ensure that parents understand how influences and motivations from outside of the classroom play a vital role in the decision making process for girls.

Limitations

A possible limitation of this study may include the lack of generalizability of findings beyond the specific research group. Creswell (2013) noted that limitations of the phenomenological approach are that the findings cannot be generalized, although much can be learned from them. Also, the participants in this study were asked to reflect on all of their STEM experiences. The reflection process is a limitation because participants may not be able to accurately recall their early experiences related to STEM. Additionally, my own biases as an African American woman who studied science,

educated others in science, and supervises science teachers may be a limitation. During the process, it was extremely important for me to have acknowledged my prior experiences and biases. Therefore, I kept a bracketing journal to reflect on such conflicts if they arose.

Significance

Data collected and analyzed from this research will provide guidance to educators as efforts are made to increase the participation of African American young women in the science fields. Hearing the voices of the African American young women and listening to their perspectives on STEM education may be valuable as their social supports are examined. Ensuring that African American young women gain access to STEM experiences early in their schooling while receiving needed support will aid in the increase of STEM professionals needed to grow and sustain the United States economy. Additionally, focusing specifically on African American young women will add value to the research that currently exists on all women in the STEM fields. Gaining a deeper understanding of why a gap exists between African American young women compared to other female groups in the STEM fields will be beneficial as efforts are made to increase the overall number of women in the STEM fields.

Summary

This study was inspired by the need to increase the number of African American young women entering the STEM fields. Using a phenomenological approach to explore the experiences of African American young women related to STEM education will provide much needed information from the population that this study is attempting to

impact. Making connections to multicontextuality and identifying cultural characteristics that African American young women exhibit will aid educators making decisions about recruitment and retention practices in STEM classes.

Chapter 1 included an introduction to the research topic. Chapter 2 will review related literature and relevant research. The methodology and procedures used to gather data for the study will be presented in Chapter 3. Chapter 4 of this study will report the findings. Interpretations of the findings, related conclusions, implications for social change, and recommendation for further study will be found in Chapter 5.

Chapter 2: Literature Review

Women and minorities are underrepresented in the STEM areas (Adam, 2013). In addition to the gap that exists between the number of men and women in the STEM areas, a gap exists between Caucasian and non-Caucasian women (Malcolm & Malcom, 2011). The purpose of this qualitative phenomenological study was to examine the experiences of African American young women in relation to STEM education.

Malcom and Malcom (2011) stated that examining barriers related to the underrepresentation of women in STEM is critical and that special attention must be given to women of color. African American women's experiences related to race and gender represent a double bind as described by Malcom and Malcom. Identifying and overcoming barriers related to race and gender will be critical as work is done to increase the number of African American women in the STEM areas.

Hazari, Sadler, and Sonnert (2013) noted that "the experience of a woman of color is not necessarily the combined experience of being a woman and being of color—it can be unique in and of itself" (p. 84). Therefore, it is important to understand the intersection of race and gender as it relates to STEM. Leggon (2010) noted that it is important to identify differences between women and ethnicity stating, "gender impacts how race and ethnicity are experienced; and race and ethnicity impact how gender is experienced" (p. 688). As stated by Hazari et al. (2013), not all women or all underrepresented minorities are alike. Therefore, it is important to examine the unique experiences of race and gender that contribute to the underrepresentation of African American women in STEM.

This literature review begins with an overview of the conceptual framework. Next, current research findings are synthesized to address the research questions and the phenomenon of the study. Efforts were made to ensure that the literature review is comprised of current, peer-reviewed articles. Multiple databases were used to identify peer-reviewed research articles ranging from 2010 to present. However, articles relating to historical trends or providing historical information may date back further than five years.

The database searches included but are not limited to the following: ProQuest, Sage, ERIC, ScienceDirect, and EBSCOhost. Key words and phrases used to search for the literature included (a) African American women and science, (b) women and STEM, (c) women and science, (d) women and mathematics, (e) culturally relevant classroom (f) STEM stereotypes, and (g) role models and STEM. Headings in this review include (a) the conceptual framework, (b) African American women's experiences in education, (c) stereotype threat, (d) role models, and (e) literature that is related to qualitative methodologies.

The Theory of Multicontextuality

The conceptual framework for this study is the theory of multicontextuality as presented by Hall (1977) and Ibarra (2001). High context cultures are identified as predominantly ethnic minorities and females. Low context cultures are predominantly northern European ethnic groups and majority males (Hall, 1977). Hall proposed high and low context as a way of understanding different cultural orientations as shown in

Table 2. The characteristics of high context cultures will be examined as connections are made to African American women in the STEM fields.

Table 2

Characteristics of High and Low Context

	Low Context (LC)	High Context (HC)
Interaction	LC speakers tend to be blunt. Being specific and exact is important. Messages are carried more by words than non-verbal cues.	HC speakers expect others to know their concerns. Nonverbal cues are frequently used in conversations.
Association	Maintain short-term relationships. Strive to stand out among peers to get ahead in society.	Relationships are built on trust. Individuals seek less attention or recognition of accomplishments.
Temporality	Time is money attitude. Emphasis placed on schedules, efficiency, and promptness.	Time does not equate with money and status. HC people do many things simultaneously and change plans easily.
Gender & Culture	Formal culture is technical, highly scheduled, task-oriented, and imposing. Teams of individuals with specific skills work together on projects. Work can be linked but is sequential and compartmentalized.	Informal culture evolves over time from shared personal experiences tying individual people to the group and its identity. Individuals work on projects in a shared group process.
Territoriality	LC people need more social distance for interaction	HC people are comfortable interacting in close social distances
Learning Styles	Fact based. Prefer an inductive reasoning process from the specific to the general. Prefer to approach tasks and learning individually.	Facts are embedded in situations or experiences. Learn by modeling, practicing, or demonstrating. HC prefer frequent talking in close proximity when working or learning.
Academics	Examination of ideas is valued more than broad comprehension of real-world applications. Highly articulate, specific, accurate distinctions.	Values appreciation of knowledge in real-world events (social skills). Associated with informal intimate language, words collapse and shorten into dialects.

Note: Adapted from "Beyond Affirmative Action: Reframing the Context of Higher Education," by R. A. Ibarra, 2001, pp. 69-76 . Copyright 2001 University of Wisconsin Press.

The theory of multicontextuality is a collection of cultural context and cognitive models used to examine the underrepresentation of minorities in STEM areas. Ibarra (2001) asserted that successful individuals in STEM display high cultural characteristics. Ibarra stated that minorities could be more successful in STEM academic areas if high context principles are incorporated. Studying in groups, building strong relationships with academic peers, and maintaining a close connection to family have proven to be beneficial in retention of minorities in the STEM areas (Ibarra, 2001). However, the traditional academic setting is more closely aligned with low context cultures.

A traditional setting is structured with the belief that rigor is achieved when students are working in isolation, deriving facts from scientific analyses, and producing individual work (Ibarra, 1999). Ibarra noted that adjusting the traditional academic classroom to include high context cultural values would neither diminish the STEM academic culture nor relinquish the rigorous nature of scientific inquiry. As educators and professions work to recruit ethnic minorities in the STEM fields, high context conditions must be incorporated into the academic environment (Ibarra, 1999).

In this literature review, I examine the historical perspective of race and gender in education, reviewed characteristics of culturally relevant classrooms, described African American young women's experiences in the classroom, explored the concept of stereotype threat and examined the impact of role models on women related to STEM. Lastly, I review qualitative methods related to women and STEM. All of these areas were viewed through the lens of high and low cultural contexts.

Historical Perspective on Race and Gender

Developing a perspective on the history of race and gender inequities in education will provide a foundation for understanding barriers that African Americans and young women have overcome as well as barriers that they still face in education (Conrad, Dixson, & Green, 2014; Ladson-Billings, 2013; Toldson, 2014). Legal issues related to race in education have been prevalent since Plessy v. Ferguson in 1896 (Toldson, 2014). In 1972, gender discrimination was addressed in Title IX of the Educational Amendments (Pauline, 2012). The following sections will address the issues of race and gender through the lens of a Plessy v. Ferguson, Brown v. Board of Education, and Title IX. These historic cases changed the trajectory for African Americans and young women in education.

Race Perspective

Long before a gap emerged between Caucasian and non-Caucasian women in STEM, an opportunity gap–which contributed to the emergence of an achievement gap–existed between Caucasians and non-Caucasians in the United States (Archer-Banks & Behar-Horenstein, 2012; Ladson-Billings, 2013). In 1896, the United States Supreme Court mandated separate but equal facilities in the case of Plessy v. Ferguson (Toldson, 2014). However, facilities, including educational facilities, were anything but equal. Non-Caucasian teaching facilities were in poor condition, had minimal resources, and were not equipped with adequate teaching supplies (Ladson-Billings, 2013). These conditions resulted in separate and unequal facilities, and the educational opportunities for students of color were minimized.

In 1954, the United States Supreme Court ruled in Brown v. Board of Education that separate but equal schools were illegal because they "forced inferior education on students because of their race" (Toldson, 2014, p. 194). Although the courts ruled in favor of desegregated schools, many communities fought against this ruling and were slow to desegregate schools. Additionally, many Caucasian families moved out of areas with desegregated schools and enrolled their children in private schools, which created the same results as legal segregation. Consequently, schools with African American children had substandard educational facilities and a lack of funding to supply educational resources (Ladson-Billings, 2013; Toldson, 2014).

Toldson (2014) noted that even when the government forced desegregation, challenges still existed for African American students. Suspension and expulsion rates were higher for African American students than Caucasian students (Archer-Banks & Behar-Horenstein, 2012; Toldson, 2014). African American students were disproportionately placed in special education classes, and honors classes were filled with predominantly Caucasian students (Griner & Stewart, 2013; Toldson, 2014). Toldson found that after 60 years of desegregated schools, one of the most important factors to ensure success for all students, is to ensure that students have access to resources, curriculum, and pedagogy that best meet the needs of all children.

Gender Perspective

Gender, like race, has played a role in access to educational opportunities (Conrad et al., 2014). Prior to Title IX, women were marginalized in many aspects of their lives and were denied access to education and sporting opportunities. Title IX of the

Educational Amendments of 1972 states: “No person in the U.S. shall, on the basis of sex, be excluded from participation in, or denied the benefits of, or be subjected to discrimination under any educational program or activity receiving federal aid” (Pauline, 2012, p. 4).

Although the foundation of the Title IX originated in the context of sports, it means so much more for women. Title IX increased the opportunities women to enter careers generally dominated by men and provided a platform to demand equal pay (Conrad et al., 2014). Pauline (2012) noted that we expect sports participation among girls to continue to rise and we need to look at how the translation of Title IX impacts employment and equal pay.

Conrad et al. (2014) examined Title IX through the lens of women of color, and they noted that the barriers faced by women of color in school and in careers are compounded by the issue of race. Malcom and Malcom (2011) also found that women of color have to overcome barriers related to gender which puts them in a double bind. Conrad et al. called for more research to focus on access to opportunities for women of color, stating that we know little about what school is like for African American girls.

Women are still underrepresented and underpaid in the STEM fields (Conrad et al., 2014; Malcolm & Malcom, 2011). Conrad et al. noted that we must make more progress in the STEM fields in terms of career opportunities and equal pay for women of color. The groundwork of Title IX has paved the way for women to pursue STEM careers and demand pay equal to their male counterparts (Conrad et al., 2014).

An overview of the historical perspective of race and gender was shared to provide a snapshot of the journey that African Americans and women have traveled in order to gain access to opportunities in education and careers. People of color have a long history of racial discrimination, which has played a role in their pursuit of academic achievement (Archer-Banks & Behar-Horenstein, 2012; Ladson-Billings, 2013). Likewise, women also had to overcome barriers in their pursuit of equal opportunities in education (Conrad et al., 2014; Pauline, 2012). African American women, who represent two marginalized groups, are presented with an even greater challenge of reaching academic success (Conrad et al., 2014; Malcolm & Malcom, 2011). Although progress has been made toward ensuring that all racial and gender groups have equal opportunities, much work is still needed.

Culturally Relevant Pedagogy

In 2011, the National Center for Educational Statistics stated that African American teachers make up less than 5% of the nation's public school teachers. Therefore, it is possible for children of all colors to go through grades K-12 and never see an African American teacher (Ladson-Billings, 2013). Consequently, African American children are in classrooms where their teachers' culture is likely different than their own. Unrecognized culture differences in the classroom can have a negative impact on student academic achievement (Ladson-Billings, 1995).

Billings (2013) stated that it is important to build relationships and learn as much as possible about the predominant culture of the classroom. Learning about different cultures in classroom environments might allow teachers to better serve the needs of the

students they encounter (Ladson-Billings, 2013; Toldson, 2014). Griner and Stewart (2013) stated that schools and teachers who implement culturally relevant pedagogy (CRP) became change agents for all students, and particularly for minority student populations.

Ladson-Billings (1995) stated that CRP is grounded in three domains: academic excellence, cultural competence, and sociopolitical consciousness. Ladson-Billings noted that identifying what students know and are able to do is the path that leads students to academic success. Ladson-Billings defined cultural competence as the ability to help students embrace their own culture while learning about at least one other culture. And the third domain, sociopolitical consciousness, is the ability to take learning beyond the classroom and connect to real world problems (Ladson-Billings, 1995).

CRP requires that a teacher plan lessons in which students are not simply learning through rote memorization. Teachers must plan engaging lessons to connect the student to the classroom while maintaining high expectations (Ibarra, 2001; Ladson-Billings, 2013). Billings stated that students today have the desire to be deeply engaged in learning rather than sit through passive delivery. The culture in which they live promotes creativity and innovation and those skills must be realized in the classroom (Ladson-Billings, 2013).

Ladson-Billings (1995) found that tapping into a student's culture can be a quick pathway to helping the child reach high achievement. Tapping into rap music for a student with a hip hop culture or classical music for students who are interested in the classics simply opens the door for relationship building and propels the child toward

success (Ladson-Billings, 2013). Ladson Billings noted that particularly in the twenty-first century, where the stakes are high, teachers much be able to build cultural relationships with students and provide support to students who live in a world with a rapidly changing culture.

Recognizing that differences are not deficits and acknowledging that all students come to the classroom with a rich culture that is waiting to be examined is the first step toward developing CRP (Ladson-Billings, 1995, 2013, 2014). Griner and Stewart (2013) stated that building student-teacher connections in classrooms can help bridge cultural divides. As it relates to African American young women in the classroom, the more teachers know and understand about students' cultures the more teachers will be able to help ensure academic success.

African American Women's Experiences in Education

Archer-Banks and Behar-Horenstein (2012) found that African American young women are marginalized by race and gender in an educational setting. Consequently, they must "negotiate both race and gender discrimination, as well as bias among school personnel to succeed in school" (p. 200). Archer-Banks and Behar-Horenstein stated that African American young women are cited more for dress code violations, talking back, and being loud. Consequently, more time is spent correcting the behaviors of African American young women and less time is spent on promoting academic ability.

In addressing how race and gender influence the high school experiences of African American girls, Archer-Banks and Behar-Horenstein (2012) suggested that highly qualified teachers should be hired to ensure pedagogical practices foster student

engagement. By implementing pedagogical practices that foster student engagement, students would be in a high-context learning environment (Ibarra, 1999). A high-context classroom environment would foster more interaction, content discourse, and overall higher achievement for African American students (Ibarra, 1999). In addition to hiring highly qualified teachers, Archer-Banks and Behar-Horenstein suggested that teachers should be trained to implement culturally relevant teaching strategies. Understanding the cultural differences between students and how those differences may impact student achievement is critical to the success of African American young women.

Ladson-Billings (1995) described cultural competence as the ability of a teacher to recognize and acknowledge cultural differences while promoting academic achievement. Ladson-Billings stated that developing cultural competence can lead to the implementation of culturally relevant instructional practices. She also wrote that in order to be successful in creating culturally relevant practices, the teacher must be willing to nurture and support cultural differences. Understanding and addressing culture, race, and gender differences in the classroom will help marginalized students reach higher levels of academic success (Ibarra, 2001)

West-Olantuji and Shure (2010) found that the lack of culturally proficient teachers in our educational systems has had a negative impact on the schooling of minority students. Griner and Stewart (2013) stated that the culture divide that exists between minority students and their dominant culture teacher impedes the ability for those students to build relationships with their teachers. Consequently, the culture divide can lead to a gap in learning which impacts student achievement (Griner & Stewart,

2013). Cultural marginalization and misunderstandings between teachers and African American students has led to increased discipline citations, stereotyping, academic tracking, and overall low expectations (West-Olantuji & Shure, 2010).

School counselors also play a role in the academic tracking of African American girls in school (West-Olantuji & Shure, 2010). West-Olantuji & Shure noted that counselors tend to place African American students and young women in lower-level classes, particularly in the math and sciences. Understanding cultural differences and helping counselors become aware of their biases toward African American students and young women can help change the direction of course placement guided by counselors.

Laughter and Adams (2012) stated that we need diverse, culturally knowledgeable teachers who are educated about cultural differences to plan engaging lessons, help students make connections to real world scenarios, and build stronger relationships with students. The strength of the relationship plays a role in the success of the child, particularly, minority students (Ibarra, 2001). Ibarra also noted that helping minority students make connections to the real world supports the development of the high-context learner.

The experiences of African American young women in schools have an impact on their future orientation toward classes and careers (Archer-Banks & Behar-Horenstein, 2012; Ramsey, Betz, & Sekaquaptewa, 2013). High-context classroom environments, which promote engagement and academic discourse, have been proven to engage female students in the learning environment (Ibarra, 2001). Ensuring that teachers and

counselors are culturally proficient will reduce incidents leading to controversial situations, low expectations, and negative stereotyping.

Stereotype Threat

Stereotype threat is a concern or anxiety that one's performance or actions can be seen through the lens of a negative stereotype (Steele et al., 2002). Stereotypes about women having low performance in the math and sciences have negatively impacted women's pursuit of STEM careers (Gunderson et al., 2012; Shaffer, Marx, & Prislin, 2013; Shapiro & Williams, 2012). Shaffer et al. (2013) noted that framing stereotypes to reflect women's positive participation in STEM can aid in the success and representation of women in the STEM fields. Shapiro and Williams (2012) stated that examining stereotype threat could lead to an understanding of how stereotypes can undermine women's and girl's performance and interest in the STEM fields. Deemer, Thoman, Chase, and Smith (2014) noted that taking a deeper look into the concept of stereotype threat will aid in understanding the gender imbalance in the STEM fields.

Appel, et al. (2011) stated that negative ability stereotypes can have a detrimental impact on achievements of members of stereotyped groups. Research conducted by Appel et al. (2011) showed that African American students, who are stereotyped to have lower academic ability non-African American students, tend to score lower on general cognitive tests. Women, who are stereotyped to have lower math and science ability than men, tend to score lower on tests in the STEM domains (Appel et al., 2011). Consequently, African American young women are experiencing lower achievement that

may be linked to negative stereotypes related to race and gender, which Malcom and Malcom (2011) referred to as a double bind.

Gunderson et al. (2012) found that women score lower on math tests when the researcher overtly identified them as a woman. Asians are associated with the stereotype of strong academic ability, particularly in the math and sciences. Women, on the other hand, are associated with the stereotype of having lower academic ability in math and science than males. When Asian women tested and were identified as Asian, they scored higher on the mathematics achievement test. However, when they were tested and identified as female they scored lower (Shapiro & Williams, 2012).

Gunderson et al. (2012) noted that environmental factors such as parents and teachers contribute to the gender related STEM attitudes held by women and girls. Studies conducted with parents showed that parents believed that males would have higher achievement in math than females (Gunderson et al., 2012). Similarly, teachers also shared the belief that males were stronger STEM students than females. Consequently, the interactions that girls have with parents and teachers may have a negative impact on a female's beliefs about being successful in the STEM fields.

Lane, Goh and Driver-Linn. (2012) found that implicit stereotypes play a major role in the pursuit of STEM careers for females. Implicit stereotypes refer to one's own thoughts about gender and race in a particular area (Lane et al., 2012). As stated by Lane et al., implicit stereotypes predict academic performance and behavior. Noting that women held negative implicit stereotypes about their place in science, they showed less

interest in pursuing a science career even when their cognitive ability demonstrated that they could be successful in science.

Lane et al. (2012) found that women were more likely to pursue the humanities and men were more likely to pursue STEM careers. As stated by Ibarra (2001), the high context nature of the humanities makes it a more attractive career for women. However, the negative stereotypes related to women's abilities in STEM (Gunderson et al., 2012; Shapiro & Williams, 2012) as well as the low context environment (Ibarra, 2001) associated with STEM create barriers for women to maintain an interest in the STEM fields.

The use of role models–people who exemplify success and achievement in a field–has been found successful in the recruitment and retention of women in the STEM fields (Rosenthal et al., 2013). Understanding stereotypes and how the use of role models can help combat negative stereotypes related to women in STEM may aid in increasing the number of women interested in STEM careers. Additionally, women seeing successful women in the STEM fields may help combat the negative stereotypes related to a woman's ability level in STEM.

Role Models

Drury, Siy, and Cheryan (2011) found that female role models assist in the retention and recruitment of women in the STEM fields, noting that role models can help improve women's performance and their sense of belonging in an environment that is predominantly male dominated. Rosenthal et al. (2013) stated that female role models play an integral role in a woman's experience because female role models illustrate how

women can navigate through and be successful in the STEM fields. Stoeger, Duan, Schirnir, Greindl, and Zeigler (2013) also stated that using role models to increase participation and interest in the STEM fields has proven to be effective in the recruitment of girls.

The use of role models can help combat stereotypes about STEM professionals. Stereotypes about professionals in the STEM fields include descriptions like nerdy, socially awkward, and unskilled at relationships (Cheryan, Drury, & Vichayapai, 2013). Women, particularly African American women, see themselves as more collaborative and like to communicate with others, making it very difficult for them to see themselves working in a low-context, stereotypical STEM environment (Ibarra, 2001). Young, Rudman, Buettner, and McLean (2013) asserted that female role models specifically positively impact girls interested in the STEM fields and reduce the stereotype that STEM careers are masculine.

Milgram (2011) and Gunderson et al. (2012) emphasized the importance of using female role models to recruit and retain women in the STEM fields. However, Cheryan et al. (2013) stated that females and male role models play a critical role in the overall recruitment of women in STEM. Cheryan et al. noted that it is not the gender alone of a role model that has the greatest impact on recruitment of women in the STEM areas–it is the ability of women to make connections to role models who do not fit the negative stereotype of a traditional STEM professional. The stereotypes include the notion that STEM professionals have a tendency toward social isolation and a singular focus on technology (Cheryan et al., 2013).

Gender roles shape the way people see themselves, and women report that they do not connect with males or females who fit negative STEM stereotypes (Cheryan, Siy, Vichayapai, Drury, & Kim, 2011). As noted by Cheryan et al., when female STEM professionals embody the characteristics of a traditional STEM professional, women lose interest in pursuing a STEM career. Cheryan et al. concluded that role models of either gender who displayed characteristics associated with STEM stereotypes interfered with women's beliefs that they would be successful in STEM fields. Conversely, interest increased when females made connections to role models and could visualize themselves sharing similarities such as raising a family and participating in a variety of non-STEM related activities rather than solely focusing on the career.

Combating negative stereotypes about women in the STEM fields will be critical as educators and employees work to recruit women in STEM classes and careers. Rosenthal et al. (2013) stated that a female student is more inspired by female role models because the student can see herself as a woman in a STEM role. Milgram (2011) stated that women need to see role models in the workplace that look like them. The use of role models allows women interested in a STEM profession to see that STEM professionals are diverse and capable of being successful contributors to innovative ideas that emerge from STEM professionals.

Motivational Factors Toward the Pursuit of STEM Careers

Motivational factors toward the pursuit of STEM careers have been examined as researchers work to develop an understanding of how to increase the number of underrepresented groups in the STEM fields (Leaper et al., 2011; Szelényi, Denson, &

Inkelas, 2013; Wang, 2013). Research continues to support the need for parental support (Garriott et al., 2014), teacher and counselor support (Archer-Banks & Behar-Horenstein, 2012), and positive classroom environment and curricular differentiation (Ladson-Billings, 2014; West-Olatunji & Shure, 2010). Additionally, social factors such as support from peers are critical in a woman's pursuit of a STEM career (Szelényi et al., 2013).

Science clubs for girls is one avenue that can provide peer support for girls. Girls in Engineering, Mathematics, and Science (GEMS) was organized as a science outreach program for middle-school female students (Dubetz & Wilson, 2013). GEMS provides additional learning experiences outside of the classroom in an effort to increase girls' participation in STEM. Data collected from young women in the GEMS club showed that teacher encouragement was one of the largest motivational factors in participating in the GEMS organization. As stated by Ladson-Billings (2014), teacher influence has a large impact on students' academic success. Data from the GEMS organization also showed that interest in STEM increased by an average of 35%.

Black Girls Code (BGC) is an organization geared toward increasing interest in STEM for girls of color. The girls in BGC range from the ages of 7 to 17. The organization has a vision of preparing the next generation of innovators in the STEM fields, promoting leadership, and encouraging girls to build their own future through exposure to computer science and technology (Griffin, 2014).

BCG promotes early access to STEM and connects girls to role models. The program runs after school and on weekends. Additionally, special events are held

throughout the year to promote coding for girls. Girls from varying backgrounds come together to build new relationships while engaging in computer programming. BGC exposes girls to programming languages such as Scratch or Ruby on Rails (Barnhill, 2013).

Early exposure to STEM activities and STEM role models continue to provide motivation for girls interested in STEM (Dubetz & Wilson, 2013; Wang & Degol, 2013). Instilling high expectations at school (Ladson-Billings, 1995) and home (Garriott et al., 2014) continue to be strong motivators for girls. Additionally, efforts to support peer engagement for girls interested in STEM can be accomplished by encouraging girls to participate in gender-based STEM group activities (Dubetz & Wilson, 2013).

Women in the STEM Workplace

A woman in the STEM workplace has successfully navigated through isolation in STEM classes and negative stereotypes about women in the STEM fields (Richman, vanDellen, & Wood, 2011). However, workplace barriers still exist. DiMara (2013) stated that is it time to open the doors of STEM fields to women so they can assume their roles as thinkers, problem solvers, leaders, and entrepreneurs. Because the STEM workforce is a male-dominated field, women face many challenges even after they have secured a STEM degree and job (Settles, Cortina, Buchanan, & Miner, 2013).

The STEM work environment is characterized as chilly toward women (Settles et al., 2013). Discriminatory practices include excessive demands, absences of mentoring, being ignored and harassed, and exclusion from work social functions (Hall, Everett, & Hamilton-Mason, 2012; Johnson, 2012). Consequently, negative interactions can lead to

low work performance and increased stress, which can result in an exit from the STEM field (Settles et al., 2013).

In addition to sexism commonly faced by women, African American women also deal with issues related to racism (Hall et al., 2012). Inferior treatment and low expectations from colleagues and superiors are compounded with harassment and isolation (Hall et al., 2012). African American women also report that they are subjected to unnecessary scrutiny with no opportunity for advancement in their careers (Hall et al., 2012).

All women, and particularly African American women, continue to be underrepresented in the STEM fields (Malcolm & Malcom, 2011; National Science Foundation, 2010). In addition to barriers impacting young women's decisions to pursue STEM pathways during school, workplace barriers impact women's decisions to remain in STEM fields. In order to provide support to women once they enter STEM fields, women should be connected to role models in the workplace and encouraged to have strong social supports such as family and social outings (Hall et al., 2012; Richman et al., 2011).

Literature Using Qualitative Methods

Adeyemi (2013) conducted a qualitative case study to explore the influences of socializers (e.g. parents, teachers, peers, and counselors) on the university female students' decision to pursue careers in mathematics-related disciplines. The participants were six students in their second to final year at a mid-size university in Canada. Face-to-

face interviews and focus group discussion were the primary methods of data collection in this study.

Findings from the Adeyemi (2013) study revealed that women made decisions based on their interests in STEM, which were stimulated by experiences with STEM subjects prior to and during high school. The study also found that socializers, especially parents and teachers, were highly influential in the decision-making process by providing encouragement or being a role model. Positive classroom experiences and engaging in science activities were also critical components in helping young women make decisions about the pursuit of STEM classes and careers.

The findings from Adeyemi (2013) support earlier research findings from Ibarra (2001) that showed engaging science activities play an important role in the decision-making process for young women in STEM. Ladson-Billings (2014) also found that the classroom environment and the overall classroom experience impacts a child's perception of the subject area and how he or she will proceed with educational choices.

An exploratory study conducted by Faitar and Faitar (2013) examined factors that might be associated with how achievement in mathematics, natural sciences, and engineering determine girls' career choices. To examine factors related to career choice, a survey was administered to the Department of Mathematics and Natural Sciences at a New York State College, during the 2010-2011 school year. A total of 32 students enrolled in a physical assistant, physical therapy, and chiropractor programs answered the survey. The survey consisted of questions such as "Who influenced you the most toward

your academic career?", "What is the major cause for your academic success?", and "In middle/high school, what was usually your teachers' perception about your efficacy?"

Results from the study showed that females attributed their success and interest toward STEM to knowledge accumulated in previous courses and laboratories. Females also acknowledged that help and support by their teachers in middle and high school played a role in their decisions to pursue STEM degrees. Similar to the results of the study conducted by Adeyemi (2013), support from teachers and counselors continues to surface as a critical component in the pursuit of STEM careers for females.

In an effort to identify contextual factors and socialization experiences related to the development of African American girls, Thomas, Hoxha, and Hacker (2013) followed a grounded theory approach to collect data. Interviews were conducted using dyadic groups. The dyadic groups were formed to increase communication and participation amongst the participants. The participants consisted 18 African American young women, in which 11 were high school students and 6 were college students. Their ages ranged from 15 to 22 years old. Each participant invited to participate in the focus group was asked to bring friend. The addition of a friend allowed the girls to feel more comfortable to answer the questions in a conversational style (Thomas et al., 2013).

In the focus groups, participants were asked questions such as "What do you think about African American girls or women?", "What kinds of stereotypes do people have about African American girls or women?", "Have you or do you ever talk to other people about what it means to be an African American woman?", "What do people, such as your

family or friends, tell you about what it means to be an African American girl or woman?"

Results from the study (Thomas et al. 2013) showed that family, peer socialization, stereotyping, and media play a large role in identity development for African American women. Respondents also indicated that negative classroom experiences acted as barriers toward positive identity development. Additionally, results showed that self-determination was a major component in helping women overcome negative imagery and negative classroom experiences.

Steele et al. (2002) noted that stereotypes about a particular group influences the decision-making process for members of that group. Therefore, if African American women view themselves through a negative lens in the area of STEM, their actions will match their negative perceptions. In the classroom, teachers can help African American young women view themselves through a positive lens by making cultural connections and building positive relationships (Ladson-Billings, 1995, 2013, 2014). Additionally, parents play a large role in promoting gender and racial identity of their African American daughters (Thomas et al., 2013). By exposing girls to cultural events and activities, encouraging high achievement, and providing positive messages about self-imagery, parents can help their daughters shape positive perceptions about themselves (Thomas et al., 2013)

Fouad, Hackett, Smith, Kantemneni, Fitzpatrick, Haag, and Spencer (2010) conducted qualitative research to assess women's perceptions of barriers and supports for

science and mathematics. One hundred thirteen women were recruited and participated in interviews. The following types of questions were asked by Fouad et al. (2010):

- What did you like about math or science in junior or senior high school?
- How did you feel about your understanding of the problems or concepts?
- How did your teachers help you understand math? In what ways?
- Was there a turning point that changed you opinion of yourself as "good in math or science" or "not good in math or science?" Describe what happened. (p. 364)

Interviews were audio-taped, transcribed, and coded, and the codes were matched with a taxonomy generated by the researchers prior to the interviews being conducted. The taxonomy of STEM-related barriers and supports was generated using journal articles, books, book chapters, and dissertations (Fouad et al., 2010). Upon completion of the coding, five broad domains and supports were identified: parental/family barriers or supports, institutional/school barriers or supports, financial/environmental barriers or supports, social barriers or supports, and internal/individual barriers or supports (Fouad et al., 2010).

The study concluded that encouragement from parents in the areas of math and science and parents' knowledge level in math and science played a role in the girls' success and motivation. Teaching methods and encouragement from teachers and counselors also heavily influenced class and career pathways for female students. Additionally, access to extracurricular activities and external STEM opportunities that

connected girls to female role models aided in girls building positive perceptions about themselves in math and science classes and careers (Fouad et al., 2010).

The study conducted by Fouad et al. (2010) added to the body of research that states internal and external influences are relevant components in determining the interest and success of women in STEM. Factors such as self-esteem, interest, and understanding of real-word applications must be examined further to better understand women's internal barriers related to STEM. Additionally, research on family support, peer support, teacher and counselor expectations, and environmental factors should be further examined to deepen the understanding of barriers that women face in STEM as well as identify supports that are needed for women's success in STEM (Fouad et al., 2010).

Grossman and Porche (2014) took a grounded theory approach to understanding adolescents' perceptions of gender and racial/ethnic barriers to STEM. Fifty-three participants answered interview questions. The interview sample included 26% Asian, 16% African American, 11% Latino, 30% Caucasian, 4% other, and 13% multiracial participants. Seventy-one percent of the girls and 55% of the boys interviewed were underrepresented minorities. The interview questions follow (Grossman & Porche, 2014):

- Do you think it's equally easy for women and men to become scientists or to study scientific subjects in school?
- Do you think it's equally easy for African Americans or Latinos to become scientists or to study scientific subjects in school?

- Do you think girls and women face discrimination because of their race/gender that limits their opportunities to be successful in science jobs and careers?
- Do you think African Americans or Latinos face discrimination because of their race/gender that limits their opportunities to be successful in science jobs and careers?
- For minority participants only. Has there ever been a time when someone discouraged you as a minority/females from working toward a job or career in science? (p. 706)

After coding the interview responses the following themes emerged: power, societal beliefs and assumptions, and gender and race support.

The power perception was based on discriminatory practices toward women and African Americans in STEM classes or careers. The concept of power related to gender (Conrad et al., 2014; Pauline, 2012) as well as the concept of power related to race (Archer-Banks & Behar-Horenstein, 2012; Toldson, 2014) has been explored for decades, but more exploration is needed. Societal beliefs and assumptions play a large role of how stereotypes are developed (Grossman & Porche, 2014). As stated by Fouad et al. (2010), the role of the media promoting positive or negative imagery about underrepresented groups in STEM impacts perceptions for women in STEM. Consistent with research conducted by Thomas et at. (2013), race and gender must be explored as researchers seek to understand underrepresentation of women and African Americans in the STEM fields.

Literature Using Quantitative Methods

Stout, Dasgupta, Hunsinger and McManus (2011) conducted a quantitative study to determine if contact with same-sex experts in academic environments involving STEM enhanced women's self-concepts in STEM, attitudes toward STEM, and motivation to pursue STEM careers. Seventy-three undergraduate women majoring in STEM disciplines were recruited to participate in the study. Participants were randomly assigned to either a male or female peer expert and were tested individually using three implicit association tests on attitudes, identification, and stereotyping. The tests assessed participants' implicit attitudes toward math versus English, their identification with math versus English, and stereotypes of math versus English as relatively masculine or feminine domains.

The question for the Stout et al. (2011) study was: Does exposure to a female versus male peer expert influence implicit reaction toward mathematics? As predicted, a two-way analysis of variance (ANOVA) with peer expert and task order revealed a significant main effect of peer expert in relation to attitudes. Participants who interacted with a male peer expert exhibited negative attitudes toward math compared with English, whereas those who interacted with a female expert exhibited equal liking for math and English (Stout et al., 2011).

For the identification implicit attitude test, results showed that participants implicitly identified with math substantially more in the presence of the female peer expert than a male peer expert. In relation to the stereotyping implicit association tests, the ANOVA results revealed that implicit stereotyping of math did not change after brief

contact with a female peer expert in math compared with a male peer expert. On average, participants stereotyped math as masculine (Stout et al., 2011).

The research conducted by Stout et al. (2011) supports the need for female role models in the STEM areas. Exposing young girls to female role models at an early age may help increase interest in STEM and help girls positively identify with STEM subjects. This research is consistent with other research conducted by Rosenthal et al. (2013) that stated women get inspiration from female role models in the STEM areas. Likewise, Young et al. (2013) echoed the notion that women are inspired by other women as they pursue STEM interests.

Although the researchers (Rosenthal et al., 2013; Stout et al., 2011; Young et al., 2013) agree that female role models increase girls interest in STEM, Betz and Sekaquaptewa (2012) cautioned against the use of female role models to motivate girls in STEM. Betz and Sekaquaptewa stated that women in STEM are labeled as unfeminine, which is a costly social label that may discourage female students from pursuing STEM fields.

Betz and Sekaquaptewa (2012) conducted a quantitative study in which 193 sixth- and seventh-grade girls responded to a set of questions on a 7-point scale after being exposed to feminine STEM professionals and gender-neutral professionals. The study sought to determine how likely middle-school girls were to study math in the future after being exposed to role models who display either STEM or general academic success and who either display feminine or masculine characteristics.

The results from the Betz and Sekaquaptewa (2012) study revealed that feminine STEM role models weakened future plans for women to study in the STEM areas. Betz and Sekaquaptewa stated that girls may not expect STEM role models to be female or feminine and what is unexpected often feels unlikely. An explicitly feminine STEM role model is more contradictory or unexpected than an everyday women who excels in a male-dominated field. Thus, the counter-stereotype had a negative impact on the middle-school-aged girls in relation to interest in STEM (Betz & Sekaquaptewa, 2012).

The study conducted by Betz and Sekaquaptewa (2012) provided a different perspective from other studies that support the need for female role models to help increase interest in STEM for girls (Cheryan et al., 2011). However, it is noted that systemic stereotypes–positive or negative–influence how women see themselves in a career (Lane et al., 2012). Therefore, as stated by Betz and Sekaquaptewa (2012), a female role model that is explicitly feminine may demotivate girls because girls may see both the STEM career and feminism in a STEM career as unattainable. The contrasting studies on the influence of female role models to motivate girls in STEM highlight the need for more research on strategies that work to increase interest in STEM for women.

Leaper et al. (2011) conducted a study using 579 ethnically diverse girls ages 13 to 18. The study examined social and personal factors in relation to adolescent girls' motivation in STEM versus non-STEM subjects. The participants in the study completed questionnaires measuring their academic achievement, ability beliefs, values, and experiences. The findings from the study conducted by Leaper et al. (2011) revealed that girls' math and science motivation was positively and significantly related to their

mothers' math and science support, parents' education, gender-egalitarian beliefs, peer support, and exposure to feminism in science. Although Leaper et al. found that exposure to feminism in science was positive and helped to increase motivation, Betz and Sekaquaptewa (2012) cautioned against exposure to explicitly feminine women in the STEM areas.

The findings of Leaper et al. (2011) were consistent with research that supports the need for parental and peer support. Garriott et al. (2014) emphasized the importance of the parental role in helping to increase girls' interest in science. Dubetz and Wilson (2013) highlighted the need for science peer groups to motivate girls to maintain interest in science. The findings from Leaper et al. also provided valuable information that support the need to provide women with multiple support systems to help them maintain interest in the STEM areas.

In a qualitative study by Else-Quest, Mineo, and Higgins (2013), the researchers sought to describe math and science attitudes and achievement at the intersection of gender and ethnicity among urban adolescents. In this study, 367 adolescents completed Likert-scale surveys to measure self-concept of ability, expectations of success, and math and science achievement.

The results of the study administered by Else-Quest et al. (2013) revealed that male adolescents report high self-concept and greater expectations for success in math and science than female adolescents. However, females reported greater interest in science than male adolescents. The gender differences in this study were subtle and the study revealed the male and female adolescents earned similar end-of-year grades in math

and science. As it related to ethnic differences, Else-Quest et al. concluded that Latino and African Americans were the lowest achieving, while Caucasian and Asian American youth reported more positive attitudes and achieved higher end-of-year grades.

The study conducted by Else-Quest et al. (2013) provided valuable information on the intersection of gender and ethnicity. The study revealed that adolescent young women have an interest in science; however, the achievement of African American women was lower than the achievement of Asian and Caucasian women. Research conducted by Dubetz and Wilson (2013) showed that women need ongoing support from teachers and parents in order to maintain interest in science. Additionally, Griffin (2014) found that providing women with an environment to nurture their interest in science is beneficial in helping African American girls maintain interest and increase achievement in the STEM areas.

Conclusion

Current research on African American women in STEM has been conducted using a variety of methods. The research summarized on qualitative methods represents studies conducted using grounded theory and case study methodologies. Current research using a phenomenology approach was not found. Therefore, the need for data to be collected using a phenomenological approach is warranted.

In addition to the need for a qualitative phenomenology study, the literature review demonstrated that more progress is needed to increase the number of African American women in the STEM fields (Fouad et al., 2010; Thomas et al., 2013). In this literature review, literature about women in STEM (Leggon, 2010; Ong et al., 2011) as

well as literature on race (Toldson, 2014) and women in history (Pauline, 2012) was examined. Throughout the literature review the benefits to having academic and social supports were highlighted (Dubetz & Wilson, 2013; Milgram, 2011). Although current research on underrepresentation of women in STEM is available, a gap in research exists for understanding specific barriers and supports needed for African American women in STEM.

In this study, the experiences of African American young women were examined in relation to STEM education. The results from this study may provide a deeper understanding of the underrepresentation of African American young women in the STEM fields and provide potential strategies to promote interest and retention in STEM amongst African American young women.

Chapter 3 will provide a description of the design of this qualitative study. A discussion of the phenomenology method will be presented. It will describe the research methodology and design, sample selection, data collection strategies, and data analysis plan.

Chapter 3: Methodology

The purpose of this study was to describe the lived experiences of African American young women in relationship to STEM education. A qualitative phenomenological research design was applied to capture the essence of the African American young women's experiences. In Chapter 3, I will detail the phenomenological research design and the plans for data collection and analysis. The chapter is divided into the following sections: research design and rationale, the role of the researcher, the context of the study, measures for protecting the participants, the criteria for selecting them, data collection and data analysis.

Research Design and Rationale

A qualitative phenomenological research design was used to examine the perceptions and experiences of African American young women in relation to STEM education. The constructivist worldview guided my decision to use qualitative research. Creswell (2014) described the constructivist view as the beliefs of individuals that as they seek understanding of the world in which they live and work. The current study relied on the participants' experiences with STEM and the participants were required to construct meaning of those experiences.

Crotty (1998) asserted that "human beings construct meanings as they engage with the world they are interpreting" (p. 9). During this research study, it was critical for participants to share their personal views of their schooling experience related to STEM education in order that I might fully understand their journey. Crotty also stated that, "humans engage with their world and make sense of it based on their historical and social

perspectives" (p. 9). As a result, the researcher must seek to understand the context or setting of the participants. According to Crotty, qualitative research is largely inductive, and meaning is generated from the data.

As stated by Creswell (2013), "the basic purpose of phenomenology is to reduce individual experiences with a phenomenon to a description of the universal essence" (p. 76). As data were collected from African American young women, a composite description of the essence of the experiences for all of the individuals was developed (Creswell, 2013). The description consisted of what they experienced and how they experienced it (Moustakas, 1994). Using a phenomenological study allowed me to probe the participants' realities as they interpreted them. African American female participants recalled their STEM experiences based on individual worldviews. Their experiences provided valuable insights into the unique meanings of STEM education for the individual. The participants' realities were analyzed for significant statements in order to describe the essence of the experience (Creswell, 2013).

Research Questions

The central question for this research study is: How do STEM experiences in K-10 education influence African American young women's academic choices in their final years of high school? The following subsidiary questions are designed to elicit responses that describe the lived experiences of African American women related to STEM education:

1. What are the formative K-10 educational experiences and perceptions of African American young women in their junior or senior year of high school in relation to STEM experiences?
2. How does the distinction between high and low context illuminate the experiences of the participants?
3. How have participants' STEM experiences influenced decisions related to future career options?
4. What recommendations from African American female students will help improve recruitment practices in STEM classes?

Instrumentation

Research and interview questions were built around the conceptual framework, Ibarra's (2001) theory of multicontextuality, and gaps found in the literature. To check for content validity, a subject matter expert with a science background reviewed the research and interview questions. The subject matter expert is a colleague in the district where I work and previously taught science for 20 years. Table 3 illustrates how research questions were aligned with the interview questions.

Context of the Study

The setting for this study was one small, Mid-Atlantic school district in the United States. The setting was selected because the district is seeking research-based information to support efforts to increase the number of young women and minorities in advanced STEM classes. The participants for this study were 11 African American young women who had just completed their junior or senior year in high school and were enrolled in

Table 3

Research Question Matrix

Research Questions	Interview Questions
RQ1 - What are the formative experiences and perceptions of African American young women in their junior or senior year in high school in relation to science, technology, engineering, and mathematics (STEM)?	IQ1 - What K-10 classroom experiences do you believe have contributed to your participation in STEM? IQ2 - What are your perspectives on how K-10 teaching strategies influenced your academic choices related to STEM? IQ3 - What experiences outside of school do you believe may have contributed to your interest in the STEM fields?
RQ2 – How does the distinction between high and low context illuminate the experiences of the participants?	IQ4 - Describe your experiences related to group work in your STEM classes. IQ5 - Describe your experiences related to lectures in your STEM classes. IQ6 - How did your experiences with group work and/or lecture influence your perspective on STEM education?
RQ3 - How have participants' STEM experiences influenced decisions related to future career options?	IQ7 - How did your experiences with STEM education, in or out of school, influence your thinking about career choices? IQ8 - Describe the characteristics of your career interest that inspire you. IQ9 - Describe how mentoring, if any, has impacted your career interests.
RQ4 - What recommendations from African American female students will help improve recruitment practices in advanced STEM classes?	IQ10 - What suggestions would you offer to educators in reference to recruiting African American young women in STEM classes? IQ11- What advice do you have for up-and-coming African American female students seeking to enroll in advanced STEM classes? IQ12- Is there anything else that you would like to share with me about your STEM experiences?

Note: *RQ* refers to research question; *IQ* refers to interview question.

one or more advanced STEM classes. Purposeful sampling ensured that I selected individuals and a site for the study that addressed the research problem and the central phenomenon in the study (Creswell, 2014). Participants were selected from all four of the chosen district's high schools. The use of the four high schools to collect data helped ensure enough participants were available for the study and to help increase anonymity.

As a result of my current position, supervisor of science and STEM, I have contacts and relationships with district officials who were interested in collecting data related to the shortage of African American young women in advanced STEM classes. I used those contacts to help me gain access to African American young women who were enrolled in advanced STEM classes. I did not directly teach any of the participants.

Measures for Ethical Protection of Participants

Prior to proceeding with the interview process, permission was granted by the school district in which I conducted the study. Additionally, Walden's Institutional Review Board (IRB) approved the study prior to proceeding with the research (approval number 07-15-15-0131810).

Once approval was granted, I worked with the district's supervisor of accountability to identify African American young women enrolled in advanced STEM classes. Because I am the district's supervisor of science and STEM, I took steps to limit bias by identifying students in classes in which I had not observed. Once the students were identified, I sent potential participants an invitation to participate in the study.

Enclosed in the invitation participants under 17 years old found assent and consent forms. Participants 18 years old and older received a consent form. The assent

and consent forms informed the participants that participation in this study would not place the child at undue risk (Creswell, 2014). Additionally, it was clearly stated that participation was voluntary.

When a parent approved their child's participation in the study, they signed and returned the assent and consent forms in the pre-labeled, pre-stamped envelopes to me. They were also asked to keep a copy of all signed forms for their records. My phone number and email address were added to the consent form, and parents were encouraged to contact me if they had questions or concerns about the research study.

Once I received the assent and consent forms, I contacted the participants to provide an overview of the research and to schedule an initial interview. The interviews were scheduled at the participant's convenience to take place at the public library or the public school. The interviews lasted approximately 30 minutes.

To ensure ethical protection of the participants, I read the assent form that described the purpose of the study prior to conducting the interviews. I emphasized that participation in this study was voluntary and participants could stop participating at any time. Additionally, I reassured participants that participation in this study would have no impact on their academic status or school record. I gave participants a $10 gift card to Maggie Moo's Ice Cream Shop or Panera Bread as a token of appreciation. Participants received the token of appreciation at the end of the study. However, they were informed if they decided to drop out of the study they would nonetheless receive the token of appreciation at that time.

Participants were also informed that the interview would be recorded. Electronic data, transcripts, and interview forms will be safely stored and secured in a locked box for 5 years. Back-up copies were made in the case that the originals are destroyed. To help ensure the promise of confidentiality, pseudonyms were assigned to conceal the identity of the participants and their schools.

Criteria for Selecting Participants

A purposeful sampling approach was used in the selection of the participants. Creswell (2014) noted it is essential that all participants have experienced the phenomenon being studied. The criteria for participating in this study were that participants must be an African American young woman in their junior or senior year in high school who had just completed an advanced STEM class.

The target population for this study was 15 participants. Creswell (2014) stated that the intent in qualitative research is not to "generalize the information but to elucidate the particular" (p. 157). Noting that the sample size is dependent on the type of research being conducted, Creswell stated that up to ten participants will suffice for a phenomenological study. I originally identified 15 participants for this study; however, only 11 responded to the invitation to participate.

Role of Researcher

As the primary researcher, my role was to capture the experiences of African American young women in relation to STEM education. My role included designing, interviewing, transcribing, analyzing, verifying, and accurately reporting the results. Creswell (2014) stated that the role of the researcher as the primary data collection

instrument necessitates the identification of personal values, assumptions, and biases at the outset of the study.

I am the supervisor of science and STEM in the school district in which I conducted research. I recognized that there may have been a concern over the perceived power that I potentially have over the female students in my district. Acknowledging potential conflict that could arise by conducting research in the district in which I work was critical for the success of this research.

In my position, I visit schools and observe teachers, but I do not go into every class during every class period. During the visits, I have minimum contact with the students in the class. As a result, it is highly likely that the female students targeted for this study will have never seen me prior to this research. My office is at the Board of Education, and I do not have personal or professional relationships with the students or families in the school district.

Acknowledging my own values and how to deal with biases was a key task during the research study (Maxwell, 2005). As an African American woman who studied science, taught science, and supervises science teachers, it was extremely important for me to acknowledge my prior experiences and biases that I may bring to this research study.

Throughout the research study, I monitored how my experiences may have potentially shaped the interpretations of the research. Creswell (2014) stated that prior experiences of the researcher might cause researchers to lean toward certain themes, to actively look for evidence to support their positions, and to create favorable or

unfavorable conclusions about the sites or participants. Phenomenological research is designed for the researcher to understand the essence of the experiences of the participants; therefore, the researchers' biases must be reduced and eliminated where possible (Creswell, 2014). As a result, I kept a bracketing journal to reflect on such conflicts that arose.

Data Collection

Semi-structured interviews were used as the data collection approach for this study. Creswell (2014) stated that interview questions should be open-ended, general, and focused on understanding the central phenomenon in the study. Interviewees were selected using a purposeful sampling approach and the type of interview questions were designed to be practical and net the most useful information to answer the research questions (Creswell, 2014).

There were 12 open-ended interview questions related to the research questions (see Appendix A). The interview process allowed me to develop a richer picture of the phenomenon under study because the voices of the participants were heard. The interviews occurred at the participants' convenience at a public location such the public library or public school. The entire interviews were digitally recorded. Upon completion of the transcription, a second meeting was scheduled for member checking. Participants reviewed the written summary of the initial interview to check for accuracy. Adjustments to the transcripts were made as needed. For example, one participant clarified that it was grade 6 in which she placed second in the science fair not grade 9 as I originally had documented in the transcript. Another participated clarified that it was her grandfather

that motivated her to pursue engineering not her father as I had documented in the transcript.

Data Analysis

Creswell (2013) stated data analysis in qualitative research consists of preparing and organizing data for analysis. The analysis process requires the researcher to reduce data into themes through a process of coding, followed by the representation of data in figures, tables, and a discussion. Creswell (2014) also noted that data collection, data analysis, and report writing are not distinct steps in the data collection process. Instead, the steps are interrelated and often go on simultaneously throughout the research process. For this study, analyses of the participants' open-ended responses to the semi-structured interview questions formed the basis for interpreting and finding meaning from the participants' experiences.

Open coding was used to organize, sort, and search for information in text. Once the data was organized, it was read multiple times to gain a deep understanding of the participants' responses. Additionally, memos were added in the margins of the text to help with the data analysis. The process of coding involves aggregating the text into small categories of information, seeking evidence for the code, and then assigning a label to the code (Creswell, 2014). Creswell suggested working to reduce large categories of information into five or six themes that can be used to write the narrative.

Once the codes and themes were identified, the data were interpreted. Interpretation involves abstracting out beyond the codes and themes to the large meaning of the data (Creswell, 2013). The interpretation process allowed me to provide personal

interpretations about the essence of the phenomenon. Interpretations can be based on hunches, insights and intuition (Creswell, 2013). During the interpretation process, I sought to identify the lessons learned related to the phenomenon.

Issues of Trustworthiness

To ensure credibility of this study, member checking occurred. Merriam (2002) noted that member checking allows the researcher to ensure accuracy of the data collected. In order to conduct member checking, I provided participants with a written transcript of their interview to check for accuracy. Changes were made as needed to reflect accuracy. Additionally, I consulted with experts in the field about the research and interview questions.

Transferability refers to the extent in which the findings of one study can be transferred to another study (Merriam, 2002). To address transferability, rich descriptions and narratives were provided about the research process. The detailed information will allow readers and researchers to determine if the findings of this study will apply to similar research studies. However, the limitations of this study, such as the use of one small geographic location, and the small number of participants, should be considered when addressing transferability.

Dependability describes the extent in which a research study can be replicated (Merriam, 2002). Detailed notes were recorded in a journal to describe the research process and decisions made along the way, data quality checks were made to check for accuracy of information reported, and peer examination was used to review interview and

research questions. I also included the data collection tools and assent and consent forms as appendices of this study.

Confirmability refers to the objectivity of study. To address confirmability, the researcher must be aware of reflexitivity. Maxwell (2005) stated that reflexitivity refers to the fact that the researcher is part of the world he or she studies. To reduce biases, I asked open-ended questions and avoided leading questions. I also monitored my own biases by using a journal to reflect on conflicts that may arise. Recognizing and minimizing potential biased influences that I may have had on the study helped produce objective data analysis that represents the data collected for the study.

Summary

The purpose of this phenomenological research was to examine the experiences of African American young women related to STEM education. Chapter 3 provided details regarding the methodology chosen for this qualitative research study. The phenomenology approach was the most appropriate research method to capture the essence of the experiences of African American young women in this study. In the search for answers to the research questions semi-structured interviews were conducted. Data analyses included organizing, categorizing, and identifying themes to interpret the participants meaning of their individual experiences. In Chapter 4, the findings of this study will be presented.

Chapter 4: Results

Chapter 4 begins with the setting and the demographics of the study. The chapter continues with the data collection and analyses procedures. Evidence of trustworthiness is then discussed, and the chapter concludes with the results and summary.

Setting

The setting for this phenomenological study was a small suburban school district in the Mid-Atlantic region of the United States. The district geographically stretches 35 miles long and consists of four high schools. The eleven participants were eleventh and twelfth grade African American young women who had recently completed one or more advanced STEM classes. The participants gave consent during the interview to post their grade levels and advanced STEM high school courses as shown in Table 4. All interviews were scheduled at a time and location convenient to the participant either at the public library or public school location.

Demographics

The study consisted of a total of 11 participants. Seven of the participants were African American young women who had recently completed an advanced STEM class in their junior year in high school. Four of the participants were African American young women who had recently completed an advanced STEM class during their senior year of high school. All of the participants were purposefully selected to meet the criteria for this study. Pseudonyms were assigned to each participant to conceal their identity and ensure privacy.

Data Collection

Data were collected from 11 African American young women who recently completed an advanced STEM class as a junior or senior in high school. Consent and assent forms were mailed to participants after approval from Walden University IRB. Participants over 18 signed and returned a consent form. Participants under 18 signed an assent form and their parents signed a consent from. Upon my receipt of the signed consent and assent forms initial and follow-up interviews were scheduled for all participants. Each interview lasted on average of about 30 minutes and were conducted at the public library or public school. Interviews were recorded using a digital audio recorder.

Table 4

Participants' Grade Levels and Advanced STEM Course Current Year Enrollment

Participant	Current Grade	Advanced STEM Course(s) Taken
Airyana	11	AP Chemistry
Carrie	12	Biomedical, AP Biology
Dorothy	12	AP Physics
Melayna	11	AP Physics
Michelle	11	AP Chemistry
Naomi	12	AP Physics
Patricia	12	Biomedical
Randy	11	AP Calculus, Biomedical
Renee	11	AP Biology
Sandra	11	Biomedical, AP Statistics
Tonya	11	AP Biology

Two of the participants in this study were enrolled in an advanced math class, AP Calculus and AP Statistics. However, it should be noted that all advanced STEM classes require concurrent enrollment or successful completion of advanced math courses. Therefore, it is important to recognize math as the gatekeeper for enrollment in advanced STEM classes. Further discussion on the importance of math is found in Chapter 5.

Data Analysis

Data from interviews were transcribed from digital audio recordings to Microsoft Word and analyzed through open coding. Through the coding process common themes emerged that provided answers to the central research question. Data analysis began with a typological view of the data informed by Hatch (2002). I began the typological analysis by reading and rereading the transcripts while listening to the corresponding recording. This initial step allowed me to ensure accuracy of the transcribed documents and understand the essence of the data.

Next, I made notations in the margins of the transcripts identifying responses that aligned with the initial codes identified in Appendix B. For example, if I read a statement in reference to group work I noted the code GW in the margins to indicate characteristics of preferring group work, and if I read a statement in reference to engaging in STEM activities I noted it with the code ESA. Margin notation was followed by color coding. Color coding was used to highlight evidence statements that aligned with the initial codes on all transcripts. The colors identified in Table 5 were used to match the initial codes.

Once I completed the color coding process to match participants' statements with initial codes, I continued my analyses with line-by-line coding. The line-by-line process

helped me develop clusters of meaning from the significant statements to capture the essence of the study. Next, I thoroughly reread the transcripts to make connections between new and emerging categories while exploring the influences of the phenomena as suggested by Creswell (2013).

My analyses continued with the process of aligning responses to Ibarra's (2001) multicontextuality theory, which is the conceptual framework for this study. Key patterns and similarities were identified, and emergent themes were aligned to the theory. The categories were compared between participants, and the comparisons were tied together to make a general description of the experiences. The data were further reduced into major themes that best described the experiences of the participants (Corbin & Strauss, 2008). Ten themes emerged that connected the experiences of the participants in this study. The themes were categorized as follows:

- High teacher expectations
- Participation in STEM extra-curricular activities
- Engagement in group-work
- Learning from lectures
- Helping others
- Strong parental involvement
- Self-efficacy
- Gender empowerment
- Race empowerment
- Strategic recruitment practices

Table 5

Color Coding Scheme for Initial Coding

Characteristics		Code	Color
High Context	Communicate Strong Relationships with Teachers	SRT	Yellow
	Communicate Strong Relationship with Parents	SRP	Lime Green
	Communicate High Teacher Expectations	THE	Red
	Communicate High Parental Expectation	HPE	Teal
	Engage in STEM Activities	ESA	Pink
	Prefer group work	GW	Light Grey
	Embrace Real-World Connections	RWC	Teal Green
Low Context	Communicate Weak Relationships with Teachers	WRT	Lime Green
	Communicate Weak Relationships with Parents	WRP	Royal Blue
	Work in isolation	ISO	Olive Green
	Prefer Lecture	LEC	Purple
	Prefer Fact-Based Knowledge	FBK	Dark Grey

Evidence of Trustworthiness

Credibility

Credibility was ensured through the member checking process after the initial interview audio recordings were transcribed. Upon completion of the transcripts participants were contacted for member checking through a second meeting. During the second meeting participants reviewed the transcripts of their initial interviews to ensure that I interpreted their responses correctly. If discrepancies were present, I made the corrections to the transcript. For example, the summary for one of the participants stated that her father was an engineer and that he was her role model. The participant informed me to correct the transcript to read her that it was her grandfather who was her role model. See audit trail in Appendix C.

Transferability

Throughout this research, descriptions and narratives of the research process have been provided. The detailed information will allow readers and researchers to determine if this study is similar to other research studies. Limitations such as sample size and the use of one geographic location should be taken into consideration as considerations are made about transferability.

Dependability

An audit trail (Appendix C) was created to track the data collection process. Coding checks, using initial codes, color coding, and line-by-line analysis were made throughout the process to watch for data agreement. Also, a subject matter expert

reviewed the questions to ensure clarity and the presence of strong connections to Ibarra's (2001) theory of multicontextuality.

Confirmability

During the interview process I asked open-ended questions and avoided leading questions (see Appendix A). I modeled reflective thinking by stating any personal assumptions or biases as they arose. For example, I am aware of conversations in the school district related to teachers having low expectations for African American students. Therefore, when three of the participants made references to their experiences with teachers displaying low expectations, I addressed my personal bias by writing my thoughts in a reflective journal. Recognizing biased influences aided in the process of ensuring objective data analysis.

Results

The results section highlights the research questions and the participants' responses as they relate to the ten themes that emerged in this study. Specifically, the most salient themes that emerged from each research question are discussed in the sections that follow. Then, each theme is characterized by connections to Ibarra's (2001) theory of multicontextuality, which identifies high context characteristics as engaging, hands-on learning experiences, for example, and low context characteristics as lecture, passive learning, and working in isolation, for example (see Appendix B).

Research Question 1

What are the formative K-10 experiences and perceptions of African American young women in their junior or senior year in in high school in relation to STEM?

Theme 1: High teacher expectations. Eight of the eleven participants made strong references to teacher expectations and how those expectations motivated them to move forward with STEM classes. Participants described how they were motivated and encouraged by teachers who had high expectations of them and encouraged them to succeed in the classroom. For example, Randy stated, "I had teachers who were very supportive of me and encouraged me to do new things like taking AP Physics." Tonya stated "Knowing that my teacher believed in me made a difference in my performance." Airyana stated, "My science teacher was one of my greatest mentors. She really pushed me and encouraged me to take AP and STEM classes."

Contrary to Airyana's science teacher's high expectations, Airyana also noted that educators are not always encouraging. She stated, "I have experienced educators saying that I couldn't be successful in the advanced classes. Teachers are like, 'Are you sure, because that class may be too hard for you?'" Airyana informed me that she thought to herself, "If I want to do it, I am going to do it. " Airyana's response demonstrated self-determination which is needed for African American young women interested in STEM classes.

Randy also noted that she experienced low teacher expectations, saying, "The day I was signing up for classes I said I wanted to take an AP class and a Caucasian male teacher said, 'You don't want to do that.'" Randy said she responded to the Caucasian

male teacher “Why not?” and he said “Just make sure you want to take this class.” Randy did sign up for class and she stated “I outperformed all the other students in my class that the Caucasian male teacher encouraged to take the class.” Randy’s response demonstrated that these young women cannot let others determine the pathway in which they will travel. If they have a desire to pursue advanced classes, they should remain focused in spite of what others may think as it relates to their ability.

It is not known how many African American young women did not sign up for an advanced STEM classes, missing out on an opportunity to pursue their academic goals, because of negative comments from educators. The participants in the study were determined to enroll in advanced STEM class even when positive encouragement from educators was absent. When African American young women find themselves in situations where they are not receiving positive encouragement, it is important for them to remain focused and move towards their goals. As stated by Tonya, Airyanna, and Randy, receiving positive encouragement from educators serves as a catalyst to pursue and reach success in advanced STEM classes.

Theme 2: Participation in STEM extra-curricular activities. The theme participation in extra-curricular STEM activities emerged when the participants were asked, What experiences outside of school do you believe may have contributed to your interest in the STEM fields? Seven of the eleven participants made connections to their involvement in extra-curricular activities and how those activities propelled them to enroll in STEM classes. As documented below, participants described how making

connections to STEM early in their schooling process helped guide their choices for classes.

Naomi said, “The science fair is what I think really got me involved in liking science. Naomi continued to say, “My first time entering into the Science Fair in the sixth grade, I got second place.” Naomi added that placing second in the science fair gave her encouragement to keep going into STEM programs.

Patricia stated “Participating in a science and engineering achievement program in middle school sparked my interest in STEM.” Patricia said “Experiments is what I really enjoyed about the STEM program?” Patricia noted that her participation the STEM program grabbed her attention and resulted in an increased interest in STEM.

Carrie said “I used to go horseback riding and I volunteered at the local animal shelter.” Carrie also stated, “I got into the mentorship program at the Animal Hospital during my senior year in high school. It was cool and reaffirmed my willingness to pursue a STEM career.” As a result of Carrie’s experiences, she is interested in pursuing veterinary science.

Michelle stated, “In middle school in sixth grade I was introduced to an engineering program for girls. Michelle added, “My friends were interested, so we decided to join the group.” As a result of participation in the middle school STEM program, Michelle said “I was motived to enroll in the engineering program in high school.”

The statements from the participants listed above highlight the importance of participation in STEM extra-curricular activities. Participation in STEM activities

allowed the young women to experience STEM work and provided motivation for them to seek further STEM opportunities. Additionally, as stated by Naomi, confidence levels increase as a result of participating in the STEM activities.

Research Question 2

How does the distinction between high and low context illuminate the experiences of the participants?

Theme 3: Engagement in group-work. One of the most prominent themes identified in the data analysis was engagement in group work. All of the participants acknowledged that engagement in group work was very important to their participation and success in the class. Randy stated, "Group work is awesome for balancing ideas and creating a science environment not so cut-and-dry." Tonya said, "Group work allows you to learn from classmates' ideas." Dorothy noted, "Doing group work will allow you to see a little piece of what you might be doing in the real world." Although Patricia said that group work was beneficial to her success in class, she shared a few reservations. Patricia stated:

> I am afraid to talk to people, but when working in a group you have to contribute somehow because the group depends on you. The group work forced me to work with and talk to people that I was afraid to talk to.

Michelle stated, "I am very hands-on and enjoy working in groups, but I am also good with notetaking." Excerpts from the participant responses related to high context can be found in Table 6.

Theme 4: Learning from lectures. The theme learning from lectures emerged in responses to interview question 5, which asked participants to describe their experiences related to lectures in STEM class. Patricia stated, "I actually like lectures, which is weird. I'm not a good note taker, but just hearing what the teacher has to say and looking at the notes on the board work for me." Patricia went on to state, "I wish there were more lectures, but I don't say that in class because some people don't like them." It is interesting to note that Patricia expressed interest in hearing more lectures, but she would not verbalize her desire to hear more lectures to her teacher because of her understanding of what others feel about lectures. Patricia's insight support the need for a classroom environment that incorporates both high and low context characteristics. Patricia also expressed the importance of doing more lectures in order to help her prepare for college noting that "many STEM classes in college are set up as a lecture and lab."

Similar to what Patricia said about lectures, Randy and Michelle also stated that lectures are valuable to the learning experience. Randy stated, "Lectures were equally good and informative as group work." Randy's comments show the connection between high and low context learning. Likewise, Michelle said, "I am good with taking notes. During lectures, I like to ask questions while writing things down." The act of asking questions represent a high context characteristics and the motion of writing represent a low context characteristics. Additional excerpts on learning from lectures can be found in Table 6.

Table 6

Excerpts Related to High and Low Context Characteristics

Participant	High Context Excerpt	Low Context Excerpt
Airyana	It's nice getting feedback from your peers not just your teacher. It's also nice to bounce ideas off of each other. In groups, you have people to consult with.	Yeah, lectures require a lot of writing, but they are always informative, providing you stuff that you need. Sitting through a lecture might be a pain in the beginning, but it definitely benefits you in the end. Once you get through the lectures, it's almost like a rainbow appears.
Carrie	I like working in groups and having hands on experiences. I have to see something, I have to write stuff down.	
Dorothy	It's fun to do different labs with groups because you get to hear what other people think. Also, group members help you spark different ideas to figure out a problem or come to a new solution.	
Melayna	I really enjoyed working in groups. Groups allowed you help others who didn't know certain material and they could help you on materials that you did not know.	My teacher said you need to be able to listen to lectures because you will have them in college. I struggled a little with lectures, but I worked my way through to be successful.
Michelle	I am very hands on when it comes to group work. I like to see the surprised look on the boy's faces when I take the lead on constructing a project.	During lectures, I ask at least 5 questions to help me understand the information.
Naomi	I learn from others in groups. Also, you get to build relationships by working together.	
Patricia	I loved group work, I really loved it. Working together allows you to bring different ideas to the table to get the job done.	I'm not a good note taker, but hearing what the teacher has to say and looking at the teacher and notes on the board is good for me.
Randy	Working in groups is awesome for balancing ideas and creating a science environment not so cut and dry.	One of my favorite teachers did lectures and then you apply what you learn in the lab. I love lectures too because they were really informative.

(table continues)

Participant	High Context Excerpt	Low Context Excerpt
Renee	Group work was fun and engaging, but most importantly, it allowed me to exchange ideas with my peers, which helped me learn the content.	
Sandra	I loved working in a team. I found it to be less stressful and more enjoyable than working without a team. Also, I had greater success when working with in a group.	The enthusiasm and energy that the teacher carried made a big difference with lecture. I enjoyed the lively ones.
Tonya	I like to have help from my group. By being in a group, I could learn better than if the teacher just stood up there and talked.	

The low context lecture class is equally important as the high context lab class. As K-12 teachers work to ensure that students are prepared for college and career, they must expose them to both high and low context learning environments. Although some participants stated that they do not like lectures, other participants stated that they are able to gain meaningful information from lectures. Lectures are considered low context, and lectures are not the preferred method of learning for most minority students, but they are needed to enrich the multicontextual class environment (Ibarra, 2001).

Research Question 3

How have participants' STEM experiences influenced decisions related to future career options?

Theme 5: Helping others. The theme of helping others emerged when the participants were asked about career interests that inspired them. When asked to describe the characteristics of the career that inspires them, nine out of eleven participants stated that they wanted to help others. Sandra stated that she wanted to become a forensic

pathologist. She said, “Although a pathologist will examine the cause of death, I feel that I will help families understand what happened to their loved one.” Randy stated, “I really enjoy service, therefore, I plan to pursue a law degree. Although it’s not STEM, I feel that the critical thinking strategies used in STEM will help me reach success on my career path.” Carrie plans to study veterinary science and has a strong desire to help animals, specifically horses.

Although all of the African American young women in the this study were enrolled in at least one advanced STEM class, only four out of eleven participants discussed pursing a STEM degree once they entered college. Carrie, Patricia, Sandra, and Randy identified a STEM career that they would like to pursue. Carrie expressed interest in becoming a veterinary scientist, Patricia expressed interest in becoming an oncologist, Sandra stated she would like to become a forensic pathologist, and Randy expressed interest in becoming an emergency medical technician. Excerpts related to career choice considerations are shown in Table 7.

Table 7

Excerpts Related to Career Options

Participant	Excerpt
Airyana	I want to become a Lawyer. I really haven’t narrowed down the type of lawyer I want to be, but helping people would be my number one priority.
Carrie	I want to be a veterinarian. People have a close relationship with their pets and I think helping to preserve that relationship is everything and helping an animal to stop hurting.
Dorothy	My AP Statistics teacher has inspired my interest in becoming a math major. Although I want a math degree, I ultimately want to become a lawyer.
Melayna	I definitely want to be an attorney. I am interested in justice in America and throughout the world.

(table continues)

Michelle	I like the creativity of literature. I want to major in English when I go to college. Literature can do so many different things for people through words. Writing can be healing for person. Putting thoughts on paper can change someone.
Naomi	Having a science and math background sparked my interest in wanting to become a psychologist. I like helping people.
Patricia	I want to become an oncologist. After learning about cancer in my class, shadowing doctors in my Biomedical program and seeing a MR, I was inspired to help people overcome something or get through something.
Randy	I really enjoy service. I plan to go into pubic heath and pursue a job like EMT or health department jobs.
Renee	I love working with children and people. So, I want to become a Teacher.
Sandra	I want to take the career path of becoming a Forensic Pathologist. Pathology allows me to take my knowledge and help people on a different level.
Tonya	I have always had my mind set on music, therefore, I want to be in music education. One of my favorite artists has lyrics on how she's going to make the world a better place.

I found it interesting that only four out of eleven African American young women from this study desire to pursue a STEM career. It may be assumed by educators that young women enrolled in advanced STEM classes are interested in a STEM career. However, that assumption is not true for the participants in this study. As noted in Table 7, participants are interested in helping others, but the desire to help others may not be done in a STEM career.

The results from this section caused me to think about the importance of educating young women in advanced STEM classes on how STEM careers are also avenues to help others. For example, designing a prosthetic arm may help someone live their life to the fullest. Likewise, engineering a specialized water system may help families in underdeveloped areas have clean water for drinking and cooking. If helping others is what African American young women seek to do, educators can help them by ensuring that the young women are aware of all avenues in which they can help people, including avenues leading towards STEM careers.

Theme 6: Strong parental support. The importance of strong parental support also emerged as a theme when participants responded to the question that asked them to reflect on mentoring experiences. Naomi stated, "When I don't understand something for a prolonged amount of time, I want to give up but having support from my parents help push me beyond my limits to set new goals." Patricia stated, "STEM support and encouragement also falls on parents telling their kids that they can do it." Dorothy stated that she received encouragement from her grandfather. Dorothy said, "My grandfather inspired me to pursue STEM and he exposed me to a lot of his work as an electrical engineer."

Seven of the eleven participants made reference to their mother during the interview process. Naomi stated, "I really look up to my mom. She taught me to push myself beyond my limits." Melayna stated, "My mother…she definitely is someone that mentored me, and she's always been on me to do my best." Patricia said, "My mom always told me that I can be successful and she encouraged me to participate in different STEM activities." Renee noted, "My mom believes that I can do anything that I put my mind to. As a result, I try harder." Renee added, "Because of the encouragement from my mom, I enrolled in advanced biology and worked very hard to be successful in the class."

One participant in this study made a direct reference to her grandfather and seven participants made a direct reference to their mother. However, it should be noted that no participant made a direct reference to her father. It is not clear from this study why fathers were not mentioned in isolation, but it is clear that parental support, mothers in

particular, are needed to encourage African American young women to pursue advanced STEM classes.

Research Question 4

What recommendations from African American female students will help improve recruitment practices in advanced STEM classes?

Theme 7: Self-Efficacy. The theme of self-efficacy emerged in answers surrounding the participants' recommendations for recruitment and enrollment suggestions. Eight of the eleven participants made reference to believing in herself to reach success in STEM. Naomi stated, "Go for it! Don't be afraid of challenging yourself." Renee stated, "The sky is the limit for what African American young women can do. Know that you can, and do it." Carrie said, "You can do anything; you can rise above anything." Airyana noted, "My biggest motivation to take not only AP science but all of my AP classes was more internal motivation than someone pushing me."

The statements from the participants about believing in oneself demonstrate their strong determination to reach their goals. Although external encouragement from teachers and parents are important variables in providing support to African American young women interested in STEM, it is also important that the young women believe in themselves. The participants in this study had high expectations for themselves and they encouraged other African American young women to believe in themselves and move toward their STEM goals in spite of barriers that may confront them.

Nearly all of the participants stressed the need to keep pushing forward to reach STEM success. The underlying message was that African American girls themselves are

in control of what they can do, and they should not let others create barriers, thus the theme of self-efficacy. Excerpts of the conversation were extracted from the transcripts and are shown in Table 8.

Theme 8: Gender empowerment. The theme gender empowerment emerged in response to research question 4. Participants explained how gender have played a role in their overall motivation to become successful in STEM. Although participants expressed frustration about how others perceive them because they are African American young women in STEM, they felt empowered to push forward to prove to themselves that they can be successful in STEM.

Nine of the eleven participants felt strongly that girls should not be academically threatened by boys while in STEM experiences. Traditionally, boys are highly represented in STEM classes and the absence or low enrollment of girls in the class can be an added barrier for girls to enroll in the class. If girls are not taught to believe in themselves and know that they have a place in STEM classes, they may believe that STEM is a place for boys.

Airyana stated, “Don’t be intimidated by the boys in your class because you think science is a boy thing. If you really think you can do this, you can do this.” Michelle stated, “It is already hard enough being underestimated as a girl. But don’t give them a reason to underestimate you.” Michelle added, “Don’t just be the African American girl in the class, be the smartest student in the class.”

Table 8

Excerpts of Advice for African American Young Women Seeking to Enroll in STEM Classes.

Participant	Excerpt
Airyana	Don't be intimated by either the minority number or the number of boys in the class. It's hard, but it's not unreachable. Don't let stereotypes get in your way.
Carrie	Don't let anybody tell you that you can't do what you want to do just because of who you are and where you come from. You can do anything, you can rise above anything.
Dorothy	Go after it! Nothing is too hard but it might seem hard at the very beginning. But you can do it! Don't quit because we need people throughout the world, many people in the future who are interested in STEM.
Melayna	Don't be intimidated. Don't listen to what other people say. If you listen to what people say, if you don't just listen to yourself and take the path that you want, you'll never be successful. African American young women need to stop trying to make it seem like, "No, I can't do it. Yes, you can. "
Michelle	Don't think you are not smart to do it. If you want to do it, do it. It doesn't matter if you don't have friends in the class. I am the only African American student in the class. That shouldn't affect you. If may seem weird but you have to focus on yourself and your work. Don't be distracted or discouraged.
Naomi	Don't be afraid to step out of your comfort zone. There's always people there that's going to help you. In STEM, there's different ways that you can apply the knowledge so it's not necessarily just your math, science, and engineering, although that's the likely pathway. However, there's different branches that you can branch off to so you will not be set into one specific category or career.
Patricia	Work hard and try as many things as you can because it's important. I want to see people like me flourish because I feel as if we are not doing enough. Keep going, work hard, and try as much as you can.
Randy	There are going to be days that you feel as if you are not smart enough or wonder if people are taking you seriously. But the most important thing is to worry about you first. Know what you want and go after it. If you have that yearning to go into a certain STEM class or club, go ahead and follow it.
Renee	STEM is for all. It is not for a specific race or gender, so go for it. Don't let stereotypes about race or gender slow you down.
Sandra	In STEM, you find mostly boys and not many African American young women, therefore, girls may feel outnumbered and may not want to pursue a STEM pathway. But you should move forward if you are interested in STEM.
Tonya	Don't ever quit. Things will definitely be hard, but you can't stop. You can't do the bare minimum. Set the bar high so that people will look up to you.

The African American young women in this study were aware of the barriers they face as it relates to gender in the STEM environment. However, they kept pushing forward. The participants in this study also recognized that in spite of the traditional look of a STEM class, which is predominantly filled with boys, girls can participate in STEM experiences as well. The participants' comments reflected their understanding that STEM is for all.

Theme 9: Race empowerment. Race empowerment also emerged as a theme from the questions relating to recruitment and enrollment. Eight out of eleven participants made reference to feeling empowered as an African American young woman in STEM classes. Tonya said, "Don't let the color of your skin stop you from reaching your goals." Tonya also stated, "Me and my friend made a pact to stand out in the crowd and succeed because we are African American young women." Sandra said, "Set goals and work hard to reach them in spite of your race." Patricia said, "You can do anything you put your mind to regardless of your skin color." Michelle stated, "I am the only African American in the class, and it sometimes feels weird, but you have to focus on yourself and your work". Patricia also noted, "Race and gender sometimes feel like a barrier, but you can do anything you put your mind to no matter your race or gender."

Theme 10: Strategic recruitment practices. When participants were asked "What recommendations from African American female students will help improve recruitment practices in advanced STEM classes?" the theme of strategic recruitment practices emerged. Ten out of eleven young women made strong statements about what they believe educators can do to recruit more African American young women in STEM.

Renee stated, “Provide STEM opportunities as early as possible to spark interest in STEM.” Tonya said, “If you grab a group of African American girls and put them together, they will feel empowered.” Dorothy stated, “You have to go into more classrooms and promote STEM and explain what benefits it really does have because STEM is such a basic necessity, especially in the world today, and [STEM] is growing so rapidly.”

Most of the participants expressed the need for educators to seek out African American young women for STEM classes and clubs, thus the theme for recruitment practices. Naomi stated, “Don’t be afraid to grab us or pick us out, because a lot of us are looking for that person to be like, ‘Hey, want to try something out of your comfort zone?’” Melayna asked the following questions to educators, “Why can’t you see past my race? Why can’t you see past my skin pigment? Why can’t you just see someone that has a brain, that has a mind, someone that has the potential to maybe do something to maybe change the world?” Melayna’s comments should encourage educators not to judge students by the color of their skin as they guide them towards advanced classes.

Participants in this study did not feel welcome to enroll in STEM classes, therefore, more work should be done to promote a welcoming environment for African American young women interested in STEM classes. Randy said, “Someone needs to recognize that African American students do not see themselves in STEM because it doesn’t reflect them.” She continued with, “It needs to be a question of ‘Why?” Randy also noted that “Someone needs to recognize that we don’t feel welcome in STEM classes.” She added, “Extending a hand or inviting African American young women in

for a class period would be helpful. Although it may seem like a little favoritism it will be giving the African American young women what they need; it would be promoting equity." Randy's response challenged educators to be more reflective in their approach to the issue of underrepresentation of African American young women in STEM.

Randy's responses caused me to ponder more questions. What can we do to make STEM more reflective of all students? How can we make all students feel welcome in a STEM class, regardless of race or gender? STEM classes are not designed for specialized groups; STEM is for all. However, if that message is not sent loud and clear to students, parents, and educators, we will miss the opportunity to create the needed diversity in STEM classes and careers.

The following recruitment recommendations were made by the participants in this study:

- expose African American girls to STEM as early as possible during their K-12 schooling,
- reach out to African American young women and invite them sign up for STEM clubs and classes,
- provide encouragement and support to African American young women once they enroll in STEM classes, and
- keep an open mind about African American young women in STEM and don't stereotype them because of race or gender.

Discrepant Cases

Some discrepant cases have already been discussed as they relate to the themes. Another discrepant case related to a response from the participant Melayna. When I asked the interview question about perceptions of teaching strategies that influenced your STEM choices, Melayna stated, "I love the Universal Design for Learning (UDL) strategies that teachers are using in the classroom." I asked Melayna, "In what ways are you familiar with UDL." Melayna stated, "Schools are starting the Common Core curriculum, and my teachers are doing integrated UDL stuff to change their instruction." Melayna surprised me with her response related to UDL. No other participants mentioned UDL in their responses. I was impressed by Melayna's response as it showed how she observed the differentiated teaching strategies that took place in her class.

UDL is the practice of providing students with multiple means of representation for learning (CAST, 2011). For example, if notes are provided on the board the teacher should also provide verbal instructions related to the notes and structure learning activities that allow for productive group work. Another example would be to present information using graphics, computer simulations, video, and sound. UDL represents a multicontextual classroom environment which ensures that high and low context characteristics are embedded during the lesson. As stated by Ibarra (2001), a multicontextual classroom provides support for minority students in STEM environments.

Other discrepant cases related to participants' responses on their dislike for lectures. Naomi stated, "I'm not really good with lectures because they kinda bore me, so

I wouldn't say it's a really good experience." Dorothy stated, "I am not a fan of lectures, even outside of STEM." Dorothy continued to say, "I just think you need to be more interactive because in the real word you're not just gonna be told what to do all the time." Although engagement in group work was the most-discussed method for learning STEM content in this study, lectures are also critically important. Without an appreciation of lectures and other low context instructional methods to aid in a child's understanding of the content, it is possible that the STEM achievement gap between minority and non-minority students will widen. Teachers must work to equip students with the understanding of the importance of lectures and not assume that the students understand the benefits of lectures.

Summary

The research questions were formulated to examine the experiences of African American young women related to STEM education. In the first research question, I inquired about experiences and perceptions of African American young women related to STEM education. The themes of high teacher expectations and participation in STEM activities emerged from the first research question. Participants described how engaging STEM activities and high teacher expectations largely influenced their decisions about STEM classes in high school.

Research question two inquired about the distinctions between high and low context experiences. The themes of group work, engagement and learning from lectures emerged from this question. Overwhelmingly, participants described experiences that

were aligned with high context characteristics. However, five of the participants also made connections to low context characteristics.

The third research question asked participants how STEM experiences influenced decisions related to their STEM choices. Data revealed that encouragement from parents or teachers played a large role in the participants' choices related to STEM classes and career options. All of the participants made decisions to enroll in one or more STEM classes; however, only five were planning to pursue a STEM degree in college. The themes that emerged from this question were helping others and strong parental involvement.

Research question four asked for recommendations to improve recruitment practices in advanced STEM classes. The themes of self-efficacy, race and gender empowerment, and strategic recruitment practices emerged from this question. Participants recommended that educators purposely seek out African American young women, and encourage them to pursue STEM classes. Additionally, participants made strong statements about encouraging African American young women to believe in themselves regardless of race or gender.

In Chapter 5, I will interpret the findings by making connections to the literature review and conceptual framework. Limitations of the study will be described, and recommendations for further research will be made. The chapter ends with implications for social change.

Chapter 5: Discussion, Conclusions, and Recommendations

The purpose of this phenomenological study was to examine the experiences of African American young women in relation to STEM education. The intent was to gain knowledge about underrepresentation of African American young women in STEM by exploring the participants' experiences from grades K-10. While examining the perceptions and experiences of the participants I was also looking for high and low context characteristics that aligned with the current study's conceptual framework, Ibarra's (2001) theory of multicontextuality. In this research study, I was also interested in learning about future career aspirations of the participants. Additionally, I solicited suggestions from the participants on ways to recruit African American young women into STEM.

When I inquired about K-10 experiences in STEM, participants stated that early exposure and high expectations set by teachers played a critical role in their decision making process related to taking STEM classes. When I asked questions related to multicontextuality responses aligned closely with high context characteristics. When inquiring about future career options participants expressed interest in careers that allow them to help others. The advice given by participants on recruitment practices is to reach out to African American young women and to encourage them to take STEM classes.

The discussion in this final chapter includes interpreting the findings and linking those findings to the literature review. Ten emerging themes were discussed in Chapter 4. The ten themes and descriptions in Chapter 4 represent the collected experiences of the participants' in STEM. The following includes the interpretation of the findings, a

discussion on the limitations of the study, recommendations for further studies, and a discussion on the implication for positive social change.

Interpretation of Findings

In this study, I addressed the underrepresentation of African American young women in STEM. The perceptions and experiences of the participants were connected through the following ten themes: (a) high teacher expectations, (b) participation in STEM extra-curricular activities, (c) engagement in group-work, (d) learning from lectures, (e) strong parental involvement, (f) helping others, (g) self-efficacy, (h) gender empowerment, (i) race empowerment, and (j) strategic recruitment practices. The following paragraphs will make connections between the themes, the literature review, and the conceptual framework.

K-10 Experiences and Perceptions

In the first research question, I inquired about the experiences and perceptions of African American young women in relation to STEM. Ramsey et al. (2013) stated that the experiences of African American young women in the classroom setting have a large impact on their trajectory toward classes and careers. Through research question one, I found that participation in extra-curricular STEM activities and high teacher expectations played the most valuable roles in participants' perceptions related to their K-10 experiences.

Teacher expectations continue to play a critical role in the academic decision-making process for girls in STEM. Archer-Banks and Behar-Horenstein (2012) found that teachers and counselors who provide motivation and positive encouragement to

young women help them feel confident about pursuing STEM classes. Likewise, teachers who create high context learning environments and promote academic discourse have a greater chance of ensuring that African American girls remain interested in STEM (Ibarra, 2001).

Dubetz and Wilson (2013) stated that exposure to STEM activities provides motivation for girls interested in STEM. Dubetz and Wilson also noted that organizations such as Girls in Engineering, Mathematics, and Science (GEMS) provide learning experiences inside and outside of the classroom to promote girls' interest in STEM. Likewise, Griffin (2014) stated that organizations such as Black Girls Code (BGC) serves as an avenue to help girls make early connections to STEM.

Aligned with the literature, participants in this study described how participating in STEM extracurricular activities served as a motivation for them to enroll in STEM classes throughout their schooling process. Participants in this study were exposed to varying STEM extra-curricular activities beginning in middle school, including engineering programs for girls, science fairs, and co-ed science and engineering programs. Missing from current literature and from this research study is data on early exposure beginning in elementary school. Although participants in this study were asked to reflect back to kindergarten experiences, no one mentioned anything earlier than sixth grade. As noted later in this chapter, the time frame for the reflection may have served as a limitation. As efforts are made to increase early exposure opportunities, educators and researchers must take a deeper look at opportunities for early exposure beginning in elementary school.

Participants in this study made strong connections with teachers who held high expectations for them and believed that they could be successful in their classes. Holding African American young women to high expectations and providing words of encouragement provided much needed motivation for the young women on their STEM journey. For example, one participant stated that the enthusiasm of her teacher and the overall high expectations that the teacher held for all students in her class kept her engaged and pushed her to work harder. Another participant described how her teacher encouraged her to believe in herself because she was just as capable as any other student to be successful in the advanced STEM class.

Contrary to the positive encouragement, participants also described experiences when educators did not hold them to high expectations when they expressed interest in STEM. West-Oluntuji and Shure (2010) noted that counselors tend to place young women in lower-level science classes. In this study Aiyanna stated, "Educators are not always the most encouraging. I have experienced educators saying 'you can't do that.'" As research (West-Oluntuji & Shure, 2010; Archer-Banks & Behar-Horenstein, 2012) has shown, educators who have low expectations of students because of race or gender hinder the child on his or her pathway to reaching high academic success.

Holding high expectations and providing encouragement for young women interested in STEM continue to be a critical component needed for success in STEM. Providing information to all educators about the impact of holding high expectations and the importance of encouraging all students to enroll in STEM classes will be beneficial to the diversity needed in the STEM fields. As stated by Ladson-Billings (2013), building

relationships with students, holding high expectations for all students, and learning about students' interests will increase children's success in the classroom.

High and Low Context Characteristics

Ibarra's (2001) theory of multicontextuality was used as the conceptual framework for this study. Ibarra (2001) stated that providing minority students with high context experiences such as hands-on, engaging learning will yield greater academic success, especially for minority students in STEM classes. Research question two probed how participants STEM experiences were influenced by high and low context characteristics. Evidence collected throughout this research makes strong connections to Ibarra's theory of multicontextuality.

All of the participants highlighted how group work, which is high context (Ibarra, 2001), was critical to their success in the STEM environment. Participants stated how important it was for them to be able to work with others and share ideas. As stated by Ibarra, providing the opportunity for minority students in STEM to have academic discourse while engaging in hands-on authentic learning tasks is crucial to the success of the minority students in the classroom. The responses from the participants in this study are aligned with Ibarra's theory related to a high context learning environment.

Although all of the participants connected to high context characteristics, six participants also connected with low context characteristics. The low context characteristics discussed by participants in this study include the ability to listen, take notes, and learn from lectures. However, it should be noted that none of the participants connected only with the low context characteristics.

As stated by Ibarra (2001), the classroom environment that best supports growth and development of minorities in the STEM class is multicontextual. Therefore, it is critical that components of high and low context characteristics are embedded in the class setting. Responses from the participants showed that it is important to have a classroom with lecture and group work. Although the majority of the participants discussed group work, it is important to note that lecture is an important aspect of the multicontextual classroom environment.

In addition to the high and low context characteristics related to group work and lectures, research question three evoked responses that aligned with high context characteristics of building relationships. Participants described having strong relationship with parents and teachers and how those relationships helped them build a solid foundation on their STEM journey. Adeymi (2013) found that socializers such as parents, teachers, peers, and counselors, greatly influence a child's choices related to STEM education.

Along with the discussion on strong relationships with parents, strong parental involvement emerged as a theme in this study. Participants described how having a strong relationship with their parents and being encouraged by their parents motivated them to push harder. Patricia stated that her mom always encouraged her to try different classes and activities in school. Likewise, Naomi discussed how her mom was influential in her participation in STEM activities in and out of school.

Gunderson et al. (2012) noted that parents as well as teachers contribute to the attitudes held by girls in STEM. If parents see STEM as a male field of study, they are

not likely to encourage their daughters to pursue STEM. On the other hand, if parents see STEM as a career option for all, they will provide the much needed motivation to their daughters to pursue STEM classes and careers. As discussed in this research study, parent involvement is an important variable that promotes interest in STEM.

Lane et al. (2012) stated that women are likely to pursue the humanities because of the high context environment. The data collected from research question three found that only four of the eleven participants plan to pursue STEM as a career. This was surprising because all of the young women were enrolled in at least one or more STEM classes, and they all described positive experiences related to STEM in the classroom. Additionally, many of the participants were also engaged in STEM extra-curricular activities.

Future Career Considerations

The inquiry related to characteristics of career interests that inspire the participants provided valuable data for this study. Although the participants were in some of the highest-level STEM courses and discussed the importance of STEM for African American young women, only four of the eleven participants were interested in pursuing a STEM career. The career interests that participants described, such as becoming a lawyer or a teacher, have high context characteristics of building relationships. Additionally, one participant described wanting to become a psychologist and one a musician, careers in which they will likely work in a group or on a team.

It is not uncharacteristic for young women to be interested in non-STEM careers (Lane et al., 2012). The hovering effects of the stereotype threat related to young women

in STEM is still a barrier for young women to overcome in the STEM fields (Shaffer et al., 2013). As a result, the decision for African American young women to pursue a STEM career has an added layer of complexity. As noted by participants in the study, they are aware of the stereotypes that follow them and they have described how they work extra hard to overcome barriers that confront them.

If African American young women demonstrate cognitive stamina by achieving success in advanced STEM classes and those young women are not entering the STEM fields, society is faced with a problem that needs to be explored further. STEM is a career that requires young men and young women to have strong math and science skills. The participants in this study excelled in math and science and they will leave high school with the skills needed to pursue STEM further. However, if eight out of eleven young women from this study are not interested in pursuing a STEM career, society will miss out on the opportunity to have highly able young women become change agents in the STEM fields. Additional thoughts on recommendation for future studies will be discussed later in this chapter.

Thoughts About Recruitment Practices

Interview question ten asked participants about recruitment practices, and interview question eleven asked participants about advice to other African American young women. The themes that emerged from the answers to these two questions, which corresponded with research question four, were self-efficacy, race empowerment, gender empowerment, and strategic recruitment practices. Answers to these questions provoked more emotions from the participants than the other interview questions in this study.

Malcom and Malcom (2011) stated that African American women are faced with the double bind of being African American and female. The participants in this study were aware of the double hurdles that they face in STEM because of their race and gender. As a result of their awareness, participants provided responses that addressed race and gender.

Participants provided strong words of encouragement to African American young women interested in pursuing STEM. The overall message is to believe in yourself, and do not let others guide your path. Yes, STEM work will be difficult, but know that you can achieve your goals as an African American young woman in spite of negative perceptions from others.

Participants gave clear recommendations to educators who are working to recruit more young women in STEM. The overall recommendation is to seek out African American young women and purposefully invite them to sign up for STEM classes. Sandra said, "Talk to them about STEM." Research shows that simply getting to know students, talking to students, and learning about their interests are components of building a competent student (Ladson-Billings, 2013). Participants in my study also encouraged educators to look at them as potential change agents despite their skin color.

Specialized programs like band recruit students who are enrolled in some type of music class. AP teachers generally recruit students who are enrolled in the honors program. Just as focused recruitment takes place for specialized programs in a school, focused recruitment is required to encourage African American young women to enroll in STEM classes. Schools must begin to look at African American young women interested

in STEM as a specialized group. Focused recruitment will allow educators to purposefully focus on African American young women and plan for a supportive, encouraging environment to ensure success in advanced STEM classes.

Examining the S, T, E, and M in STEM

As defined by Bybee (2010), STEM education is an inquiry approach to acquiring scientific, technological, engineering, and mathematics knowledge to identify issues, acquire new knowledge, and apply the knowledge to STEM-related issues. As I reflect on that definition, it is important to emphasize that STEM encompasses all of the components of the acronym, not the components in isolation. However, this study showed that when communicating about STEM, most participants made direct reference to science.

All of the participants in this study made direct references to science courses such as biology, chemistry, or physics. However, only two participants made a direct reference to math, and only one participant made a direct reference to engineering. No participants made direct references to technology, likely because technology in STEM is generally a tool to help you achieve your STEM goals.

Although only two participants made a direct statement about math in this study, it should be noted that the prerequisites to enroll in advanced STEM classes require the completion of higher level math courses such geometry, algebra II, or calculus. Without successful completion of the prerequisite math courses a student cannot enroll in advanced STEM classes. For those reasons, math has been considered the gatekeeper to STEM success (Reigle-Crumb & Humphries, 2012).

Reigle-Crumb and Humphries (2012) noted that not only is math the gatekeeper to elite occupations in the STEM sectors, it is also stereotypically a male-dominated course. As it relates to African American young women, educators must work to ensure that African American young women are prepared to enter through the math gate at an early age with proficient skills in order to access higher level STEM courses. Likewise, as negative stereotypes about a young woman's math ability surface, educators must work to combat those stereotypes and create environments to ensure math success for all (Shapiro & Williams, 2012).

Understanding all of the barriers that African American young women face in STEM will be important as educators work to help African American young women overcome those barriers. Students cannot enroll in an advanced STEM class without having completed the appropriate prerequisites, which includes math and science classes. Without focused attention on African American young women and the pathway that they pursue, it is possible for highly able African American young women to be misguided, causing them to have missing prerequisites on their transcript. Purposeful recruitment in the early years pipeline would allow educators to work with African American young women to ensure that they are prepared with the appropriate perquisites to achieve their STEM goals.

Limitations of the Study

Because there were only eleven participants, each of whom may have had her own biases, the study is limited in its applicability to all African American young women in STEM. During the study, the participants did not discuss science, technology,

engineering and mathematics equally, so the data collected are not necessarily applicable to each discipline separately. The study is also limited by the fact that the theory does not address culture, ethnicity, gender or learning styles in isolation to explain the preference of high context or low context experiences. Another limitation of this study was the time in which participants were asked to reflect. Students who recently completed their eleventh or twelfth grade year in high school were asked to reflect back on experiences beginning in their kindergarten year. The reflection process was a limitation because no participant discussed experiences earlier than sixth grade.

Additionally, my own biases from the perspective of an African American woman who studied science, educated others in science, and supervises science teachers served as a limitation. During the process, I acknowledged my prior experiences and biases that may have impacted this research study in order to reduce biased interpretations of the data. I kept a journal to reflect on biased situations as they arose. For example, I once wanted to become a pathologist as one of the participants described. When she talked about her career goals, I thought about how I wanted to pursue that pathway as well. To avoid digressing and thinking about my own past career aspirations, I reflected on those thoughts at a later time in a reflective journal.

Recommendations for Future Research

The findings and related literature reviewed in the study highlighted the need for additional research. One of my recommendations would be to probe deeper into the career interests of African American young women. Findings from this study showed that most of the participants are not interested in pursuing STEM careers. More research is

needed to explore why the most highly able African American young women who are enrolled in advanced STEM classes are not pursing STEM careers. On the other end of that spectrum, recommendations to examine the perceptions and experiences of African American young women already in the STEM fields may provide data that will encourage high school girls to pursue STEM careers.

Another recommendation for further research would be to explore K-5 STEM experiences for all students. In this study, participants reflected as far back as sixth grade. No participants referenced STEM experiences in grades K-5. Research is needed to focus specifically on K-5 experiences by purposefully selecting participants from grades seven and eight. Reducing the reflection process to 6 years rather than 11 years may yield different responses from the participants as it relates to STEM early exposure.

A final recommendation for further research would be on STEM recruitment practices. Students in this study provided recommendations to educators for recruiting African American young women in STEM. However, examining how much is known about recruitment practices may be beneficial in helping to increase the number of African American young women in STEM. If research is conducted to explore STEM recruitment practices, school districts, and employers may learn about best practices to recruit students and workers for a diverse STEM environment.

Recommendations for Action

Low context instructional activities matter (Ibarra, 2001). Lectures, reading, individual classroom assessments, and standardized tests are all considered low context instructional strategies and they play an important role in a child's success in the

classroom. It is recommended that educators actively teach minorities, especially girls, the skills needed to be a good listener, a good note-taker, and a good test-taker to ensure that students are equipped for academic STEM success. The skills listed above would help African American young women strengthen their academic skills needed to be successful in a multicontextual classroom.

As stated by Reigle-Crumb and Humphries (2012), math is the gatekeeper to STEM success. Therefore, educators must ensure that all students have access to rigorous math courses prior to entering high school. Just as the participants in this study recommended strategic recruitment practices to help increase African American young women's participation in advanced STEM courses, I recommend that educators plan strategic recruitment practices to ensure that African American young women and other minority students enroll in advanced math classes in middle school. Enrolling in advanced math classes in middle school would allow African American young women to gain access to advanced level STEM classes in high school. If African American young women enter high school without the appropriate prerequisites, the journey to pursue advanced STEM classes becomes more challenging.

Although most school districts are divided into elementary, middle, and high school, we cannot wait until high school to place students in advanced math classes. The prerequisites for enrolling in advanced STEM classes may include a science course, but all prerequisites include successful completion of an advanced level math course. The work must begin early in our efforts to pave the way for successful participation in STEM.

Once students enter high school, I also recommend that educators purposefully pay close attention to young women enrolling in advanced math classes and strategize on how to keep the girls in the advanced math pipeline. Negative stereotypes related to a young woman's ability to be successful in math have been a hindrance for young women enrolling in advanced level math courses (Appel et al., 2011). Therefore, work must be done to encourage girls to enroll in advanced math classes, and educators must provide ongoing encouragement and support to help them maintain success in rigorous math courses. Providing added support to African American young women would help ensure that they can enter and remain in a STEM pathway.

Implications for Social Change

In order to maintain competiveness in the STEM fields, we need a diverse STEM workforce which includes African Americans and young women (McNally, 2012). One of the social change implications would be to have an increased number of African American young women in STEM classes and careers. As research shows, African American young women are underrepresented in STEM (Adam, 2013; Milgram, 2011). Using the results from this study to aid in increasing the number of African American young women in STEM classes and careers would be a great movement toward social change in society.

The findings from this study also have great implications for social change in the schools. Participants discussed how positive encouragement from teachers and being in school settings where all educators held high expectations for all empowered them to succeed. Therefore, teachers and counselors should reflect on their interactions with

African American young women and make changes to ensure that their actions are promoting STEM inclusiveness.

There are also implications for social change for parents. Strong relationships and positive encouragement from parents played an important role in the pathway that African American young women followed. If parents are open-minded and can see their daughters pursuing any class or career that they choose, African American young women will be inspired to move in the direction of their choice, which may include STEM. However, if parents embrace the idea the STEM is for boys, their daughters will embrace that idea also.

Although this study focused on African American young women, there are also social change implications for African American young men and other minority groups. The theory of multicontextuality as described by Ibarra (2011) stated that all minority students benefit from a multicontextual learning environment. Likewise, high teacher expectations, strong parental support, and self-efficacy will aid in the success of any minority student who desires to pursue advanced STEM classes and careers.

I am hopeful that the most significant social change impact is for the African American young woman herself. Being in a double bind, as described by Malcom and Malcom (2011), adds to the barriers that African American young women must overcome to reach success in STEM. However, as stated by African American young women in this study, you can reach whatever goals you set for yourself. One participant stated, “Do not be intimidated by race or gender.” Another participant said, “Do not let others place barriers in your way because this journey is for you and your tracks will pave the way for

others to follow." Once this research is accessible to schools, teachers, parents, and students, I am hopeful that African American young women will feel encouraged and empowered to pursue STEM classes and careers without reservations.

Conclusion

Diversity drives innovation; therefore, it is critical to the United States economic development that we ensure the STEM fields are diverse with both genders and all races. Men and women bring different perspectives to the innovation of twenty-first century products. Likewise, the experiences of people from different cultural backgrounds add value to understanding varying societal needs. The African American woman brings the two underrepresented characteristics of race and gender needed for the diversity of the STEM fields.

Although enrollment in advanced STEM classes is a step toward increasing interest in pursuing STEM careers for African American young women, it is not enough to ensure participation in the STEM fields. African American young women need encouragement and support from all those that they encounter to help them avoid the feeling of social isolation that currently exist in STEM classes. Also, intentional support and guidance is needed from teachers and parents to help move African American young women, who are cognitively able, toward pursuing the rigorous work of a STEM professional.

Educators and parents must work together to educate African American young women on STEM opportunities and provide encouragement as they seek to pursue STEM classes and careers. Educators and parents should also encourage participation in extra-

curricular activities. As the results of this study showed, STEM activities serve as a catalyst to move young women toward advanced STEM classes. Coupled with lecture experiences, educators should work to create high context learning environments, which promote discourse and engage student in authentic learning tasks. African American young women must believe in themselves and push forward toward their goals. Educators should recruit African American young women on purpose and provide encouragement for enrolling in advanced STEM classes.

Unfortunately, women have had a difficult time finding their place in STEM classes and careers. African American young women have been discouraged by educators as well as by their peers of different races and gender. However, African American young women should feel encouraged knowing that STEM is for all, all races, all genders, and all ages. STEM is not a color; STEM is not male or female; and STEM does not have an age. STEM should be a place where diversity meets creativity and where innovation occurs to make the world a better place.

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Appendix A: Research Questions and Interview Questions

Central research question: How do STEM experiences in K-10 education influence African American young women's academic choices in their final years of high school?

Research Questions	Interview Questions
RQ1 - What are the formative experiences and perceptions of African American young women in their junior or senior year in high school in relation to science, technology, engineering, and mathematics (STEM)?	IQ1 - What K-10 classroom experiences do you believe have contributed to your participation in STEM? IQ2 - What are your perspectives on how K-10 teaching strategies influenced your academic choices related to STEM? IQ3 - What experiences outside of school do you believe may have contributed to your interest in the STEM fields?
RQ2 – How does the distinction between high and low context illuminate the experiences of the participants?	IQ4 - Describe your experiences related to group work in your STEM classes. IQ5 - Describe your experiences related to lectures in your STEM classes. IQ6 - How did your experiences with group work and/or lecture influence your perspective on STEM education?
RQ3 - How have participants' STEM experiences influenced decisions related to future career options?	IQ7 - How did your experiences with STEM education, in or out of school, influence your thinking about career choices? IQ8 - Describe the characteristics of your career interest that inspire you. IQ9 - Describe how mentoring, if any, has impacted your career interests.
RQ4 - What recommendations from African American female students will help improve recruitment practices in advanced STEM classes?	IQ10 - What suggestions would you offer to educators in reference to recruiting African American young women in STEM classes? IQ11- What advice do you have for up-and-coming African American female students seeking to enroll in advanced STEM classes? IQ12- Is there anything else that you would like to share with me about your STEM experiences?

Note: *RQ* refers to research question; *IQ* refers to interview question.

Appendix B: Initial Codes for High and Low Context

Characteristics		Indicators	Code
HC	Communicate Strong Relationships with Teachers	Express enjoyment of student/teacher relationship	SRT
	Communicate Strong Relationship with Parents	Describe the value and importance of strong relationship	SRP
	Communicate High Teacher Expectations	Share how teacher motivated and pushes student toward success	HTE
	Communicate High Parental Expectation	Share how parents motivate and push students toward success	HPE
	Engage in STEM Activities	Participate in extra-curricular STEM activities	ESA
	Prefer group work	Express the desire to work in groups or with a partner	GW
	Embrace Real-World Connections	Describe the value of application of classwork	RWC
LC	Communicate Weak Relationships with Teachers	Discuss unneeded strong/personal relationship with teachers	WRT
	Communicate Weak Relationships with Parents	Discuss unneeded stuff from parents for success	WRP
	Work in isolation	Express the desire to complete projects and assignments alone	ISO
	Prefer Lecture	Describe the desire to take good notes and learn directly from the teacher	LEC
	Prefer Fact-Based Knowledge	Describe the desire to be told factual information	FBK

Appendix C: Audit Trail

This audit trail outlines the steps I took to collect and analyze the data for this phenomenology study.

Collection of Data

Participants

A. The Supervisor of Accountability was contacted to obtain the names and mailing address of potential participants for the research study.

B. I mailed assent and consent forms to 48 potential participants on July 20, 2016.

C. Once assent and consent forms were received back from the participants, they were contacted via telephone to schedule an interview.

Interviews

A. Eleven African American young women's returned assent and or consent forms to participate in the interview. The chart below is a list of interview dates and location.

B. An identical list of questions was used with each participant. Probing questions were asked as needed.

C. Each interview was transcribed and summarized in preparation for member checking.

D. A 2nd interview was scheduled with participants to ensure that I interpreted their responses correctly.

E. Revisions were made to reflect accuracy of the interview responses.

Table C1

Interview Schedule

Student (Pseudonym)	Date of Initial Interview	Location of Initial Interview	Date of Follow-Up Interview	Location of Follow-Up Interview
Airyana	07/28/15	Public Library	08/05/15	Phone Interview
Carrie	07/30/15	Public Library	08/05/15	Public Library
Dorothy	07/30/15	Public School	08/12/15	Phone Interview
Melayna	08/05/15	Public School	08/13/15	Public School
Michelle	08/06/15	Public School	08/17/15	Phone Interview
Naomi	08/12/15	Public Library	08/24/15	Public Library
Patricia	08/13/15	Public Library	08/24/14	Phone Interview
Randy	08/19/15	Public Library	09/02/16	Public Library
Renee	08/20/15	Public Library	09/03/14	Public School
Sandra	08/24/15	Public School	09/03/15	Pubic School
Tonya	08/24/15	Public School	09/04/15	Public School