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Encouraging Young African American and Hispanic Women to Choose STEM Disciplines

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Encouraging Young African American and Hispanic Women to Choose STEM Disciplines

A Thesis
Submitted to the Faculty
of the Department of Leadership Education
College of Education
of Winona State University

by
Augustine Brutus

In Partial Fulfillment of the Requirements
for the Degree of
Master of Science

Date: April 28, 2021
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Abstract

The persisting disparity of young African American and Hispanic women in STEM disciplines has been a long-standing issue for education leaders, policymakers, and industry leaders. One way to address this issue is to explore the best strategies for building confidence in young African American and Hispanic women and increasing their self-efficacy at the high school level to pursue STEM disciplines. Community support, role models/mentors, and hands-on experiential learning are essential parts of the support and experience these young women of color (YWOC) need to feel confident in their abilities to succeed in STEM fields. This study identified the challenges young African American and Hispanic women faced when selecting a STEM discipline and identified the best strategies to overcome these challenges. An online survey and semi-structured interviews were conducted to gather the lived experiences of young African American and Hispanic women currently enrolled in a STEM discipline or working in a STEM field. The survey results and interview results demonstrated that parents’ and teachers’ involvement and continued support are essential to building young African American and Hispanic women's confidence to persist in STEM disciplines. Peer support played a significant role in developing STEM identity and self-efficacy. Additionally, hands-on experiential learning that ignites creativity, critical thinking, collaboration, and communication are also needed to persist in STEM disciplines. This study’s findings are significant as they provide additional insights to existing data regarding the best strategies for promoting confidence and high self-efficacy in YWOC to pursue STEM opportunities.

KEYWORDS: African American, Hispanic, high school, science education, Self-efficacy, STEM education, and young women of color
Chapter 1: Introduction

Women’s representation in Science, Technology, Engineering, and Mathematics (STEM) varies widely across occupations. Women comprise 47% of the overall workers in the US and make up 50% of all employed adults in STEM occupations (Funk & Parker, 2018; Young et al., 2019). This data considered the STEM workforce's broad definition classified in a U.S. Census Bureau’s American Community Survey. Here, the STEM workforce includes 74 occupations, namely computer, mathematical, engineers, architects, physical scientists, life scientists, and health-related jobs, including healthcare practitioners and technicians, but it does not include nurses and medical assistants. Women accounted for 48% of life scientists, 53% of medical scientists, 60% of social sciences, and nearly monopolized psychology careers at 73% compared to men (National Science Board, 2018; Funk & Parker, 2018). In contrast, women have a lesser presence in larger science and mathematics occupational categories, specifically computers, and engineering. In fact, women have the lowest level of representation in engineering fields (16%) and computer science areas (25%), according to PEW Research Center (2019). Furthermore, out of the 16% of women in engineering fields, only 2% of these jobs are held by African American and Hispanic women (U.S. Department of Labor, 2019a; Eisenhart & Allen, 2020). While women have found parity in life science and healthcare fields, they continue to be underrepresented in the computer and engineering disciplines (National Science Foundation, 2015).

Data shows these numbers get smaller for women when focused on both the aspects of race and sex in STEM. Young women of color (YWOC) have historically been underrepresented in STEM disciplines and are viewed as a dually marginalized population as students of color and female learners (Young et al., 2019). There have been years of research done to try to understand
the gap of YWOC in STEM disciplines. The numbers and percentages of representation in minority groups have remained persistently low across some STEM disciplines. For example, we know African Americans and Hispanics represent 27% of the US overall workforce but occupy just 16% of all STEM jobs. It is also true that the 16% are mainly low salaried jobs (Funk & parker, 2018).

Historically, women have been underrepresented in STEM fields. For women of color (WOC), the statistics are even more dismal. Only 20% of young African American and Hispanic women received degrees in STEM fields compared to 60% of white women, according to the National Center for Science and Engineering Statistics (2017).

Studies suggest that teachers are critical to addressing the complex problem of closing the STEM participation gap for minority groups. Teachers can help YWOC get into STEM disciplines with lifestyle-driven educational programs that ignite creativity, critical thinking, collaboration, and communication (Palmer et al., 2011). Educators can facilitate students’ opportunities to socially interact, both inside and outside of the classroom (Scione, 2020; McCoy et al., 2017). It is well documented that students of color from underfunded schools often do not get an early start in STEM like their peers who attend schools with more resources, better-qualified teachers, and modern facilities (Davis, 2020). Thus, for these minority groups, especially those from urban communities with large minority populations, the STEM journey often has no chance of beginning until the high school level.

According to Bystydzienski, Eisenhart, and Bruning (2015), young African American and Hispanic women are interested in STEM fields. However, young African American and Hispanic women face social, economic, and stereotyping challenges that diminish their opportunities to access qualified resources. Access to helpful resources would enable them to
excel and foster the interest necessary to succeed in STEM disciplines compared to their white peers (Farinde & Lewis, 2012).

In 2018, African American women made up 53% of the overall Black labor force, and Hispanic women made up 42% of the Hispanic labor force; this equals 26% of the overall female labor force, according to the U.S. Bureau Labor Statistics. Our economy's future is partially dependent on our ability to get more WOC into STEM careers to keep up with the market demand. U.S. legislators, education leaders, researchers, and industry leaders seeking to regain the country’s highly competitive standing have become increasingly aware of the need to promote students’ interest and increase the participation of YWOC in STEM disciplines (Cunningham, 2017).

**Background of the Problem**

Filling the demand for individuals in STEM fields is vital to the United States' economy, and some believe it is a partial answer to a more prosperous future. According to a report from the PEW Research Center analysis of U.S. Census Bureau data (2019), STEM employment grew 79% from 9.7 million to 17.3 million since 1990. It represented 13% of the United States workforce in 2016, outpacing overall U.S. employment. Despite the substantial growth in STEM jobs, the overall lack of women’s representation remains a growing concern for educational leaders, policymakers, and government agencies (Graf et al., 2019). The current US market lacks technically skilled workers to maintain global competitiveness with developing countries and a diverse workplace (Rotermund & White, 2019). This critical issue calls for government agencies and educators to work together to create avenues for placing essential resources in high schools so that students who are not pursuing STEM-related disciplines for skilled technical jobs will
develop interest and have more opportunities. YWOC can help meet the market demand in
STEM fields.

An abundance of research has been done to address the gender gap in STEM disciplines. Despite YWOC being underrepresented in STEM fields, policymakers, researchers, and practitioners have yet to find solutions to cultivate more interest and participation of YWOC in more lucrative STEM disciplines (National Research Council, 2014; Muenks et al., 2019). STEM representation for WOC is minuscule in lucrative STEM fields, namely engineering and computer sciences. These jobs accounted for about 41% of all STEM jobs in the United States in 2016 (Funk & Parker, 2018). Furthermore, women make up 50% of all adult jobs in the United States workforce but only hold about 25% of STEM-related careers, most of them being in low-paying healthcare jobs, according to the PEW Research Center (2019). The potential barriers for higher levels of STEM degree attainment must be addressed in underrepresented groups. In 2019, the National Center for Education Statistics (NCES) showed that less than 4% of Hispanics and African American women held engineering and computer degrees.

**Problem Statement**

Young women of color represent an untapped potential resource for increasing and sustaining a diverse STEM workforce. However, they face many challenges that inhibit them from reaching their full capabilities. Their talents and high academic performances often go unnoticed because of racial bias, sex discrimination, lack of opportunities, and limited environmental support (Espinosa, 2011). Students of color have reduced access to high-quality schools that offer core subjects which would help them develop STEM identities at the high school level. YWOC often do not have the confidence to pursue STEM once they have reached high school (Young et al., 2019). They often lack the fundamentals generally developed in early
education to succeed in STEM disciplines. Some teachers discouraged or did not challenge these students to explore these educational opportunities because of unintentional gender biases in the STEM classroom (Bernasconi, 2018; Moss-Racusin, Molenda, and Cramer, 2015). According to Mallow et al. (2010), when confidence is a characteristic that leads to persistence and increased self-efficacy, an unbiased educator’s role can positively impact the decision of YWOC to enroll in STEM disciplines and persist when challenges are encountered. Letting biases go unchecked can reinforce the negative self-perceptions that YWOC have regarding their abilities in science and math and their capacity to pursue STEM disciplines.

According to Bystydziensky, Eisenhart, and Bruning (2015), young women of color’s decision not to pursue STEM is not because they lack academic skills or interest in the field. Other major factors such as financial resources, social support, and fear of failure in these majors are significant issues that make STEM paths appear distant and inaccessible (Bystydziensky et al., 2015). In fact, many YWOC are honor roll students who perform well in math and science courses. This makes them ideal students who would thrive in STEM disciplines. Unfortunately, one of the major barriers they face is the lack of mentorship and guidance, which help align STEM disciplines to advanced placement, chemistry, and physics courses. As a result of the lack of support, they distance themselves from pursuing STEM disciplines. Some states have taken it upon themselves to create inclusive schools to enhance STEM proficiency among students in urban communities. These inclusive schools are designed to foster interest in talented young women from underrepresented minority groups who are economically disadvantaged (LaForce et al., 2019). This study will identify strategies that build confidence in young African American and Hispanic women to engage in STEM disciplines.
Purpose of the Study

The purpose of this study was to identify the challenges young African American, and Hispanic women faced when selecting a STEM discipline and to identify strategies to help overcome those challenges.

Research Questions

RQ1. What are the best strategies for building confidence with young African American and Hispanic women to pursue STEM-related disciplines?

RQ2. What are the challenges faced by young African American and Hispanic women when considering a STEM discipline?

Limitations/Delimitations

There were some limitations in this study. This research study's main limitation was finding current African American and Hispanic young female college students in STEM due to the small number of these young women enrolled in STEM disciplines. Due to the Family Education Rights and Privacy Act (FERPA), it was difficult to reach a larger number of student populations within the research study demographic. Another limitation was that students are weary of surveys at the postsecondary education level. Therefore, it was challenging to get student organizations and diversity and inclusion departments within state universities and colleges to share a list of students who met the study criteria.

Second, this study is focused on only two particular underrepresented groups. It is focused on young African American and Hispanic women but did not consider Asian students in this study because they are overrepresented in STEM disciplines.

Definition of Terms

For purposes of this study, the following operatives were used:
African American – African American is an American ethnicity with ancestry from West Africa (Gilbert et al., 2015).

Hispanic – Refers to Americans who self-identify as being Spanish-speaking background which could trace their descent from Central and South America, Cuba, Mexico, and 20 other Spanish-speaking countries and nations (Lopez et al., 2020).

Minority groups - A subordinate group whose members have significantly less control or power over their lives than members of a dominant or majority group (Schaefer, 2015).

STEM disciplines - Full science, technology, engineering, and mathematics fields and curriculum centered on education in the disciplines of science, technology, engineering, and mathematics (Hallinen, 2018).

Self-efficacy - An individual’s belief in their abilities and overall competence to complete a given task (Bandura, 1993).

Stereotypes - Stereotypes are judgments of individuals based on their social category membership, which profoundly affect our behavior toward others (Eaton et al., 2019).

Women of color - Refers to women belonging to African American, Hispanic/Latina, and Native American groups who are underrepresented in higher education proportional to their representation in the U.S population (Ong et al., 2011).

Summary

Chapter 1 provides the background of the problem, the problem statement, the study's purpose, and research questions. Chapter 1 also includes the limitations, delimitations, and a list of relevant terms and definitions related to the lack of African American and Hispanic women in STEM disciplines. Chapter 2 provides a literature review related to the problem statement and research questions guiding this study. Chapter 2 discussions will include topics such as a
historical overview of WOC in STEM, WOC and STEM challenges, WOC and STEM strategies, and the problems over the last ten years. Chapter 2 will also discuss the theoretical framework model that helps build confidence in young African American and Hispanic women and overcome challenges within their STEM environments to pursue STEM disciplines.
Chapter 2: Review of the Literature

This chapter discusses the historical overview and the last ten years of WOC in STEM, WOC and STEM challenges, and WOC and STEM strategies. Chapter 2 will also discuss the theoretical framework that provided a rationale and informed the study's design. This study's theoretical framework was based on the construct of self-efficacy theory within Bandura’s Social Cognitive Theory developed in 1977.

There is a considerable amount of research regarding the lack of young women in STEM disciplines. However, these studies have not addressed the narrower group of young African American and Hispanic women in the various STEM disciplines. In fact, most studies center on the issues of persistence and degree attainment among students who have previously demonstrated high achievement to pursue STEM education (Young et al., 2017; Garriott et al., 2013). The lack of attention to YWOC only confirms students’ negative perceptions of themselves and their lack of confidence to persist in STEM fields. Many educators lack understanding for meeting the needs of, and connecting with, African American and Hispanic students regarding STEM disciplines. Research has indicated that students of color generally are not given the opportunity to enroll in advanced high school math and science courses (Young et al., 2017). This creates many barriers and missed opportunities for this group of students and continues to cause STEM illiteracy. Due to the lack of exposure to STEM-related activities and programs, African American and Hispanic students lack preparedness and self-efficacy to enter foundational STEM courses with self-confidence. Therefore, encouraging participation of YWOC in STEM courses and activities at the high school level or sooner could raise self-efficacy and reduce negative perceptions of themselves as competent individuals (Weber, 2012). Taking such an approach may help in beginning to see a higher representation of these students
in science and math classrooms. Furthermore, by inspiring and engaging YWOC to explore STEM-related careers, we can reduce implicit stereotypes of gender associated with STEM fields, build high self-efficacy, as well as decrease cultural biases and restrictions (Zuga, 1999; Brown et al., 2017; See Lane et al., 2012; Halper, 2020).

The STEM education crisis in minority groups is a worldwide concern. Countries like the United States have made significant efforts to increase STEM education access in minority group communities. However, research has shown that being in school is not the same thing as learning. Schools in areas largely populated with minority groups (at least 50% of student enrollments are African American and Hispanic) lack well-trained teachers, resources, and support necessary to matriculate through the STEM pipeline (Young et al., 2017; Jones, 2020). Therefore, simply attending school and being in the classroom does not mean that students are engaged in learning that produces high self-efficacy to build confidence to pursue a STEM discipline in postsecondary education (Saavedra, 2019). However, when there is an increase in the engagement and encouragement of dialogue amongst underrepresented student groups, it increases self-efficacy and promotes higher achievement and interest in STEM, according to McCormick (2019). A call for more STEM graduates came from former President Obama in 2009. The President asked that American students, “move from the middle to the top of the pack in math and science proficiency scale”, within ten years. He encouraged colleges and universities to graduate an additional one million STEM students. Moreover, former President Obama concurred with researchers and stated that the achievement gap could only be reduced if Hispanics, African Americans, and other underrepresented groups participated in STEM fields, especially women in those groups.
Historical Overview of Women of Color in STEM

Historically, men have been known to occupy most STEM fields that require more analytical skills and competitiveness to succeed. This is especially true in STEM fields that are math-intensive and focus on advanced science. Men are perceived as better at math, science, and technology fields than in careers that focus on helping other humans. In contrast, women tend to lean towards more STEM-related careers that value nurturance and social sensitivity and are more people-oriented who want to help improve the lives of others (Koenig & Eagly, 2014; Dunlap & Barth, 2019). Historically, women are drawn more towards medical and health science-related fields and less to the lucrative STEM fields (Wang & Degol, 2016) and seem to avoid pursuing STEM careers that are known as male-dominated fields. Taking this further to people of color, they are historically marginalized and are believed to be less competent and unqualified for university study in those disciplines (Dunlap & Barth, 2019; Eaton et al., 2019). Until now, researchers have offered and debated theories to explain and address these claims, but limited literature has been provided. These previously stated stereotypes, combined with racial and gender marginalization, have kept YWOC from pursuing careers in STEM, specifically those options that are more lucrative careers. Thus, WOC continues to fight these outdated stereotypes.

Reports show that young African American women outperform their young African American men counterparts in math on average and the academic performance gap through high school is very small (Bystydzienski et al., 2015). However, when it comes to declaring math-related STEM disciplines, statistics demonstrate that women have not yet reached parity with men (Wang & Degol, 2016). The United States Bureau of Labor Statistics predicts that these are where critical workforce shortages occur (Dunlap & Barth, 2019; Xue & Larson, 2015). These
issues have received widespread attention in the U.S. by educators, policymakers, and industry leaders to develop solutions. There is no recent evidence to support the notion that STEM competencies and skills are innately tied to gender or race (Fine, 2010). Unfortunately, these gender, race stereotypes, and false beliefs persist despite excellent abilities demonstrated by YWOC. In order to reshape and reverse these biased notions, equal educational opportunities must be given to all genders and race demographics.

**Women of Color and STEM**

While women of color have historically been excluded in the science and technology fields, they represent ample talent to address the national shortage of STEM workers in the United States. To make use of this underutilized capital, it is of paramount importance that policymakers, educators, and industry leaders address the challenges WOC, especially young African American and Hispanic women, encounter in STEM fields to ensure future prosperity in these fields. According to Malcom and Malcom (2011), the barriers and challenges WOC face is now less about rights versus wrongs and more about support versus neglect, less about the behavior of individuals and a culture that was accepting of bias as the, “natural order of things,” and more about the responsibilities and action (or inaction) of institutions. This means that encouraging and promoting this group of underrepresented women to pursue STEM disciplines has become a social justice issue that can no longer be delayed. Addressing these social justice issues will allow marginalized groups to move up socially and economically (Basile & Lopez, 2015; Vasquez-Grinnel, 2019). Therefore, these issues deserve recognition and need to be dealt with by academic policies and industry leaders of the 21st century.

Recent research found that the interest level for WOC to pursue STEM disciplines is just as high as their white counterparts (Strayhorn, 2010; Hill, 2021). However, the STEM pipeline
becomes leaky at the postsecondary education level for WOC. In 2012, the National Center for Education Statistics reported that approximately 50% of students leave their STEM discipline, move to a different field, or completely drop out of college. Moreover, of all bachelor’s degrees earned in 2012, African American and Hispanic women were far less represented in comparison to white females (National Science Foundation, 2012). According to the National Center for Education Statistics, less than 5% of the science and engineering degrees were awarded to African American and Hispanic women in 2017. This struggle could be due to the lack of institutions’ response to underrepresented groups' growing interests and failure to take advantage of their academic talents. However, a greater challenge that may explain why fewer WOC persist and complete STEM disciplines is the lack of role models and seeing very few women like themselves in STEM careers, which can create low self-efficacy in succeeding in STEM.

According to the National Center for Education Statistics (2018), the racial gap in STEM degrees awarded to females was clearly demonstrated by these numbers; 61% White, 15% Asian, 12.3% Hispanic, and 5.2% African American. Many researchers believe that the attrition in STEM degrees in young African American and Hispanic female students is related to the lack of STEM background courses for first-year college students. The lack of mentorship, support, and opportunity to build a STEM coursework momentum may lead to students switching from STEM to non-STEM degrees later (Davis 2019). Therefore, the lack of degree attainment is not due to a decrease in populations but an issue that trickles down to access to STEM-related courses and qualified resources for preparation. Many would agree that STEM preparation begins in early education to build the confidence needed to matriculate to a college-level curriculum. Research has shown that high school is not too late to begin the foundation of STEM-related courses (Bystydzienski et al., 2015).
In his 1966 report, James Coleman stated that the average 12th grade African American and Hispanic students were placed in the 13th percentile of the score distribution in math and science (Jones, 2020). Fifty years later, in 2016, this gap barely narrowed, according to a similar study by Lauren Camera (2016). Despite the vast commitment to increased resources in schools nationwide and hopes for racial equity and equal education for minority groups, Camera found that African American students’ scores only increased by 9% to the 22nd percentile in 2016. Reports show that the number of high school students who take Advanced Placement (AP) exams in mathematics and science continues to rise. However, these numbers are not as promising for free-reduced lunch students who generally come from underrepresented minority groups, according to the U.S. Department of Education (2016). According to the National Science Foundation (2018), underrepresented minorities account for 40% of K-12 STEM students in the U.S., but only 17% go on to get a bachelor’s degree in STEM.

Research has indicated many factors for the STEM achievement gap. One inexplicable reason is that students of color are not given the opportunity to enroll in advanced high school math and science courses (Young et al., 2017). Researchers believe that the poor state of education, coupled with people of color's precarious financial hardships and lack of the support and encouragement to consider these courses, undermines the ongoing efforts to close the achievement gap. Educators themselves must address education inequity.

According to the National Science Board Science and Engineering indicators (2018), fully certified, well-prepared, and experienced teachers were not equally distributed across schools and classes. In 2011, fully certified (88%) math and science teachers were less prevalent in high-minority and high poverty schools when compared with schools with students from higher-income families (95%). Also, 95% of teachers from low-poverty schools had an in-field
degree compared to 87% of those at high-poverty schools. According to the National Science Board Science and Engineering Indicators (2016), the level of experience showed a gap as well, with 18% of teachers in high-poverty schools having less than three years of experience versus 10% at low-poverty schools.

It is evident that to close the gap in minority students’ underrepresentation in STEM, having more certified and experienced teachers in minority classrooms are paramount. In the effort to address this crisis, President Obama asked the nation to take on the responsibility to develop, recruit and retain 100,000 highly trained STEM teachers over the span of 10 years, according to the President’s Council of Advisors on Science and Technology (2012). The lack of trained teachers in high minority group schools keeps students from getting a high-quality education to prepare them for college-level STEM disciplines. The lack of “likeness” to the classroom teacher also hinders Hispanics and African Americans from enrolling in STEM classes because they believe they do not belong and not have received equal opportunities and support prior to college.

Research has reported that more women are needed in these fields. However, they fail to address the even more narrow representation of WOC in STEM. Too few WOC are encouraged to consider these disciplines. The U.S. National Academies of Science, Engineering, and Medicine (2016) states that U.S. student proficiency in STEM is trailing behind other countries. For the U.S. to continue to succeed as a global leader, it is time for educators to direct their attention to women, specifically young African American and Hispanic women.

Women of Color and STEM Challenges

A large body of evidence has indicated that women are expected to be less competent and successful in STEM disciplines than men (Smeding, 2012; Eaton et al., 2019). Researchers have
agreed that these gender stereotypes undercut young women’s math and science performance, which can partially explain women's disparity in STEM (Shaffer et al., 2013; Schuster & Martiny, 2017; Smeding, 2012; Eaton et al., 2019). YWOC is a dually marginalized STEM population (Young et al., 2017; McDermott & Mark, 2014). They are faced with gender stereotyping and racial discrimination that has posed barriers for the entry, retention, and success of racial and ethnic minorities in STEM (Beasley & Fischer, 2012; Grossman & Porche, 2014; Eaton et al., 2019). Both African American and Hispanic students are stereotyped in ways that are incongruent with perceived success in the STEM disciplines. They are viewed as less competent and having a lower STEM ability than White and Asian students (Blaine, 2013; Jimeno-Ingrum et al., 2009; Eaton et al., 2019).

A substantial amount of pragmatic evidence indicates that racial and ethnic differences and inherent aptitudes for math and science are nonexistent (Gupta et al., 2011; Jimeno-Ingrum et al., 2009; Fine, 2010). However, some previous research suggests that highly male-dominated fields are associated with greater gender bias and inequity (Cheryan et al., 2017; Eaton et al., 2019; Riegle-Crumb & King, 2010). This can explain the gender gap in science and engineering, which comprise the most lucrative and male-dominated occupations. In sum, these stereotypes about African American and Hispanic students' limited academic abilities may negatively affect their choices to major in and pursue careers in STEM.

Research to date has primarily focused on women's demographic in general, but few studies have focused on African American and Hispanic students. These are the two most stereotyped and underrepresented female groups in STEM. This is problematic because it leaves educators and policymakers to make broad assumptions that may not apply to demographic groups who are more negatively affected, and this can create both oppression and unfair
judgment (Eaton et al., 2019; Steinbugler et al., 2006). African American and Hispanic women face multiple barriers and may be perceived as the least competent in the STEM fields compared to other racial and gender groups (Eaton et al., 2019; Steinbugler et al., 2006). This is typically a result of the stereotypes associated with intersecting minority statuses (Eaton et al., 2019).

The intersecting minority statuses in the STEM disciplines were formally addressed by the American Association for the Advancement of Science, published in 1976. The intersecting marginalities, also known as the “double-blind,” referred to the intersection of different types of discrimination that WOC experienced in their STEM careers (Nkere, 2016; Malcolm, Hall, & Brown, 1975). It explains how WOC's persistent sexism and racism made it challenging for them to persist and be as successful in STEM as white women. In a report written by Malcolm and Malcolm to celebrate the thirty-fifth anniversary of “the Double-Blind: The Price of Being a Minority Woman in Science” publication, they provided an insightful perspective on the development of STEM over the last three decades in minority women. They found that not much has changed with the overwhelming representation of white males dominating high-income STEM fields. In fact, lack of access to high quality K-12 education, rigorous course work, and high expectations continue to be difficult hurdles within the U.S. society for young African American and Hispanic women, especially where schools fail to provide what is needed to support success in STEM fields (Malcom & Malcom, 2011). Furthermore, in prior research, YWOC suggested several other issues they personally faced persisting in STEM. They described these challenges as building a professional network, a lack of relatable role models, and feeling different from their white peers within their community (Vasquez-Grinnell, 2019; Kachchaf, Ko, Hodari, & Ong, 2015; Ong, Wright, Espinosa, & Orfield, 2011).
Research has indicated that young African American and Hispanic women possess unique characteristics that support their persistence in STEM disciplines. These young women have a strong rapport for STEM disciplines that is often not affirmed or, even worse, discouraged (Young et al., 2017). However, despite these barriers, parents of young African American and Hispanic female students foster competence, self-reliance, and self-efficacy that drive high academic performance compared to young men. As a result, African American girls outperform African American boys in every measured academic category (Young et al., 2017; Varner & Mandara, 2014).

Research confirms that YWOC who are interested in STEM and enter higher education are just as interested in entering STEM careers (Horna & Richards, 2018). In fact, approximately 32% enter a STEM discipline with the intent to complete it, while 31% of their white counterparts planned to pursue a STEM discipline (Mack, Rankins & Woodson, 2013; Vasquez-Grinnel, 2019). However, despite early interest and parental support, they face unique STEM obstacles, including teacher bias, insufficient institutional support, and lack of role models for pursuing STEM disciplines (Hill et al., 2010; Young et al., 2017, Malcom & Malcom, 2011). Additionally, students of color are under-referred for Advanced Placement courses at the high school level. (Ford, 2013; Young et al., 2017). This discrimination persists even if they have the same academic profiles as their white counterparts (Grissom & Redding, 2016). This disparity of being under-referred could undoubtedly explain why WOC are underrepresented in STEM fields.

**Women of Color and STEM Strategies**

Several research studies suggest that institutional action or inaction can impact young African American and Hispanic women's educational experiences in STEM disciplines (Malcolm & Malcolm, 2011). In a 2011 Harvard Education review of The Double-Blind: The
Price of Being a Minority Woman in Science report, Malcom and Malcom (2021) recommend that institutional policy and practice should intentionally support the advancement of underrepresented groups in STEM through engagement in hands-on experiential learning within STEM fields and student-faculty mentoring relationships. Access to professional development and networking opportunities are excellent strategies to support YWOC to build confidence and persist in STEM education (Malcom and Malcom, 2021).

The U.S. educational system must focus on strategies that will foster students’ skills and build confidence to ensure WOC are competitive in STEM fields (Finkel, 2017; Vasquez-Grinnell, 2019). This is especially important at the high school level while helping students navigate through the STEM pipeline. Student-teacher relationships are critical to YWOC’s persistence at the high school level when taking STEM-related courses. Teachers can create a safe space, provide support, and serve as mentors or coaches to YWOC, which can be the difference between deciding to pursue or discontinue STEM disciplines (Vasquez-Grinnell, 2019; Ong et al., 2011).

One fundamental strategy that is overlooked when considering avenues to support WOC in a STEM discipline is financial assistance through scholarships and grants. Although one may excel in advanced math and science courses at the high school level, financial aid and scholarships play an essential role in their decisions to persist in their STEM field of interest once they enter postsecondary education. When financial concerns are no longer a hurdle to overcome, YWOC gains more confidence to persist and complete their discipline. Therefore, understanding the financial needs of young women students of color is vital and may be a key factor in addressing the lack of diversity in STEM fields (Jackson & Laanan, 2015; Vasquez-Grinnell, 2019).
The Last Ten Years of the Problem

In 2009, President Obama made a national announcement of his desire to bring US high school students to the top of the science and math achievements and articulated a clear vision for STEM education for the next ten years. The premise of this initiative was to increase federal investment in STEM, to prepare 100,000 new teachers, and increase the participation of minority groups in STEM, particularly young African American and Hispanic women, according to the President’s Council of Advisors on Science and Technology (2012).

During the 2015-16 academic year, nearly 75% of the total high school student population was enrolled in Algebra I&II, Geometry I, advanced mathematics, or Calculus, and about 54% were enrolled in Biology, Chemistry, or Physics, according to U.S. Department of Education (2018). This was a 14% decline from 2009 high school completers who were enrolled in those math courses at 89% (National Science Board, 2018). In contrast, advanced science courses taken at the high school level from 2009 to 2016 more than doubled from 21% to 54%. Enrollment in mathematics and science courses had approached parity for males and females (51% vs. 49%) in 2016. Furthermore, female students enrolled accounted for an average of 47% advanced math and science courses enrollment compared to males at 53% (U.S. Department of Education, 2018).

In comparison, only 16% of the overall high school enrollment in 2016 was African American, and they accounted for 13% of students in advanced math and science courses (U.S. Department of Education, 2018). Hispanic students constituted 24% of the overall high school enrollment and accounted for 21% of students in advanced math and science courses, according to the U.S. Department of Education (2018). In fact, in high schools with a high enrollment of
African American and Hispanic students, only 33% have Calculus courses available, and only 48% have Physics courses available (Halper, 2020).

According to the National Science Board (2014), college enrollment differences remain for demographic groups, and it may be where gender and race disparity begins. In 2015, 69% of low-income students who immediately attended college after high school were STEM majors. The percentage from high-income families was 83%, a 14% difference (National Science Board Science and Engineering Indicators, 2018). The National Science Board Science and Engineering Indicators (2018) also reported that both African American and Hispanic students were underrepresented in all degree levels in 2017. It is no surprise that this issue gained prominence due to President Obama’s policy plan in 2009.

However, the increasing numbers of STEM graduates in the last decade and its close linkage to America’s economic prosperity have not significantly impacted the root of the issue. The issue at stake is much bigger. The lack of WOC in STEM fields represents a long-standing concern of equity regarding the achievement of women and students of color that is as important as any call for action to address the US economy. Despite the fact the number of women in STEM fields has doubled over the last decade, the increase in women of color’s representation has been modest (National Science Board Science and Engineering Indicators, 2016).

**Theoretical Framework**

The theoretical framework of this research study relied on the studies of self-efficacy within Social Cognitive Theory (SCT) by Albert Bandura (1977, 1993, 1994, 1997, 2001, 2006), and how it relates to building confidence in young African American and Hispanic women to pursue STEM disciplines and the challenges they faced when considering STEM disciplines. There has been a substantial amount of social cognitive literature around diversifying the STEM
domain and the impact of self-efficacy within social cognition as they relate to confidence-building and persistence of students in STEM fields (Armstrong, 2019). Albert Bandura (1977) originally proposed the social cognitive construct of self-efficacy theory in the publication of “Self-efficacy: Towards a unifying theory of behavioral change.” Self-efficacy is an individual’s belief in their abilities and overall competence to complete a given task. According to Bandura (1993), “efficacy beliefs influence how people feel, think, motivate themselves, and behave” (p. 118).

It is important to be reminded of the impact of interpersonal, social, and environmental influences when exploring and identifying strategies that potentially build confidence for young African American and Hispanic women to pursue and persist in STEM. Social Cognitive Theory (SCT), especially the concept of self-efficacy, is beneficial to this research study because research demonstrates the predictive influence it has on confidence in academic tasks and making decisions to pursue STEM disciplines in minority groups (George, 2019). SCT also provides a clear understanding of how individual experiences and performances within their environment influences their subsequent belief about their cognitive abilities, future goals, and most importantly, how these beliefs dictate their level of motivation to persist and reach academic achievement in STEM disciplines (Armstrong, 2019; Lent, Brown, & Hackett, 1994).

As it relates to young African American and Hispanic women in STEM, those with higher self-efficacy are more likely to persist in their environments than those with lower self-efficacy. Thus, individuals’ self-efficacy levels can be explained through personal factors, behavioral patterns, and environmental factors. According to George (2019), personal factors consist of cognitive, affective, and biological events. Behavioral patterns relate to how one reacts or behaves. Environmental factors include the imposed environment, selected environment, and
constructed environment. Bandura (1993) explains that the three components must all work together to construct and influence a person’s self-efficacy.

According to George (2019), SCT’s triadic reciprocal causation is widely accepted as instrumental in young women's self-efficacy. It elucidates and foresees learned behaviors, as well as personal and environmental factors that help to influence their self-efficacy. Each factor is intertwined with and influences one another. Therefore, a young woman’s self-perceptions and belief in her abilities to achieve or effectively perform STEM tasks are all within her personal factors, followed by her skills or capabilities in that STEM task being part of her behavioral factors.

Finally, environmental factors can be either externally physical or social in nature (Bandura, 1977; George, 2019). George (2019) illustrated these triadic reciprocal phenomena perfectly in his work. He explains that a student with a lower self-efficacy in a certain subject (personal factor) may avoid or drop out of that class subject (behavior) if the class is made up of one specific demographic that they may find intimidating (environmental factors). According to Bandura, students are more likely to partake in activities that they believe have a higher chance of success than those where they do not have high self-efficacy. The example above provided a clear perspective on the challenges young African American and Hispanic women face that cause lower self-efficacy in STEM disciplines and shines light on potential strategies that can be used to build confidence in these YWOC to consider STEM disciplines. Therefore, educational and political leaders must shift their focus to identify and develop the best strategies that will foster a high level of self-efficacy in young African American and Hispanic women to build the confidence needed to persist in STEM disciplines (Sharpe, 2019; Artino Jr., 2012; Schunk & Mullen, 2012).
According to Bandura (1977), four different sources of experiences build a person’s self-efficacy, which may result in high confidence to pursue STEM disciplines. He describes these four sources as mastery experiences, vicarious experiences, verbal/social persuasions, and emotional/physiological states. Research has reported a significant impact the areas of self-efficacy can have on young women within STEM. Thus, it may help to discover the best strategies to build confidence in young African American and Hispanic women to pursue and persist in STEM disciplines and how to best overcome the challenges they face.

Mastery experiences are when individuals believe they can accomplish a set of tasks and become increasingly engaged in that specific task. According to Zeldin et al. (2008), “people are more likely to perform a task if they believe in their abilities to accomplish it and are less likely to engage in a task of which they feel less confident” (p.136). This mastery experience action helps students feel successful in increasing their self-efficacy and builds confidence to pursue and persist in similar tasks (Bandura, 1993; Bandura, 1995). Since mastery experience depends on personal accomplishments, it is sufficient to build a sense of confidence in YWOC in STEM. Students can create a measure of their capabilities based on their success and failure in certain tasks (Grata, 2020).

In contrast, vicarious experiences allow an individual to compare oneself with similar abilities and characteristics as the desired role model. In observing and modeling another’s goals and behaviors, YWOC would gain the opportunity to build their self-efficacy and increase their corresponding desire to succeed in their chosen STEM disciplines (Grata, 2020; Bandura, 1997). Research has shown that YWOC benefit from observing other more experienced and successful women in STEM as they develop their own confidence in their abilities to persist in STEM fields. Thus, young African American and Hispanic women must gain experiences that
assimilate social modeling and social interaction through constructive feedback to increase their STEM self-efficacy (Sharpe, 2019; Zeldin & Pajares, 2000).

Social/verbal persuasion has the biggest impact on building young African American and Hispanic women's confidence in STEM fields. African American and Hispanic female students face many challenges when considering STEM disciplines. Thus, when they receive verbal praise, YWOC experience an increase in perceived ability to excel in STEM disciplines, according to Bandura (1977). Another strategy that may increase self-efficacy and confidence for YWOC students is to urge prominent figures and role models, such as parents and teachers, to use social/verbal persuasion by giving positive feedback and encouragement to all students equally (Grata, 2020; Rittmayer & Beier, 2008). Research has reported that when YWOC in STEM have the opportunity to experience vicarious experiences and social/verbal persuasion through a postsecondary education program that is well-designed, it will build high self-efficacy in young African American and Hispanic women to persist in STEM disciplines (Sharpe, 2019; Artino Jr., 2012; Schunk & Mullen, 2012).

Finally, a person’s emotional and physiological reaction may affect their self-efficacy and future learning experiences and outcomes. According to Brown et al. (2016), students' self-efficacy within their STEM classroom can increasingly predict whether a student will persist during STEM-related classes. For example, a student who claims that math and science appeal to them naturally will foster and build confidence within STEM, leading to higher self-efficacy. Thus, efficacy in the desired STEM discipline may increase, and so would the likelihood of pursuing that path.

Moreover, project-based learning has been identified to increase high school young women interested in building academic self-efficacy skills within the classroom, which could
lead to a higher possibility of young women choosing a STEM discipline in postsecondary education (Liu et al., 2014). On the contrary, Villavicencio and Bernardo (2016) argued that while positive experiences within the construct of self-efficacy may help to promote positive outcomes within STEM disciplines, negative emotion associated with a set of tasks within the subject matter can hurt a student’s personal belief system, harming the student’s personal self-confidence. This is especially true for young women taking high-level math courses.

**Summary**

The literature review provided a historical overview of women of color in STEM, WOC and STEM, WOC and STEM challenges, WOC and STEM strategies, the last ten years of the problem, and the theoretical framework for exploring and identifying best strategies to building confidence and understanding challenges faced by young African American and Hispanic women when considering STEM disciplines. Self-efficacy within Bandura’s (1977) Social Cognitive Theory is critical to the academic success of minority group students within their personal factors, behaviors, and environmental perceptions and experiences in STEM fields. Chapter 3 will discuss the research methodology construct with the research design, sample and setting, instruments used to collect data, and data analysis.
Chapter 3: Research Methodology

The purpose of this study was to identify the challenges young American and Hispanic women face when selecting a STEM discipline and to identify strategies to help overcome those challenges. This chapter provides detailed descriptions of the current study's research method and design and offers the rationale for using a qualitative approach. This chapter also includes an amplified and detailed description of the population, participant sample, instruments used, data collection procedures, and analysis data. The following research questions guided the study:

RQ1. What are the best strategies for building confidence with young African American and Hispanic women to pursue STEM-related disciplines?

RQ2. What are the challenges faced by young African American and Hispanic women when considering a STEM discipline?

Research Design

This study uses the qualitative research method to identify the best strategies for building confidence in young African American and Hispanic women to pursue STEM disciplines.

Research has shown that YWOC lack STEM education experience due to "structural constraints and opportunities" which they continuously face (Johnson et al., 2011; Ong et al., 2017). This study will identify ways to help build confidence that African Americans and Hispanics need to consider STEM disciplines and overcome some of the many challenges they often face by inquiring about their paths to choosing a STEM discipline, how experiences impacted them, or what encouraged their decisions in high school.

According to Russell and Russell (2015), qualitative research designs are used to answer questions about participants’ lives or social experiences and give meaning to these experiences. This study used an online survey and semi-structured interviews. Interview questions were open-
ended to allow participants to share their experiences and journeys in pursuing STEM during high school. A qualitative approach was selected to better understand different factors that explain young African American and Hispanic women's decisions to pursue STEM disciplines and help more of these students consider these disciplines.

**Sample and Setting**

Participants for this study were recruited through purposeful sampling to obtain a sample of African American and Hispanic female college students enrolled in a STEM discipline and young professionals working in STEM fields. The three participating schools (two public Minnesota Universities and one private technical college) and young professionals were chosen using the researcher's networking contacts for selecting a wide range of participants. The chosen institutions provided a group of young African American and Hispanic women students that met the study's desired characteristics. The colleges and universities were selected based on the offering of STEM courses and disciplines.

A total of three young African American and Hispanic women enrolled in STEM-related disciplines, and three young professional women who work in STEM fields were asked to complete an online survey with a brief voluntary demographic questionnaire including seven Likert scale survey questions and participate in a 30-minute semi-structured Zoom interview with the researcher. The ideal size sample in qualitative research is often between three and twelve. The collected data be from a medium sample size is usually preferred since qualitative data collection methods can often be time-consuming and costly; (Padgett, 2004; Nkere, 2016). According to Nkere (2016), a medium target sample size is a typical qualitative research analysis sample size to discover new ideas from further analysis of the data. The sample size of six was a
target number for gathering the necessary information to answer the research questions and provide flexibility in case of unknowns.

**Instruments**

The principal investigator conducted the interviews of this study. According to Miles et al. (2014), the instrument's effectiveness in qualitative research depends on the researcher's abilities to gather relevant information. The criteria of an excellent qualitative researcher-as-instrument as described by scholars is as follows: (1) has an in-depth understanding of the current study and the context beneath it, (2) has a comprehensive approach, (3) can help people feel comfortable to open up and pay special attention to details, (4) portrays a non-biased and nonjudgement stance on the current study, and (5) has a high level of empathetic engagement, coupled with a balanced sense of objective awareness (Miles et al., 2014; Cunningham, 2017).

Data was collected through a short 4-point Likert scales online survey combined with three open-ended demographic questions and a 30-minute, semi-structured, one-on-one Zoom interview with the participants. The interview questions were created for the current research study (see appendix A).

The data and information collected from individual interviews were recorded in Zoom and used MediaSpace captioning as a tool to transcribe audio and video files. MediaSpace is a software with the ability to convert speech into text as accurately as possible. This software allows users to edit and make corrections to transcription for accuracy by using a built-in editor. All files were stored in the Kaltura Capture password-secured account in a password-protected laptop throughout the study. Any paper copy documents, such as notes/meetings from interviews, were locked in a file cabinet to increase the study's reliability (Yin, 2014).
The interview protocol process consisted of an overview of the study, a list of all necessary items needed to conduct the interview (e.g., recording document and audio recorder), and an interview schedule with the list of interview questions. Following this protocol ensured reliability, trustworthiness, and accuracy (Krueger & Casey, 2015; Yin, 2014; Cunningham, 2017). Interview questions were tailored to be directly aligned with each research question and the purpose of the study to ensure that the research phenomenon was thoroughly explored (Cunningham, 2017; Bloomberg & Volpe, 2008).

Data Collection Procedure

This research study consisted of two phases of data collection: an in-depth one-on-one semi-structured Zoom interview with participants and a short 4-point Likert scaled online survey combined with three open-ended demographic questions.

**Phase 1:** In phase one, participants were asked to complete a 4-point Likert-scaled online survey. Before starting the survey, participants were directed to the survey page to accept or deny consent to participate in the study. If they clicked "YES" they were directed to the survey. When the process did not produce the desired responses, the researcher sent a follow-up email five days later to the individuals who failed to respond to the initial email. A request to schedule the one-on-one Zoom interview was delivered to the participants who did affirm participation and completed the online survey. An email confirmation was sent to the final selected group of participants, and they received a reminder email two days prior to their scheduled interview.

At the beginning of the survey, participants were asked to complete three open-ended demographic questions. Collecting this data provided information that included participants’ current STEM declared major, STEM-related courses taken at the high school level, and the ethnic makeup of STEM classroom peers.
**Phase 2**: For the second phase of the study, a 30-minute interview with each participant (total of six) was conducted to understand participants' experiences that built their confidence to pursue STEM disciplines. Open-ended questions about their high school environment and personal experiences were used to determine what promoted their confidence during their STEM education to persist in these disciplines. A strong point of this study design was to ask participants to share their experiences and perceptions during their STEM education process. Interviewing each individual provided the opportunity to gain a better understanding and point of view of each participant's experiences and perceptions regarding what strategies helped build their confidence to pursue STEM and the challenges they faced during their STEM journey.

**Data Analysis**

To identify themes and unique narratives from the participants, all interviews were transcribed, copied, and pasted onto an individual Microsoft Word document for thematic coding analysis upon completion of the interviews. After verifying the accuracy of the transcripts, each Microsoft Word document was uploaded to Quirkos and analyzed using a thematic analysis approach for emergent trends. The interviewer coded the interview responses according to Bandura's (1997) four categories: mastery experience, vicarious experience, verbal/social persuasion, and emotion/psychological state. The analysis involved linking patterns of common strategies that participants experienced during their past and current STEM educational journeys and their role in building their confidence to persist in STEM disciplines. The open-ended interview questions, online survey, and documentation review from national statistics data provided a set of matching patterns explaining critical strategies used in their environments that educators could adopt nationwide to encourage young African American and Hispanic women to pursue and persist in STEM disciplines. Within these themes, seven responses were coded into
subcategories. Results were organized, categorized, and subcategorized based on the themes that emerged. Utilizing data from three measurement methods increased the research findings' credibility and validity and enhanced the research study's conclusions. For example, Bryman (2004) describes this triangulation of the data collection approach as "the use of more than one approach to the investigation of a research question to enhance confidence in the ensuing findings."

**Summary**

Chapter 3 discussed the research methodology constructed with the research design, sample and setting, instruments used to collect data, and data analysis. The study used a qualitative method approach to understand each participant's perceptions and personal experiences. A group of young African American and Hispanic women were recruited to yield a rich analysis. The participating colleges and universities were purposely selected from two public Minnesota State Universities, one private technical college, and young professionals through networking convenience sampling.

Chapter 4 will provide a description of demographics, data analysis, results of the online survey and interview questions, and summary.
Chapter 4: Results

Introduction

Chapter 4 explores the results of data analysis to identify the best strategies for building confidence in young African American and Hispanic women. This chapter will also identify challenges these young women faced to persist in STEM disciplines through the experiences and perceptions of six young African American and Hispanic women. This chapter includes a detailed description of the demographic characteristics of the participants in this study. It also includes data collection, interviews, a thorough analysis of the qualitative data obtained through an online survey, a one-on-one semi-structured Zoom interview, and a summary.

Description of Demographics

Six young African American and Hispanic women pursuing STEM disciplines in the upper midwest participated in this research study. Participants for this research study declared a major or have a career in Biology, Engineering, Aerospace Engineering, Architecture Drafting and Design, Clinical Laboratory Sciences, Mathematics, Physics, Engineering Drafting and Design, and Mechanical Engineering.

The interview protocol comprised of ten core interview questions to inform the two main research questions for the study, three demographic questions relating to STEM community ethnicity make-up, major declared, and highest high school STEM-related courses taken. The semi-structured open-ended interview questions approach gave participants an opportunity to assess their personal experiences and perceptions and openly express them during the interview by sharing their journey and path traveled that built their confidence, resulting in their choice to pursue and persist in STEM disciplines and careers. The second research question helped discover the challenges they faced when considering STEM disciplines.
Data Analysis

An online survey through Qualtric was administered to six African American and Hispanic STEM students and young professionals. Participants declared majors in the following STEM fields: Architecture, Aerospace Engineering, Clinical Laboratory, Construction Sciences, Mathematics, Physics, and Mechanical Engineering. One student double majored in Mathematics and Physics. The survey asked participants to answer questions about their experiences within their STEM community during high school and college that helped build their confidence to persist in STEM disciplines within Bandura’s four areas of self-efficacy: mastery experience, vicarious experiences, verbal/social persuasion, and emotional and psychological states (Bandura, 1997).

The survey was comprised of three demographic multiple-choice questions and seven Likert scale questions ranging from 1 (strongly disagree) to 4 (strongly agree). Participants were asked to agree or disagree to statements that closely described their personal experiences and were identified as best strategies during their STEM education journey and built their confidence to pursue STEM discipline and career. To participate in this study, students had to identify as African American or Hispanic female in a STEM discipline or career. Therefore, they were not asked these demographic questions on the survey. Instead, they were asked about their declared major, the highest math and science courses completed at the high school level, and the ethnic make-up of their math and science classes. These questions helped identify key themes based on the students’ selected disciplines to find the best strategies that helped them decide on and persist in these specific STEM fields. The data showed 83% of participants completed at least calculus, or physics, or both in high school. One participant selected ‘other” but did not disclose what other course she took. The survey also showed that 83% of participants described the majority
ethnic make-up of their STEM classroom in high school as white and 16% African American. Participants responded to a Likert scale survey with statements describing different strategies that built their confidence or challenges they encountered in their STEM environment while in high school. The data is described in the table below for all seven variables of the survey's Likert scale portion.
Table 1 outlines the data collected for each item regarding participants’ personal experiences that fostered confidence and high self-efficacy to pursue and persist in STEM fields.

Table 1

| Percentage Responses, Mean, Standard Deviation for Strategies to Building STEM Confidence |
|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|
| Survey Item                                  | Strongly Disagree (%) | Disagree (%) | Agree (%) | Strongly Agree (%) | M    | SD    |
| My teachers encouraged me to take advanced mathematics and science courses in high school (n=6) | 17               | 17            | 33        | 33                  | 2.8  | 1.07  |
| Other students in my high school STEM courses took my suggestions/comments seriously (n=6) | 17               | 17            | 33        | 33                  | 2.8  | 1.07  |
| I enjoyed STEM-related extracurricular activities in high school (n=6) | 17               | 17            | 50        | 17                  | 2.6  | .94   |
| In high school, I was a member of a team to design and build a hands-on project (n=6) | 33               | 17            | 17        | 33                  | 2.5  | 1.26  |
| I feel supported in my STEM community (n=5) | 20               | 0             | 80        | 0                   | 2.6  | .80   |
| More time should be spent on STEM hands-on projects in high school (n=6) | 0                | 0             | 17        | 83                  | 3.8  | .37   |
| I often hear or read about high-achieving people of color in STEM (n=6) | 50               | 33            | 17        | 0                   | 1.6  | .75   |

Note. Sample sizes differ by item due to skipped responses.

Table 1 illustrates the percentage of participants who selected each response option describing strategies for building STEM confidence with the corresponding mean and standard deviation per item. The highest response rate in the survey indicated that participants feel that more time should be spent on STEM hands-on projects in high school ($M = 3.83$, $SD = .38$).
**Interview Results**

Six participants were interviewed in a one-on-one semi-structured Zoom call. These interviews were audio-recorded and then transcribed for coded analysis. Transcripts were sent to each participant to check for accuracy and language usage. Quikos, a qualitative analysis software that gives researchers a visual and intuitive way to manage, analyze, and explore qualitative research, was utilized to code the transcript data to identify themes within each interview. After completing this process, each grouped theme was compared to identify the best strategies to build confidence in young African American and Hispanic women and explore challenges they faced when considering pursuing STEM disciplines. The following research questions were proposed:

Research Question 1 (RQ1): What are the best strategies for building confidence with young African American and Hispanic women to pursue STEM-related disciplines?

Interview questions used to inform the first research question were:

Interview Question 1 (IQ1): Would you say that you are confident in your STEM discipline? Why?

Interview Question 2 (IQ2): What is a specific example of something or someone that built your confidence to pursue STEM-related disciplines?

Interview Question 3 (IQ3): Would you consider yourself a successful student in science and mathematics? Why?

Interview Question (IQ4): What were some of the strategies that you used to become successful in science and mathematics throughout your high school education?

Interview Question 5 (IQ5): What support do you need to complete your STEM discipline?
Interview Question (IQ6): Who do you know personally (relative, friend, etc.) who is working in a STEM profession?

Research Question 2 (RQ2): What are the challenges faced by young African American and Hispanic women when considering STEM disciplines?

Interview questions used to inform the second research question were:

Interview Question 1 (IQ7): What was the ethnic make-up of your high school STEM teachers?

Interview Question 2 (IQ8): Were there any instances in high school where you felt discouraged to pursue your current major? Why?

Interview Question 3 (IQ9): What are some challenges you are experiencing in your current environment?

Interview Question 4 (IQ10): What recommendations do you have for other African American or Hispanic students on how to persist in STEM courses throughout high school?

Addressing research question one, in response to IQ1, “Would you say that you are confident in your STEM discipline? Why?” All six participants (100%) stated that they are confident in their STEM discipline. Each participant explained why they are confident and how confidence was developed to persist in pursuing their fields. Participants described how intrinsic (33%) and extrinsic (50%) or both (17%) motivations played a significant role in building their confidence in their perspective STEM disciplines. Participant 2 shared that her confidence was not developed until she made it to college. She joined Residence Life which challenged her to become outspoken and build leadership skills she would use in her professional career.
Participant 5 stated that her confidence stemmed from her innate ability to perform well in STEM-related courses, which built her confidence to consider a STEM discipline.

"I would say yes. I've always been driven to do something in the medical field, and there weren't really any instances where I felt deterred from that. I found joy out of mathematics throughout primary, like probably from kindergarten, all the way through high school, so I really took to that subject in particular. So, I guess I kept pursuing those classes. For example, I took AP calculus in high school. That was a difficult class, but there was still some sort of fulfillment behind it - when you do arrive at the correct answers and just learning something new yourself. I am pretty confident in the area."

Participate 6’s confidence is driven by both intrinsic and extrinsic motivation as she persists in her current major. She explains,

"Yes, I do believe that I am very confident in my STEM field as of now. And the reason why I believe that I am confident is because I'm actually the first within my family to go into STEM. And this knowing this really pushes me to want to take these challenges. So, it’s just something that I internally wanted to challenge myself to do. And that confidence just came with knowing that I have the power to make it happen, but I just have to do it."

In responses provided for IQ2, “What is a specific example of something or someone that built your confidence to pursue STEM-related disciplines?” Five out of the six (83%) participants shared that they are part of a strong social community comprised of mentors, role models, and family support, which built their confidence in STEM. In her response, participant 3 described how having a mentor and a role model helped her decision-making to pursue her mechanical engineering major. She stated,

"I would say my stepdad back then was definitely a great role model for me. He would do all of the mechanic work at home when one of our cars broke down. At first, I liked being helpful, so I liked to help around the house with that. But then, I started getting interested in how the engines work and how to make each component work together to build for this big machine, you know.

I was also in the Robotics Team in high school for three years, so it really took me down another path like I got to see how things are made and how the design process went, and that is where I really became interested in that way too. My high school STEM teacher, who was also the Robotics Team mentor, encouraged me to take some of those classes, and that's where I got more engaged and interested. The hands-on component of the classroom helped too. We actually were studying and learning how it works."
Unlike participant 3, participant 1’s experience was far from positive and encouraging to pursue her architecture major at a non-for-profit technology college. She described her experiences as stated below:

"When I wanted to learn about architecture, I remember my instructor at the community college I was planning to transfer from was not really encouraging. I don't think he really believed that I belonged in that field. He didn't really support me like I had hoped he would have. I think that's what gave me confidence because I wanted to prove to myself and others that I could do this - if I'm honest to you."

For IQ3, “Would you consider yourself a successful student in science and mathematics? Why?” Four (67%) participants described their success in STEM as natural because they found math and science enjoyable, they also stated they excelled academically in both subjects. However, two (33%) of the six participants found that they had to work a little harder than most in order to achieve success in math and science both in high school and college. Participant 1’s provided the following response to IQ3:

"As an ESL student, I just had a really bad experience in high school. I had math classes, but I had them online and tried to translate everything on my own because my ESL teacher that was supposed to teach me English, was always busy that hour. She was always working on other stuff for her other classes. After I finished my work, I reviewed my work about three more times just to make sure I was doing the right thing because math is the same in every language. It's universal. So, it was hard but translating everything that's what was hard about it."

Similarly, Participant 6 felt that she has room to grow and learn as she embarks on her major in Construction Science. She explains her current math and science efficacy as:

“I will say I'm a mediocre right now, and I mean, I'm not perfect. I'm still yet learning. Because I am in college, I don't have as much experience I want, but I know that I will.”

In contrast, participant 2 shares similar math and science perspectives with the other three participants who found math and science to come naturally to them and get more enjoyment out of these STEM-related courses.
“Yes, those are definitely my strong subjects. I think I was just intrigued by them from the beginning. I always loved math and science, doing science experiments in school and at home. They were definitely my strong subjects. Maybe they just came more naturally to me. My mom is also strong in math as well. So maybe it was because she could help me out more there. I think it just came more naturally to me, and then I just stuck with it. So, in high school, I took more advanced math and science classes… I guess I probably started at the middle school, but I was always ahead in my math and science courses.”

Participant 4’s high school and college math and science success continue to bring her more success as a young professional. She reported in her response:

"Yes, I do. I got good grades. I graduated with honors from engineering school. I was hired right out of college. I got promoted a couple of times in a short period of time. So yeah, I think I'm pretty successful."

IQ4 asked, “What were some of the strategies that you used to become successful in science and mathematics throughout your high school education?” The participants identified three key themes as the best strategies for becoming successful in mathematics and science courses throughout high school: peer community support, support from teachers, and hands-on learning. Five (83%) of the six participants mentioned at least once that peer-to-peer interaction through a group project, study group, and common academic interests helped in their persistence in a STEM discipline. In her response, participant 4 described her diverse high school community as being motivated by excellence. She explained:

“Yes. So, my high school was actually pretty diverse. And so, we were all required to take physics and math and stuff like that. So, there was no like, oh, you're the only black person in this class that only came through college. And so, in high school, it was like we were motivated by excellence…And so just like being around them really, really helped me, and I'm still friends with those folks from high school. Again, building a community. I think that's pretty essential. I'm seeing it, but I didn't realize that until I've talked about it right now, but yeah.”

Participant 5 provided additional insight regarding peer support and its impact on her confidence to pursue and persisted in her STEM discipline:

"I would say I tended to take classes the same semester as a friend would be taking it. Or if that did not work out and I were to take a class that I didn't know anybody and I try to
make friends with at least a couple of people in the class just so that you can bounce ideas off of each other or get together and study or do homework together. If you have somebody there who's going through the same problems and having the same difficulties, you connect and kind of like bounce things off each other to work through problems. It makes the class a little bit more enjoyable.

… Our teachers, I guess, really focused on putting us into groups within the class for like problem-solving, like practice and all that stuff. Otherwise, it would be a little nerve-wracking at first for me personally to meet new people, but as the semester went on, it was fine. Just because we didn't really have to put in the effort to be outgoing."

On the other hand, participant 3 did not benefit from this approach until she arrived in college. She shared her revelation as:

"I feel like I really didn't do the things I should have in high school… because I felt like they were so different from me, and they wouldn't understand that I struggle… But in college now, I can see that it's definitely also helpful to make those connections with other people so you can learn more things."

Four (67%) out of six participants identified that a hands-on learning approach was an excellent strategy for building their STEM confidence. Participant 4 shared her experience with hands-on STEM-related courses at her high school. She described her excitement and experience as "one of a kind," which helped her connect how she could connect engineering to real-world applications. She discussed that these hands-on projects provided an opportunity to work on "real-life engineering problems."

Participant 2 provided her view on hands-on learning within STEM-related courses at the high school as not comparable to reading and English. It taps a different side of learning that many other subjects do not. The hands-on portion of STEM was what initially drew her closer to STEM. The opportunity to "mix chemicals together and look what happens or get to build and doing engineering stuff” made STEM more attractive. Because of the hands-on component, she took all STEM-related electives so that she could learn as much as possible through multiple different courses.
The third theme for IQ4 is teacher support. Half (50%) of the participants said that teacher support increased their self-efficacy and built their confidence to persist in STEM disciplines.

Participant 4 described her experience and relationship with her teacher as critical to her persistence in STEM. She recalled him by name, stating, “high school physics teachers were super accessible. Whenever I needed help, they would always have office hours. He didn't make it seem like one type of person should be doing physics, which I really appreciated.”

Three themes rose when answering IQ5, “What support do you need to complete your STEM discipline?” Participants expressed that having a mentor, the support of their teachers, as well as institutional support in navigating the financial aspect of their education made a positive impact in completing their STEM discipline.

Participant 4 stated that she did not receive a lot of support from her institution or teachers when she went to college. She expressed that tutoring was available when needed, but she missed out on the opportunity to build and create a close relationship with her teachers that could have helped her develop in her academic journey. Furthermore, she discussed the lack of diversity within her STEM community until a couple of years after she graduated college and entered the professional world. She was dismayed to say that “the first time I actually ran into another black person, a black female engineer, I can't even believe I had to say that, which was two years after college. She is now my mentor.”

With the impact COVID-19 had on learning and connecting with others, participant 6’s answer provided a different view regarding how that has affected her ability to complete her discipline successfully. She described her concerns as:

"The support that I need is having that connection with other people within my STEM discipline, and I think because of COVID, you know, just circumstances that we're facing
right now, it's become harder to sort of have that connection, and those platforms to connect with other students within my discipline. So, I think more connected platforms would definitely help support me."

Two (33%) out of six participants expressed they had institutional and teacher support, but more financial support was necessary to complete their STEM discipline successfully.

Participant 1 stated:

“I have pretty good instructors. At the college, they help me a lot. I feel like the only thing that I need right now is financial help to complete my program right now.”

Participant 2 concurred in stating:

"Probably the biggest one for me was figuring out college. How to get there, how to apply, how to get a tour, "the FAFSA," and all of that. I was a first-generation, under-represented, and "low-income student." I was the first in my family to go to college… I enrolled in the Trio Student Support Services at the college, and that really helped with a lot of that transition into college.

… Like figuring out college, and I know that can be a hold-up for so many students. They don't even realize that a college is an option for them. Then they see the "cost of how expensive it is," and that will be the end right there… I'm still learning it. But yeah, that was probably the biggest challenge for me to overcome."

To conclude the interview questions for research question one, IQ6, “Who do you know personally (relative, friend, etc.) who is working in a STEM profession?” Five (83%) of six participants said they knew a family member or a relative who was working in STEM during high school and was responsible for building their confidence to pursue a STEM discipline.

Participant 4 recalled her STEM environment experience in high school and explained in her answer:

"I honestly don't think so. I mean, yeah, I thought about this before, and I couldn't think of any other minorities, like even female engineers, that I did know. Like I say, my dad is an engineer, so he worked at a national lab, and they have programs where they had like a girl in STEM day where you meet with, get a mentor for the day, and then shadow them basically. So besides that, NO!"
Participant 5’s role model was her aunt, who works as a nurse, where she had many opportunities to shadow and observed some of the experiences of working in the healthcare area before making her decision to pursue her clinical lab degree. She looked back on those memories with sheer joy as she shared those experiences during her interview. She grew to enjoy the medical environment her aunt worked in as a nurse, and so she began to spend a lot of time getting shadowed and being mentored by her aunt at an early age. She stated, “I liked the environment that she was working in, and I saw the firsthand impact she was making in the lives of others, so I definitely found value in that aspect of it.”

Participant 3 remembered her role model experience a little differently. She could not recall knowing anyone other than her auto mechanic stepdad, who was in STEM. She only knew of her teachers, who encouraged her to excel in her STEM-related courses and to take part in engineering-based extracurricular activities, such as First Robotics. However, her Stepdad was the primary reason she decided on her mechanical engineering degree.

On the contrary, participant 2 could not recall knowing any relatives or close friends when she was making her decision to pursue her STEM disciplines after high school. She searched her memory the best she could but came back empty, not being able to remember a time she encountered someone in STEM other than her teachers while in high school. She then continued to explain that because of that when people asked her, “What you want to be when you grew up?” She would respond, “I want to be an engineer.” However, she did not know what being an engineer really meant until later in her high school years.

In responses to research question two, IQ7, “What was the ethnic make-up of your high school STEM teachers?” Five (83%) of six participants said their STEM teachers were all white, and one (17%) said she had at least one Hispanic physics teacher. Participant 4 stated:
“It was all white. I don't remember anyone being anything else.”

Participant 5 answered:

“My teachers, I think they were all Caucasian. I don't think they had any minority teachers in STEM. Actually, my calculus teacher was Hispanic, and he was great.

I don't think any of my teachers outside of STEM were of minority groups either.

…no minority professors come to mind.”

And participant 6 echoed participant 5 experience with the following response:

“Not that many African Americans or Hispanics were in those sort of educational positions in STEM. So as far as ratio say like two teachers.”

IQ8, “Were there any instances in high school where you felt discouraged to pursue your current major? Why?” Four participants (67%) felt discouraged due to the lack of diversity and not fitting into their STEM community in high school which presented a challenge when considering pursuing and persisting in their selected disciplines.

Participant 2 recalled an emotional and painful experience where she struggled to stay in her STEM track in high school:

"I don't think there were too many of that. Mainly because I didn't really interact with my peers most of the time, but there was this one time when a group of guys made fun of me because I was the only girl in the class and would see me struggle. They would laugh. It was frustrating in a way, but there were other people that had my back during those times."

Participant 2 shared her view on the lack of people who look like her by stating:

"I would say it's discouraging not to see anyone in the industry who looked like me. So even growing up with like Bill Nye, the Science Guy, like that's great, but where's, you know, where is someone that looks like me as well? When you think of someone in a lab coat, you definitely picture a white male wearing it. That was definitely discouraging.

As far as like in my classes go, I can't think of any specific examples where I felt targeted as a student by my teachers…”
However, two (33%) of participants reported that they never wavered from pursuing their STEM pathways and persisted with confidence all through their professional careers. Participant 4 answered:

“No. I knew exactly what I wanted to do, and I wasn't going to let anybody stop me.”

Participant 5’s answer shows she was not deterred from pursuing her STEM discipline in the healthcare fields, as she stated:

"Not so much changing my career path completely, but I guess as far as going the medical school route, I took a detour to the medical lab field with the possibility of the med school track. I think it came down to cost for me, and I realized it was not realistic to support myself for another 8 to 12 years going through medical school. And that's something that I didn't really want to burden my parents with… but if I did decide that I wanted to do something more than a lab, I could easily change that back into a med school track if I wanted to."

Responding to IQ9, “What are some challenges you are experiencing in your current environment?” An overwhelming 100% of participants reported that one of the challenges in their STEM environment is the lack of diversity. The lack of both women of color and female mentors made it challenging to stay confident and persist in their STEM disciplines and fields. Participant 1 stated:

"Prior to COVID-19… I was the only colored person in my class. Yes, since I got into this major, I've been the only female with a second language and Spanish. And it's not a challenge anymore, but at the same time, it is, but as I said, I always have to try harder. You know, I feel like sometimes people don't think I can do it and I have to prove those things. All of these things challenge me a lot sometimes in a good way, though."

Participant 4’s response provided a perspective to both situations, in academia and her professional career:

"In the beginning of my career working for a conservative company in the Twin Cities, my first challenge was getting used to people being okay with me being black and female because at the other company I was at, people were very, very uncomfortable with that. They did not know what to do with a woman. They didn't know what to do with a black person. They assumed I was like janitorial staff or something. I know it's my old company. I don't know, but I just experienced a weird dynamic."
…but at my current company, people are super aware of the issues and sometimes really almost too aware. Like almost like at last company, they didn't want to address it. And they felt weird about minorities, but at the current company, they want to address it. But it's almost like I'm in the spotlight now, but it's a little bit overwhelming because I'm the only person. There are only three Black people at a company of 300 people there. So yeah.

When I went to a straight-up engineering school after "my first bachelor," no, no, it was awful. It was like it was a daily struggle. People would say. Some weird comments like, oh, you only got in because you're like a minority or like, you know, they'd say some weird thing like I being a woman and black, it's like compound. Engineering school wasn't very fun.

When I left engineering school, I did not look back."

Participant 5 echoed participant 4’s perspective on the high school level of challenges she faced in her environment. She stated that one of the biggest challenges for her was the lack of representation of WOC in STEM when she was growing up. The lack of people who looked like her in leadership roles were rare. Therefore, she says that, “you don't really see what's tangible for yourself, you know? I guess it would be a lot more helpful, in my opinion, if there were a little bit more diversity.” The lack of diversity makes it that much more challenging for young African American and Hispanic women to envision themselves in a way they have not seen others who look like them and are successful in STEM. The lack of diversity is a deterrent for these YWOC to even consider these options. Participant 6 also stated:

"In my current environment, there are not as many women mentors that I have, and I think that to me is a challenge because I know that the field that I am entering is very male-dominated. And just having that mentor, female or African American or whatever, it definitely will help. And since I don't have it, it kinda makes me feel like I don't have everything together as of now."

Lastly, participants were asked to offer some advice based on their lived experiences to current high school students who are looking to consider a STEM discipline. IQ10 asked, “What recommendations do you have for other African American or Hispanic students on how to persist in STEM courses throughout high school?” Participant 2 offered a list of excellent strategies that
would build confidence and help young African American and Hispanic women persist in their STEM disciplines and overcome challenges to succeed in their fields. She responded:

"I guess a couple of different things. One, if they have an opportunity to find a mentor, I think that is huge. Find that one person that you can always go to that's not from your family, get an outside resource or a mentor that kind of sees things from a different lens, or maybe works in the industry. I think that would be great.

Also, taking advantage of some of those after-school programs. Your courses in high school are important. And start strong early. Better off slacking a little bit in your senior year than playing catch up because you didn't do well in your freshman classes. And that's one thing that I did really well. Your grades and your freshman year are definitely important. And take advantage of the elective courses that you can take. So instead of just taking a Study Hall, you know, you could take an extra math class, especially if you're interested in going in STEM.

I would say to just doing other extracurricular activities that are outside of STEM as well. So, if you're interested in sports, do sports. If you're interested in arts and crafts, do arts and crafts. Because for me, my confidence built outside of the classroom, but then it translated back into the classroom.

It's not bad to have good grades. I know that's another stereotype like kids don't want to be nerdy, they don't want to be smart. It's not cool to get straight A's, but again, you, you have to set yourself up for the future.

Lastly, just sum it up for them, just know that what's happening in your classes in being the only female or one of color's only person is not fair and shouldn't be the case. But don't let it break you down, like, you have to stay strong and just know that that's what it is. Don't feel, I mean, you could feel upset by it, but don't let that anger overcome you. Because I've definitely seen instances like that, like, this isn't for me. Like "so-and-so told me that I'll never be an engineer" or whatever and it's like, you know, it shuts people down, but you have to know in yourself that's what you wanna do and keep going because there are people that have done it and who do believe in you. You literally have to believe in yourself."

Participant 3 offered:

“Based on what mistakes I made in high school. I would say, try to make friends, and if you are in STEM classes and try to make friends with those people. That's just because you share common interests… … don't be intimidated by being the only girl or person of color in your classroom. You have every right to speak like everyone else in the class. And if you’re wrong, then just learn from your mistakes. It's not necessarily a bad thing.”

Participant 4 and participant 5 concurred:
“So, in terms of advice, I mean, like the common theme here is get yourself a community. That is probably the number one piece of advice I'd give them then.”

“Advice I would give is to make sure your friend group is strong and that they also have high goals for themselves and for their careers later on after their studies.”

Participant 5 also added:

“One thing I wish I did more of in high school was shadowing, or just reaching out and going into the hospital to say, “Hey, can I follow this doctor, or this nurse, or this pathologist for a couple of hours” to see and get a better idea of what the role actually entails prior to making a decision about your major or program. Without shadows, you almost come up with your own idea of what that career requires. Then, you may realize it’s not what you expected at all. So that I would say go out, shadow a few people - if you know any family members that are in fields of interest, go talk to them for a couple of hours and see both the positives and negatives of that career decision and then make an informed, realistic decision.”

Summary

The qualitative survey and interview results uncovered themes that can create high self-efficacy in African American and Hispanic young women to pursue STEM disciplines. Four themes: peer support in STEM-related classrooms, teachers building STEM confidence, and academic achievement, family support, hands-on learning, were identified as the best strategies for building confidence with young African American and Hispanic women to pursue STEM-related disciplines. Three themes were reported as challenges faced by African American and Hispanic students when considering STEM disciplines: lack of diversity in gender and people of color, lack of professional mentorship in STEM, and lack of role models due to gender disparity. Chapter 4 discussed the results of the data collection. Chapter 5 will provide a discussion of the findings, leadership implications, recommendations for future research, and a summary.
Chapter 5 Discussion and Conclusions

The purpose of this study was to identify the challenges young African American, and Hispanic women faced when selecting a STEM discipline and to identify strategies to help overcome those challenges. Previous chapters discussed the background of African American and Hispanic women in STEM fields, a review of the available literature discussing the theoretical framework that informed the study, the research questions and methodology, and the study's findings. This study demonstrated that challenges to pursue STEM disciplines certainly persist for young African American and Hispanic women. However, this study also identified the best strategies that can be utilized to help build confidence in these YWOC to pursue STEM disciplines. The results presented in Chapter 5 include a discussion and interpretation of the data based on the theoretical framework and literature review discussed in Chapter 2 as supportive documentation. Finally, Chapter 5 will discuss the findings with discussions and conclusions, theoretical connections, leadership implications, and future research recommendations.

Discussion and Conclusions

This qualitative study aimed to identify the challenges African American and Hispanic women faced when selecting a STEM discipline and identified strategies to help overcome those challenges. The following two research questions guided this study:

RQ1. What are the best strategies for building confidence in young African American and Hispanic women to pursue STEM-related disciplines?

RQ2. What are the challenges faced by young African American and Hispanic women when considering a STEM discipline?

The two research questions yielded various responses from participants that helped reveal challenges and obstacles YWOC continue to face when considering a STEM discipline and
identified the best strategies for building confidence in young African American and Hispanic women as they pursue and persist in STEM fields.

Data collection was performed through semi-structured individual Zoom interviews. The researcher used thematic coding to analyze the data. Seven themes emerged from RQ1 and RQ2 and allowed for reflection on each participant’s experiences and the best strategies that helped build their confidence to persist in STEM at the secondary and post-secondary education levels. RQ1 and RQ2 also helped identify the challenges they faced in their STEM environments when considering pursuing STEM disciplines. There were four common themes that helped in building confidence in young African American and Hispanic women: (1) peer support in STEM-related classrooms, (2) teachers building STEM confidence and academic achievement, (3) family support, and (4) hands-on learning. Additionally, three common themes identified challenges faced when considering STEM disciplines: (1) lack of diversity - both gender and people of color, (2) lack of professional mentorship in STEM, (3) lack of role models due to gender disparity.

**Theoretical Findings and Connection to Current Study**

Self-efficacy theory within Bandura's Social Cognitive Theory served as the theoretical framework for this study. Social cognitive theory suggests that individuals foster their self-efficacy beliefs by making sense of information within their environment from four different sources, "mastery experience, vicarious experience, social persuasions, and physiological or affective states" (Albert Bandura, 1986, p. 275).

According to Betz (2004), mastery experiences of people with high self-efficacy come from performance-based circumstances, such as academic achievement and confidence. Individuals with low self-efficacy are considered as non-mastery experiences. They often do not
excel in task-achieving situations and do not display confidence in their academic settings (Betz, 2007). During the interview, participants identified strategies through academic resilience and excellence. Participant 5 stated, "I kind of pushed myself throughout high school to achieve good grades and to push myself to the next level classes. I took AP Calculus my senior year and then statistics the semester before. I also took physics, I believe my senior year, which I found challenging, but very interesting to learn about the different phenomena of everyday life, and how things all around you work."

Students foster various vicarious experiences based on learning through observing others perform tasks (Cowan, 2006; Rittmayer & Beier, 2008; Hill, 2021). Diversifying STEM-related classrooms and promoting more people of color in STEM fields encourages young African American and Hispanic women to rely on information modeled by their peers and adults concerning confidence building and making astute judgments. According to Dweck (2006), students who lack positive role models or coaches in their lives generally develop and display a low self-efficacy pattern. Furthermore, Liu et al. (2014) found that high school STEM female students' STEM self-efficacy was positively impacted when they had role models of the same gender engaged in the STEM fields. Participant 5 offered her perspective for building confidence and high self-efficacy using peer resources and information to persist in STEM-related courses. She stated that having a solid friend group with high goals for themselves and their careers later on after their studies were vital to navigating STEM pathways.

In this study, participants explained that verbal and social persuasions had the most significant impact on their decisions to pursue STEM disciplines. Verbal and social persuasion is defined as, "others' judgments, feedback, and support," according to Rittmayer and Beier (2008). All six (100%) participants stated that parents, peers, and teachers were essential role models
who helped develop their high self-efficacy through their STEM education pathways. The support and positive feedback from these role models are essential to excel in STEM courses. Therefore, it is vital that educators and parents understand the impact their involvement has on closing the disparity and boosting young African American and Hispanic women's confidence to pursue and persist in STEM disciplines.

The physiological states of students with high self-efficacy are determined by how they interpret their emotional and physical states from performance-based situations regarding their level of contentment and eagerness to achieve specific tasks. According to Messer (2008), individuals who experience low self-efficacy in the physiological states often display less confidence in performance situations, such as academic study. Four of six (67%) participants stated that having good grades helped boost their confidence to persist in STEM-related coursework. Participant 2 stated, "I personally got more confident in myself when I got to college, and it showed in my discipline as well. I always got good grades, but I felt better about them when I was in college. I was more confident as a person."

Several participants also identified various strategies by applying hands-on learning that helped build confidence and high self-efficacy to pursue and persist in their STEM discipline. According to Liu et al. (2014), hands-on project-based learning has been a meaningful way to increase African American and Hispanic high school young women's interest while building their academic self-efficacy skills and confidence within the classroom. Participant 2 discussed how she is "a super hands-on learner, and the teachers that go that extra step to figure out how to make it more hands-on or relatable to the students just make a world of difference." Participant 4 also shared that her high school offered engineering classes that provided various hands-on
projects, creating real-life engineering problems that can increase achievement and critical thinking skills.

**Interpretation of Findings**

Based on participants' responses for RQ1, "What are the best strategies for building confidence with young African American and Hispanic women to pursue STEM-related disciplines?" Four positive themes emerged: peer support in STEM-related classrooms, teachers' support to build STEM confidence and encourage academic achievement, family support, and hands-on learning.

**Theme 1: Peer support in STEM-related classrooms**

Various participants felt that the positive, supportive culture within their STEM environment at the high school level allowed them to pursue their dreams and goals free of stereotypes when grouped with peers of similar interests. These types of environments are responsible for fostering and motivating young African American and Hispanic women to challenge themselves to pursue STEM-related courses. According to Bernasconi (2017), a peer group is a significant influencer and a support source that increases students' competitiveness within classes and the pursuit of STEM disciplines when they challenge each other academically.

The following responses support theme 1:

Participant 2: I started to make a few friends when I was still trying to figure things out. But then, once the coursework got a little bit harder, and there was more math involved, I was excelling. Then some people were coming to me because of that. I would create study groups, and in a way, I was proving my value. Although when I came to [Nonprofit Institution], I didn't know what a mill or lathe was. Some of the guys in my class came from that world, so they understood the manufacturing side of things, and I didn't. We could still pair our strengths together and work well on a project.

Participant 3: Try to make friends, and if you are in STEM classes and try to make friends with those people. That's just because you share common interests. So, I
think it won't be too hard to make a friend then make those kinds of connections.

Participant 4: In high school, we were motivated by excellence. I'd say many people, like student-athletes who played two sports and in the music program, enrolled in these higher mathematics classes. Being around them really, really helped me, and I'm still friends with those folks from high school. Again, building a community. I think that's pretty essential.

Participant 5: I tended to take classes the same semester as a friend would be taking it. Or if that did not work out and I were to take a class that I didn't know anybody and I try to make friends with at least a couple of people in the class just so that you can bounce ideas off of each other or get together and study or do homework together. Otherwise, it could be challenging trying to stay motivated to stay in your class.

The advice I would give is to make sure your friend group is strong and have high goals for themselves and their careers later on after their studies. And if your friend group is not very strong, then don't be afraid to build friendships and relationships with people in your classes that you know will be in the same lineup of classes throughout your major. It will definitely be helpful if there's somebody there that you're comfortable going to if you have questions about anything because your teachers will not always be readily available. So if a classmate is there and they can help you out with one problem you don't understand, that would be beneficial for you.

Theme 2: Teachers’ support to build STEM confidence and encourage academic achievement

Research indicates that teachers from high-minority and high-poverty schools have fewer certifications to teach in their subjects and have less experience than teachers in schools with students from high-income families (88% vs. 95%) (National Science Board Science and Engineering Indicators, 2018). African American and Hispanic students often come from high-poverty communities. Young African American and Hispanic women must receive a high-quality education that fosters a STEM foundation to build the confidence to prepare them to take college-level courses. School administrators must hire qualified teachers to teach STEM-related coursework and have a willingness to go the extra mile with students. Training should be
accessible to teachers to help them understand the benefits of creating an engaging lesson, the power of a growth mindset, and how to be a teacher who is not afraid to dive into the STEM curricula and make subjects relatable real-world application (George, 2020). The following responses support theme 2:

Participant 2: I'm a super hands-on learner, so the teachers that go that extra step to figure out how to make it more hands-on or relatable to the students just make a world of difference.

Participant 3: I was on the robotics team in high school for three years, and it took me down another path. I got to see how things are made and how the design process went, and that's where I really became interested in that way. And then, the mentor in that robotics team was the STEM teacher in my school. He encouraged me to take some of those classes, and that is where I got more engaged and interested. Then in the classroom, we actually are studying and learning how it works.

Participant 4: My high-school teachers, my high school physics teachers were super accessible. So whenever I needed help, they would always have office hours. I remember my high-school physics teacher's name. He was super cool. He made himself very available. He didn't make it seem like one type of person should be doing physics, which I really appreciated. So, yeah, I'm really grateful for the teachers in my high school.

Participant 5: I also had a couple of teachers in high school (Algebra 2 and Spanish) that really took the time out to recognize the quality work I was doing and to encourage me personally to continue to stay focused and I would be able to accomplish anything I put my mind to.

Theme 3: Family Support

All six (100%) participants related that family members significantly influenced and helped build their confidence to pursue STEM disciplines. According to Hill (2021), one factor that deters young African American and Hispanic women from choosing STEM discipline in postsecondary education is a severe lack of knowledge in introducing and promoting STEM opportunities from family members. The study also suggests that STEM students' interests begin to diminish as they enter secondary education. Therefore, entering high school is a critical time
for parents and other family members to continue encouraging YWOC to persist in STEM throughout their educational and professional careers. In the interviews, participants expressed their gratitude for family member's involvement that exposed and guided them through the early phases of their STEM identity. Two of the participants discussed having at least one parent who works in STEM who fostered and helped develop their interest early. The other four participants discovered their passion for STEM through a close relative. The following responses support this theme:

Participant 2: We were taught to value education and also sports. One was not more important than the other. It was basically you come home, you do your homework, and you go to basketball practice. That was kinda the everyday repetition. But yeah, I'm definitely fortunate in saying I was encouraged at home to get my homework done. And it didn't seem like a chore per se. I enjoyed it like we made it fun, or I'm trying to think of other words to use. But definitely, that encouragement came from inside the house.

My mom is strong in math as well. So maybe she could help me out more there.

Participant 3: I would say my stepdad back then was definitely a great role model for me. He would do all of the mechanic work at home when one of our cars break down, and at first, I was thinking I liked being helpful, so I would help around the house with that. But then I started getting interested in how the engines work and how to make each component works together to build for this big machine, you know.

Participant 5: I would say it started pretty young. Spending most of my time growing up in Antigua, I've always said I want to be a doctor. So, throughout that time in my life, I would always have family members like my grandmother and my parents who would always be that echo in my ears, speaking it into existence already long before I even got to the point of making a decision for my career, you know, or for what I wanted to pursue in college. So, I think that played a big part in where I knew that they were confident that I could achieve that type of career path for my life, and that meant a lot.

I had a few Aunts that were nurses growing up. So that's probably where the interests on the medical side came from. And then I had an uncle that was an engineer, although I wouldn't say I knew too much about engineering at that point of my life. But I guess I would look up to my
Theme 4: Hands-on learning

The majority of participants (67%) spent a large portion of the interview discussing the impact that applied hands-on learning and problem-solving projects had on building their confidence and high self-efficacy to persist and pursue STEM-related coursework. Project-based STEM coursework is an effective way to capture students' creativity, develop social cognitive, and critical thinking skills that promote vicarious experiences and a healthy physiological mindset to achieve academic excellence in their STEM environment. Participants expressed that when they were able to work on hands-on projects, they were more engaged, obtained more learning materials, and their interest in STEM grew more robust when they could see how things fit together in the real world. Liu et al. (2014) emphasized the importance of teacher's value for hands-on learning. In his research, real-world scenarios are paramount to promote critical thinking, problem-solving, collaboration, and creativity. This approach increased students' academic performance in STEM and provided a positive perception compared to traditional classrooms. The below discussions are relevant to this theme:

Participant 2: I believe science is very hands-on compared to reading and English for the most part, or like even history are just like social studies in general, not quite as hands-on as science. Maybe that's what my initial attraction was to it. It's like, oh, we could mix these chemicals together and look what happens, or we get to build this, you know, doing some engineering and stuff. I did go to a science camp when I was in seventh grade. We built the tiny robots and probably built bridges.

In high school, a lot of the elective courses I took were related to STEM. I took shop class and electronics. And rather than taking "home economics" classes, I always took elective classes that were centered around STEM. They're just, again, cool to be hands-on. If I could go back again, I would take even more of them. I wanted to take a small motors class or a
construction building class. In general, those just always caught my attention right away in those classes.

Participant 4: So, my high school started this one engineering class where we did these hands-on projects. It was so cool! We basically got a bunch of these different projects where we get a big cardboard box, and ten 2-liter pop bottles, a trash bag, and you have to build a boat. The high school had a pool, so you had to build a boat and actually sail this boat in the pool. We got to do these real-life engineering problems.

We also built this like a life-size catapult. It was this huge, huge catapult. It was just so cool to have these hands-on engineering classes.

Based on participants' responses for RQ2, "What are the challenges faced by young African American and Hispanic women when considering STEM disciplines?" Three common themes emerged: lack of diversity - both in gender and people of color, lack of professional mentorship in the STEM, and lack of role models due to gender disparity.

**Theme 1: Lack of diversity in STEM - both in gender and people of color**

Lack of diversity in STEM has persistently been a challenge for women in STEM. The stereotype that women are less competent in math and science has portrayed a negative image that keeps young women from building high self-efficacy in STEM-related courses in high school, resulting in few women teachers and professionals in STEM fields. When narrowing this angle for lack of diversity in STEM to dually marginalized groups, such as young African America and Hispanic women, the disparity is even more significant. According to Wood and Eagly (2010), gender and race are the most potent social biases upon which people stereotype others. WOC have experienced gender-STEM stereotypes for decades, even though they have made significant strides in STEM-related fields. If gender and racial stereotype threats persist, they will continue to have a negative impact on women's persistence in STEM, and the gender gap will remain in these fields. During the interview, participants expressed discouragement and disappointment for the lack of African American and Hispanic women as role models, such as
teachers in the classroom and WOC who look like them in the STEM professions. Furthermore, (83%) of participants said that their STEM teachers were white males.

The following interview discussions support this theme:

Participant 1: I was the only colored person in my class. Since I got into this major, I've been the only female with the second language in Spanish.

Participant 2: At my high school, there was some diversity, and they're not necessarily in my classes because I was in like the more advanced science and math courses.

Participant 4: My first challenge was getting used to people being okay with me being black and female because, at the other company I was at, people were very, very uncomfortable with that. They did not know what to do with a woman. They didn't know what to do with a black person. They assume I was like janitorial staff or something.

Participant 5: I guess a big challenge probably from high school on, even right now in my career, I would say again, is representation. You don't really see too many people who look like yourself and in leadership roles or anything like that. Again, no professors that were of my color and less females than males. So, you don't really see what's tangible for yourself, you know? I guess it would be a lot more helpful, in my opinion, if there was a little bit more diversity.

Theme 2: Lack of professional mentorship in STEM fields

Although most participants discussed family support as one of the main driving forces that built their confidence to persist in their STEM disciplines, lack of mentorship at the postsecondary education and professional level proved to be a challenge for them to excel in their fields. According to Sharpe (2019), mentorship has positively impacted many factors related to self-efficacy. Mentors focus on providing support and growth opportunities by offering their expertise to help young individuals achieve their goals or improve their skills (Galbraith & Cohen, 1995). However, participants in this study felt that the lack of women's mentorship in STEM held them back from building the confidence they needed to persist in their respective disciplines or careers. African Americans and Hispanics feel they are not prepared to enter a
STEM discipline and STEM professional world because it is hard to find qualified mentors to mentor them. Therefore, they fear they are not on the same level as their white counterparts when entering STEM fields. In essence, having a mentor who shares the same interests and values an individual's personal goals is critical for success in STEM disciplines.

Participant 4: I hate to say it, but I'm not sure there was a ton of support. The only thing I could say is like there was tutoring. But I did not have a mentor in college.

The first time I actually ran into another black person, a black female engineer, I can't even believe I had to say that. It was two years after college. And she is now my mentor. It's been really nice to have someone to look up to and say like, wow, this is what your career looks like. I've never had that before, and I haven't actually seen it since. After my mentor, I've only met one more female black engineer, and actually it was this year.

Participant 6: There were not that many African Americans or Hispanics in those sort of academic positions in STEM. It impacted me in a way that maybe made me feel like, you know, where are the people who look like me within these positions that already got through those STEM disciplines? And they can tell me about their challenges. Not saying that someone else's challenges isn't different. But having a closer relationship with a mentor definitely would have made me feel more confident.

There are not as many women mentors that I have in my current environment, and I think that to me is a challenge because I know that the field that I am entering is very male-dominated. And just having that mentor, female or African American or whatever, it definitely will help. And since I don't have it, it kind of makes me feel like I don't have everything together.

Theme 3: Lack of role model due to gender disparity in STEM

The participants spent a large portion of their interviews discussing the influence of role models in their lives as they decided on their STEM pathways. Each participant described family, teachers, and peer groups' roles in shaping their STEM course choices and postsecondary education pursuits. Even though these participants may have had some role models that started early and at home, they faced the most challenges when they left for college. Eighty-three
percent of participants did not recall seeing or having other prominent role models they can look up to while in college. Those participants who did not develop a STEM identity at an early age, such as in elementary or middle school, find themselves having to work harder than their peers to excel in STEM-related courses.

According to MacPhee et al. (2013), an individual's assessment of themselves, such as the ability to complete and perform various tasks, involves learning from various social world experiences and verbal persuasion from people they look up to for encouragement. This personal assessment can positively impact that individual's outlook and self-efficacy in STEM courses. Lack of role models due to gender disparity in STEM fields can create low self-efficacy in young African American and Hispanic women, causing them to drop out of college. Thus, it is widening the gap for WOC in STEM disciplines and careers.

The following interview discussions support theme 7:

Participant 2: Honestly, I don't really think I had anyone around me that was in STEM. I literally don't even know. I don't know where it came from. And I know that I don't know because when people say, "what do you want to be when you grew up?" and I said, "I want to be an engineer." It wasn't until way later that I realized that "engineer" is not a job. You would be a specific type of engineer like mechanical, electrical, software, a civil engineer.

Participant 3: I don't think I knew anybody other than my instructors/teachers at that time [High School]. I didn't really have a role model to help me with that process of making a STEM career, and it was mostly my instructors that they pushed me into doing that.

After conducting individual interviews with six participants, reviewing the literature, and synthesizing the findings in chapter 4, the following conclusions were drawn from the study:

1. The need for peer support and positive encouragement is closely associated with young African American and Hispanic women considering and persisting in STEM disciplines.
2. The need for teacher support, followed by student and teacher relationships, is essential for building young African American and Hispanic women's confidence to pursue and persist in STEM fields.

3. Creating more hands-on and practical learning opportunities in and out of the classroom to empower students and increase their academic interest while building self-efficacy skills within the classroom is essential.

4. The need for diversity related to gender inequity and the need for more people of color in STEM classrooms and work environments is critical to build YWOC’s confidence.

5. The need for young African American and Hispanic women to be connected and interact with mentors, role models, and coaches during their STEM education path is vital to their progress and success in their disciplines.

6. The need for more family engagement and encouragement to positively encourage participants' decision to choose STEM courses and pursue STEM disciplines is paramount.

Leadership Implications

This study identified key strategies to help build young African American and Hispanic women’s confidence to pursue STEM disciplines at the postsecondary education level. This study also identified some challenges faced by this group of minority students and offered up different ways educators, policymakers, and industry leaders might help to overcome these challenges. This study's results are significant because they add to the existing literature for best strategies to help build WOC's confidence to pursue and persist in STEM disciplines. Suggestions for best strategies and how to overcome STEM bias challenges were provided by a group of young African American and Hispanic women students and young professionals who
are currently using or have used these strategies to help them persist in their STEM field of study. After carefully reviewing and analyzing the collected data, six leadership implications were gathered and discussed in the following section.

**Implications for Leadership Approach**

**Conclusion 1**: The need for peer support and positive encouragement is closely associated with young African American and Hispanic women considering and persisting in STEM disciplines.

**Implication**: Educational leaders must understand the impact peer-to-peer support has on students’ emotional and self-efficacy development when assigned to a group with others who share common interests. Four out of six participants explained that when paired with peers for projects, they enjoyed bouncing ideas off one another to problem solve. Furthermore, participants 2 and 4 described how these group projects helped them discover their leadership skills and develop abilities to lead a team. However, others described their high school STEM course as isolated and "singled-out" (being the only girl, Black or Hispanic person in the class). Young African American and Hispanic women do not choose STEM-related courses at the high school level because they do not know others in those classes and often do not look like them.

Educators are responsible for creating an environment welcoming for all students, no matter their looks or ethnicity. A great way to do this is to continue creating opportunities for group project activities in the classroom that promote creativity and teamwork while discouraging stereotypes. When actively engaged in activities, students can develop more confidence and high self-efficacy when given the same opportunities to learn in a shared space.

**Conclusion 2**: The need for teacher support followed by student-teacher relationships is essential for building young African American and Hispanic women’s confidence to pursue and persist in STEM fields.
Implication: As reported by the U.S. Department of Education (2018), teachers from high-minority schools (50% or more African American and Hispanic student enrollment) have fewer certifications to teach in mathematics and science subjects. They also have less experience than teachers who are in schools with students from high-income families. This report is alarming, considering that teacher support is critical to African American and Hispanic female students’ confidence to choose and continue taking STEM courses. Therefore, it is paramount that school administrators bring in teachers to encourage every student equally to grow and reach high academic achievement in STEM. Hiring more STEM teachers of color and females provides an opportunity for struggling YWOC to develop their confidence because these students often already had a defeated mindset before even trying a STEM lesson. Various participants expressed their appreciation for the teachers who made themselves accessible and went the extra mile to help them succeed in their STEM classes. Young women look up to those who show they care for their success. When teachers have the proper training and tools to create a reciprocal relationship with their students, students feel more comfortable asking for assistance when needed, and they continue to grow within their STEM environment.

Conclusion 3: Creating more hands-on and practical learning opportunities in and out of the classroom to empower students and increase their academic interest while building self-efficacy skills within the classroom is essential.

Implication: Traditional learning styles are not enough to keep YWOC in STEM when they constantly face stereotypical threats that make them feel that they do not belong and have few or no role models to look up to. In this study, participants shared the significance of hands-on learning in their decisions to continue in STEM-related courses. School Administrators should value this practical approach to learning to get African American and Hispanic female students
more interested and engaged in learning STEM. Implementing project-based courses helps students develop critical thinking and problem-solving skills to foster self-confidence and high self-efficacy to persist in a STEM discipline. Additionally, STEM-type extracurricular and afterschool programs, especially when started early in grade school and even middle school, would be abundantly helpful.

Schools with limited resources may have negative implications in developing quality STEM education, so perhaps even community-type programs would help. There was also some mention from the survey participants of sports giving more confidence and preparing for leadership roles in academics and future roles. Athletic programs can also help maintain good grades, build teamwork and time management skills that can be used in all aspects of life.

**Conclusion 4:** The need for diversity-related to gender inequity and the need for more people of color in STEM classrooms and work environments are critical to building YWOC’s confidence.

**Implication:** It is the responsibility, through strategic hiring, of the school administrators and policymakers to diversify campuses and classrooms for students who may not have a role model at home. For many students of color, the importance of exposure to STEM opportunities in the classroom and within their campus cultures is imperative. Therefore, when hiring teachers for STEM-related courses, school administrators and education leaders should keep in mind a unique set of qualifications of teachers who will cultivate an environment welcoming to all types of students and who are highly committed to all students' success in the classrooms. The obvious solution is to put more qualified teachers of color in STEM-related courses. However, the foundational issue is the lack of qualified STEM teaching training programs producing diversified STEM teachers who can teach and mentor. White males teach the majority of STEM-related courses. In this study, participants reported they do not feel connected to male teachers
because it does not help them picture themselves in those fields as it would if they had a female teacher who is also a teacher of color.

Furthermore, media and social media platforms do not portray females or females of color in STEM roles. When YWOC see others, who look like them playing important characters, it can help them identify as that figure and grow the confidence to consider these fields. Historically, many of these roles are most often only played by a white male. Therefore, to close the diversity gap in STEM, it is essential that more females and female of color teachers are placed in the classrooms, more media coverage showing successful WOC in STEM, and more STEM training programs which will increase the number of teachers of color teaching STEM-related courses at the high school level must be developed and implemented.

**Conclusion 5:** The need for young African American and Hispanic women to be connected and interact with mentors, role models, and coaches during their STEM education path is vital to their progress and success in their disciplines.

**Implication:** Finding a mentor in a STEM field is paramount to the development of young African American and Hispanic women. This study's participants suggest that a suitable mentor is a woman and preferably a woman of color. As a mentor, a woman of color is rated as having high importance to help build confidence and high self-efficacy based on vicarious experiences. It is more relatable and comforting, knowing that the same struggle with gender and racial bias most likely occurred with this mentor in the same way the participant has experienced. When a student is exposed to the importance of leadership and teamwork, as demonstrated by mentors, she may come to recognize that one of the qualities of becoming a successful engineer or scientist also involves being a good team member. School administrators and education leaders can implement mentorship programs by hosting guest speakers from various STEM fields. These
mentorship programs can help students visualize and connect subject matter to the real world. Offering field trips, exploring opportunities, and visiting STEM companies to see what scientists and engineers do in their day-to-day work would also be highly valuable. Hearing from and seeing a role model figure that may look like a student can boost the confidence needed to pursue a STEM discipline or career as well.

**Conclusion 6:** The need for more family engagement and encouragement to positively encourage participants' decision to choose STEM courses and pursue STEM disciplines is paramount.

**Implication:** Family support builds confidence at an early age, and this support is more meaningful and long-lasting because of the foundation it is rooted upon. Family can be a regular reminder to excel in academic goals that an individual set for herself. Although African American and Hispanic female students may lack the knowledge for different STEM disciplines and opportunities, family members can serve as mediators and support academic success in school. Teachers and parents can collaborate to ensure students thrive in STEM-related coursework. Education leaders should invest in and put forth more effort to collaborate between community, family, students, and local colleges to engage in STEM activities and listen to guest speakers who can offer ways to support and encourage YWOC through their STEM pathways. Organizing and hosting STEM-themed family engagement events brings families and teachers together to better understand how to serve students who may require different learning approaches.

**Recommendations for Future Research**

Future research is encouraged to identify best practices for teachers to build confidence and support young women of color in STEM classrooms. For example, developing teaching
approaches that are more effective at reaching young African American and Hispanic women and allocate funding to train more teachers in the best STEM teaching approaches would be helpful. More research is also needed to identify professionals in STEM fields who can serve as role models for young women of color at the high school level.

Additionally, while the participants, sites, and methods selected for this study were suitable for the study’s purpose, further studies should be expanded regarding geographical location, and the sample size should be increased to validate the findings further.

Summary

The current study identified seven key strategies for building confidence in young African American and Hispanic women to pursue STEM disciplines and overcome challenges in STEM environments. The theoretical framework and literature used to inform the study were constructed from self-efficacy within Bandura's Social Cognitive Theory (1977) to support the experiences that encouraged young African American and Hispanic women to persist in STEM disciplines.

Participants spent a large portion of their interviews discussing different approaches that guided them in choosing STEM-related courses at the high school level and helped them persist in college STEM disciplines. Data analysis yielded seven relevant themes pertinent to the two central research questions. The support of family members, peer groups, teachers, and hands-on learning opportunities proved to have significant positive impacts for encouraging and empowering young African American and Hispanic women to develop high self-efficacy and achieve STEM academic excellence. To increase the representation of young African American and Hispanic women in STEM, access to qualified role models and mentorship is essential. Additionally, promoting and fostering gender and racially balanced environments in school and
the professional world can close the diversity gap that serves as a barrier, keeping women of color out of STEM fields.

Based on this study's outcome, African American and Hispanic female students and young professionals are aware of their continued underrepresentation in the STEM fields. Responsibility for change is in policymakers' and educators' hands. They need to listen and implement the strategies that have worked for building confidence and developing high self-efficacy to overcome challenges that presented roadblocks for this group of young minority women.
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## Appendix A

### Interview and Survey Questions

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<tr>
<th>Research Question 1</th>
<th>Open-ended</th>
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<tbody>
<tr>
<td>What are the strategies for building confidence with African American and Hispanic young women students to pursue STEM related disciplines?</td>
<td>1. What specific example of something or someone that built your confidence to pursue STEM related disciplines that you would be willing to share?</td>
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<td>2. Would you say that you are confident in your STEM discipline? Why?</td>
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<td>3. Would you consider yourself a successful student in science and mathematics?</td>
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<td>4. What were some of the strategies that you used to become successful in science and mathematics throughout your high school education?</td>
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<td>5. What support do you need to complete your STEM discipline?</td>
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<td>6. Who do you know personally (relative, friend, etc.) who is working in a STEM profession?</td>
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<tr>
<th>Research Question 2</th>
<th>Open-ended</th>
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<tr>
<td>What are challenges faced by African American and Hispanic students when considering STEM disciplines?</td>
<td>1. What was the ethnic make-up of your high school STEM teachers?</td>
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<td>2. Were they any instances in high school where you felt discouraged to pursue your current major? Why?</td>
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<td></td>
<td>3. What are some challenges you are experiencing in your current environment?</td>
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<td></td>
<td>4. What recommendations do you have for other African American or Hispanic students on how to persist in STEM courses throughout high school?</td>
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