

Parental Academic Socialization and the Advancement of Black Women in STEM: A Literature Review (Research)

Ms. Amanda Melinda McLeroy, North Carolina Agricultural and Technical State University

Amanda McLeroy is a second-year Rehabilitation Counseling Ph.D. student at North Carolina A&T State University. She holds a B.S. in Psychology from George Mason University, and an M.S. in Clinical and Mental Health Counseling from Columbus State University. Although she has been in the mental health field for four years, Amanda has recently integrated her previous knowledge and experiences into the STEM field to work with minority students. She currently works as a graduate assistant and interdisciplinary researcher in the Computer Systems Technology department. Her primary research interests include childhood and racial trauma, parents of children with disabilities, and multicultural issues affecting underserved and underrepresented populations.

Dr. Evelyn Sowell-Boone, North Carolina Agricultural and Technical State University

Dr. Evelyn R. Sowell is an assistant professor in the Computer Systems Technology department at North Carolina A&T State University's College of Science and Technology. Prior to joining the School of Technology faculty, she held position at U.S. Department of Energy, N.C. A&T's Division of Research and College of Engineering. Dr. Sowell earned a Ph.D. in Electrical Engineering from North Carolina A&T State University's College of Engineering. She also holds a M.S. and B.S. in Computer Science with a concentration in software engineering from the same university. Her primary research interests are in the areas of efficient digital systems design and STEM education. As a result of her work, she has numerous peer reviewed journal and conference publications. She recently authored a book entitled "Low Power Self-Timed Size Optimization for an Input Data Distribution," which explores innovative techniques to reduce power consumption for portable electronic devices. She was recently awarded the 2016 Chair's award for Rookie Researcher of the year in the Computer System Technology department. Dr. Sowell is the lead investigator of the Females in Technology (FiT) summer boot camp grant project for academically gifted low income rising senior and junior high girls for recruitment into the technology degree areas. She is also the co-PI of the Aggie STEM Minority Male Maker grant project focused on early exposure to technology to stimulate interest in technology of middle school minority males. Evelyn is not only outstanding in teaching and research, but also in service. She recently received the 2013 Chair's Award for Outstanding Service in the Department of Computer System Technology and is a member of Upsilon Phi Epsilon, Computer Science Honor Society, American Society of Engineering Education's Electronic Technology and Women in Engineering Divisions, and American Association of University Women.

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Amanda McLeroy, M.S. and Dr. Evelyn Sowell-Boone

Abstract

Although there is a high priority placed on science, technology, engineering, and math (STEM) education across the country, a shortage exists among girls and women who pursue STEM degrees and careers. The underrepresentation of women in STEM education results in innumerable missed achievements and opportunities, ultimately affecting their future career paths in those fields. The implications are even broader for young African American women and for those who are economically disadvantaged. To this effect, parental influence has been established as a critical factor in building young women's involvement and confidence in STEM, catalyzing the value of mentoring and a supportive environment for diverse women. More specifically, parents' socialization practices employed to help improve academic achievement can impact advancement within the field. Research on this topic is expanding; however, there is a paucity of literature concerning Black women's perception of these messages at different age levels. To address these gaps and understand the current state of the literature, we conducted a literature review of articles published between 2000 to 2020 on the impact of parental academic socialization messages on Black women's advancement in STEM.

Introduction

The shortage of Black women persisting in Science, Technology, Engineering, and Math (STEM) fields in the United States is shocking. Over the past decade, there has been a dramatic decline in the number of Black women obtaining STEM degrees¹, despite higher interests of Black women to major in STEM disciplines in comparison to their white counterparts^{1,2,3,4}. Scriven⁵ noted that due to a lack of support and self-isolation, Black women are 800% less likely than White women to obtain a STEM degree. Additionally, Black women experience many social and environmental barriers, including gender bias, stereotypes, and classroom climates that continuously hinder their progress and academic satisfaction in STEM^{6,7,8}. By having intersecting identities in two marginalized social groups, both Black and female, these women are confronted with patriarchal treatment and expectations aimed directly at their race and gender^{10,11}. Scholars, however, have argued for a greater understanding of the lived experiences of Black women in STEM as it concerns the intersection of these identities^{10,11}. While Black women in STEM may have differing degrees of racial and gender salience, an analysis incorporating aspects of their social identity development within education is imperative to offer a more detailed view of their academic self-concept^{11,12,13}. Namely, through parental academic socialization (i.e., parental encouragement and motivation). And as a result, parents and educators may better understand how to increase STEM representation among this population. Towards that, critical evaluation of the research literature is also essential to maximize the retention and recruitment of Black women in STEM, specifically by reviewing credible sources and identifying knowledge gaps to distinguish fact from lore.

Purpose

This paper aims to review empirical literature concerning the academic advancement of Black women in STEM and the influence of parental academic socialization messages. Guided by a learning and growth perspective, this review examines how these messages received impact the

academic progression of Black women in STEM who have experienced a myriad of social and environmental barriers, including gender bias, stereotypes, and classroom climates. Throughout the paper, the key question that will be explored is as follows:

- How have parental academic socialization messages historically impacted the advancement of Black women in STEM?

Definitions

STEM

Although STEM comprises various sub-workforces and is multifaceted, for this review, it refers to knowledge acquired and shared in the physical sciences (physics, chemistry), technology (computer science), engineering, and mathematics disciplines¹⁴. STEM mainly entails instructional activities throughout every grade level - ranging from preschool to post-doctoral - in informal (i.e., summer programs) and formal (i.e., classrooms) environments. All grade levels will be considered within this paper.

Black Women

Black women in this literature review are identified based on their race, including individuals who self-identify as Black and have origins in any Black racial groups in Africa¹⁵. For this study, Black and African American will be used interchangeably.

Parental Academic Socialization

Parental academic socialization messages are used to communicate academic expectations, attitudes, beliefs to their children related to academic performance¹⁶. Parental academic socialization messages are instrumental in developing a positive identity and self-concept among students. Through this communication, children improve their understanding of all academic skills and identities, learn to interpret academic encounters, and begin to develop academic persistence and motivation^{17,18}. In the current literature review, these messages refer to the dissemination of academic messages, school-related encounters, and parental practices.

Method

This study undertakes a literature review of articles published between 2000 to 2020 to identify research that explored the academic advancement of Black women in STEM and the influences of parental academic socialization messages. Inclusion criteria consist of scholarly, peer-reviewed meta-analyses, systematic reviews, and empirical studies investigating Black undergraduate women in STEM or parental ethnic-racial socialization messages. Each of the studies was also published in a scholarly academic journal in English. Exclusion criteria consist of studies that did not directly investigate Black undergraduate women in STEM or parental ethnic-racial socialization messages. Additionally, other publications such as monographs, unpublished manuscripts, and editorials were also ineligible.

Throughout this literature review, variations of key terms were examined within titles and abstracts to evaluate as many relevant studies as possible. In each database, we included terms such as *STEM*, *advancement*, *academia*, *retention*, *recruitment*, *parental involvement*, *parental influence*, *parental messages*, *support*, and *academic socialization*. Several search qualifiers were also added to obtain publications specifically related to the experiences of Black undergraduate women in STEM. Those terms included *Black*, *African American*, *women*,

females, and *students*. References in the selected articles were also reviewed to find additional research studies for consideration.

Our literature search originated from five electronic databases, Academic Search Complete, Education Database, ProQuest, PsycINFO, and SAGE Journals Online, to broaden the search results. Given the nature of our research, we found these databases to be appropriate, as they contain publications that identify dominant patterns and themes in STEM, higher education, social sciences, and gender-based research.

Findings

Based on our selection criteria, thirty-two articles were identified for this review. Four major themes were present throughout the literature related to academic socialization: interests in STEM, self-efficacy, STEM identity formation, and academic performance. The selected articles are summarized below as well as in the appendix on table 1 and figure 1 to 3.

Academic Socialization and Interests in STEM

Research continues to emphasize the importance of parental involvement in increasing females' self-confidence, engagement, and interests within STEM-related fields^{19,20}. Majority of the articles identified in this literature review focused on the role parents play in fostering the STEM interests of students during their high school and college experience^{20,21,22,23,24,25,26,27,28,29,30,31,32,33}. Parental involvement in STEM careers was among the most frequently discussed as important factors to influence interests in STEM; however, encouragement and familial support were also thoroughly discussed. For Black women specifically, research posits that they are provided tremendous educational support and offered a plethora of opportunities and resources by their parents^{21,29,34}. To this effect, strong positive relationships have been established between parental support and women's interests in STEM-related fields^{26,32}. Adeyemi²¹ conducted a qualitative case study to explore female college students' decision to pursue mathematics-related careers, and the influence socializers (i.e., parents) had on these decisions. Findings from six individual interviews with women in their junior year of college demonstrated a strong influence of parental encouragement for STEM interests on women's decision-making process.

Although support from both parents was found to be significant in a bulk of the selected literature, the influence of individual parenting styles on women's STEM interests were also explored. According to Ellington and Frederick²³, the loving and supportive environment created by mothers are vital factors in fostering the initial interests of Black students pursuing STEM-related careers. In his qualitative study on young African American women (13 to 30 years old), Hanson²⁹ investigated the influences of women's high school science experiences. In opposition to the Ellington and Frederick²³ study, findings revealed that fathers were the most substantial influence on the women's initial interests in STEM, as they emphasized education and independence throughout their daughters' lives. The qualitative data offered distinct perspectives on the complexities of socialization processes in African American households. Despite the bulk of participants perceiving family as a significant influence on their experiences in science, many did not acknowledge this influence. Researchers have shown that familial support may not spark interests in science among African American students.³¹ As such, the scope of these results reinforces claims for the use of qualitative and quantitative data to better understand the educational processes of African American women pursuing careers in science²⁹.

In addition to the impacts parental support and encouragement had on women's STEM interests, parent education and experience in STEM-related career fields were also frequently addressed in the literature. According to Espinosa²⁵, students currently active in STEM were motivated by their parents to participate in STEM-related extracurricular events outside of the school. Parents who motivated their children were also involved and successful in STEM careers themselves. This seemed to be a key element in encouraging students to clarify their ambitions and plans, with parents aiding their children to pursue meaningful career opportunities. Moakler's³⁰ findings supported Espinosa's²⁵ argument, as students with parents who have STEM jobs were nearly two times more likely to pursue a STEM major and enter a STEM profession. Similarly, Kricorian³⁰ conducted a quantitative study to discuss STEM experiences and family pressures among undergraduate and graduate students as well as STEM professionals. Analyzes revealed that nearly one-third of the participants identified having a parent in a STEM profession and most (68 percent) had parents who inspired them to pursue a STEM career. Overall, it appears that students need at least one or two strong positive parents to inspire them to pursue careers in STEM.

Academic Socialization and Self-Efficacy

Self-efficacy was among one of the most common factors highlighted within the literature when discussing the advancement of Black women in STEM^{21,25,26,36,37,38,39,40,41}. As Black women face more academic, career, and social barriers, confidence in their ability to effectively perform STEM-related tasks begins to diminish. However, Turner et al.⁴¹ posit that parental support can moderate these barriers, specifically by decreasing their impacts on Black women. Findings from their study revealed that participants' fathers, compared to their mothers, significantly predicted self-efficacy. Additionally, their results mirrored findings from several other studies related to parent support and self-efficacy among women^{19,41,42}. However, it is imperative to note that the impact of culture on gender disparities may affect parents' support of their daughters' career preferences^{28,39}.

There is a growing body of literature that found parental motivation as vital in the development of literacy in STEM-related subjects among academically gifted Black students, where they reported benefiting significantly from parents who encouraged academic excellence in their households^{23,35,40,44,45,46}. The interplay between self-efficacy and academic motivation is essential in determining advancement in STEM. For instance, Jackson and Remillard's⁴⁴ qualitative study found that African American mothers took their advocacy role seriously when concerning their child's education, especially in mathematics. These mothers demonstrated a proactive and strategic mindset related to their children's futures and the types of opportunities they foresaw for them. The aspirations mothers had for their children's success led them to further encourage their children academically. And as a result of their mothers' encouragement, the children's confidence in their math abilities increased.

Comparative to the qualitative findings by Jackson and Remillard⁴⁴, Olivares & Cegelis³⁷ posit that children received more emotional and academic support in mathematics from parents with high self-efficacy beliefs. Students who received this support in the home also understood the importance of developing math resilience, resulting in positive self-efficacy and ownership in one's education. These results confirm Mohr-Schroeder and his colleagues'³⁶ findings, where the association between parents and students' attitudes toward mathematics was positively linked. In fact, those who had higher self-efficacy beliefs had increased achievement in mathematics and

work ethic. For the students who were unable to obtain sufficient parental support, they refused to seek outside assistance, which led to doubt in their ability to succeed.

Academic Socialization and STEM Identity Formation

Black women's confidence in their abilities enables them to develop academic competency and build their STEM identities^{7,8}. According to Young et al.⁴⁷, it is the responsibility of parents to serve as the strongest and perhaps most effective support system for Black girls pursuing STEM-related careers. More specifically, Black parents are ideally placed to support Black girls in establishing their STEM identity and perception of what being Black entails. Although there is limited research on the exploration of Black women's STEM identities and their interpretation of that identity, this section offers a succinct overview of the literature examined for this review.

Gibson and Espino⁴⁸ drew attention to Black women's perception in STEM-related fields as it concerns their intersecting racial and gender identities, especially within a culture that is historically oppressive to women and people of color. Results of eight, individual interviews with Black undergraduate women illustrated that mothers positively impacted identity development despite the negative experiences participants had on campus. Similarly, a mixed-method study conducted by English-Clarke²⁴ revealed that adolescents were subjected to parental lectures regarding the intersections between mathematical and racial identities, including lack of representation, stereotypes, and the racial discrimination African Americans experience in mathematics. Despite the lack of discussion surrounding gender gaps in the English-Clarke²⁴ study, her results demonstrate that socialization processes may be nuanced in African American families. The prevailing message from African American parents tends to be that adolescents experience difficulties with mathematics⁴⁶, and these difficulties are internalized^{24,37}, which in turn generalize to other subjects, including technology.

In another study, Tao, Scott, and McCarthy²⁰ sought to determine if there was a gendered variance in African American adolescents' technological competence and what contextual aspects influenced their engagement. Quantitative findings support parental motivation as a significant influence on adolescents' technological experiences. Both parents may devalue technological participation for their daughters due to the internalization of social pressures. Similarly, mothers historically encounter more difficulties with technology because of gender role stereotypes (i.e., women participating in more social occupations rather than technology), and thus, they more often restrict their daughters' aspirations of technological engagement. To this effect, discrepancies between the encouragement received in the household by African American females greatly influence their ability to build self-efficacy, involvement, and interests in technology. Overall, the messages parents provide their daughters about their technological endeavors are critical to foster a positive identity in technology.

Academic Socialization and Academic Performance

Parents frequently emphasize the significance of STEM education, citing its value in promoting economic and educational growth^{27,35}. In particular, a qualitative study conducted by Walker⁴⁹ indicated that students report their parents as integral parts of their academic success. They consistently spoke of their parents' expectations for them to earn good grades, specifically related to the importance of their parent approval and how disappointing them was unacceptable. Despite the high standards and repercussions for poor achievement, children often identified distinct periods where their parents helped them improve performance in mathematics.

Comparingly, the relationship between parental expectations and achievement in mathematics is similar to the study quantitative study conducted by Alliman-Brissett and Turner⁶, which revealed a positive association between math outcome expectations and parental support.

Parents' encouragement and support in early childhood have a profound effect on students' academic progress throughout their college and professional careers³³. According to McGee and Spencer³⁵, parental engagement in mathematics learning and participation is more nuanced than standard parental support notions. The researchers address how Black parents are conscious of educational inequities and how they are actively invested in their children's academic success. This was achieved through the parents becoming motivators, teachers, and advocates of mathematics. Thus, when parents explicitly express their expectations and participate in their daughters' school activities consistently, academic performance increases among Black girls⁴⁶.

Discussion

The nuances of being a Black woman in STEM are encapsulated within the complex history of society and academic institutions. Although Black women earn the largest amount of college degrees in the United States, they only hold 10 percent of degrees and 2 percent of jobs within STEM disciplines⁵⁰. Merely increasing the number of Black women in STEM disciplines will unlikely address the multifaceted challenges they experience within the field. However, providing them with encouragement, support, and guidance from an early age will help build resilience towards these challenges. According to Hanson²⁹, progress in STEM is increased by parents' messages to their children inside the household. With this information, we decided to conduct a comprehensive analysis of publications that analyzed the impact of these messages on Black women's advancement in STEM. We focused on articles published between 2000 to 2020 from five electronic databases, Academic Search Complete, Education Database, ProQuest, PsycINFO, and SAGE Journals Online.

The articles identified in this literature review showcase a wide range of outcomes from parental socialization messages. These studies provide evidence that academic socialization during Black women's early developmental years can contribute to their self-efficacy, identity formation, academic performance, and interest within the STEM field. Surprisingly, it seems that the parental messages disseminated towards Black women about their academic expectations in STEM disciplines were not distinct across age groups. However, the purpose of these messages was not always positively received by women in college²³. Additional work is necessary to better understand the various elements of Black women's perception across all age groups, specifically as it concerns their individualized and collective socialization processes in STEM. Fortunately, research in this area is steadily increasing, which is consistent with educational research on Black women. Similar to other aspects of their lives, Black women's socialization in STEM is also racialized and gendered^{6,8}. As such, it is also imperative to engage in further research regarding the complex ways they engage in their cultures, in and outside of the household, to serve their educational needs efficiently.

Limitations

Our study has several limitations to be addressed. First, the search terms and data sources we chose may have restricted the scope of our topic. Although we used several search terms associated with our topic, such as parental influence, parental messages, and academic socialization, we may likely have overlooked relevant articles. Additionally, the term 'parental

academic socialization' is a newer term that is in the process of being widely adopted, and searches on the term might have been omitted in a few articles. Our use of parental academic socialization in this literature review was broad (i.e., including parental encouragement and motivation), which is distinct from many other studies that operationalized this term^{16,17,18}. Finally, because this paper focuses on scholarly papers and empirical studies, details regarding the impact of parental academic socialization messages on Black women in STEM that may be published within other sources, such as monographs, books, or editorials, are not included. Despite these limitations, we posit that findings published within this literature review can catalyze the retention and recruitment of Black women in STEM by understanding these socialization messages and supporting future research in this area.

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Appendix

Figure 1. Percentage of Selected Papers by Method

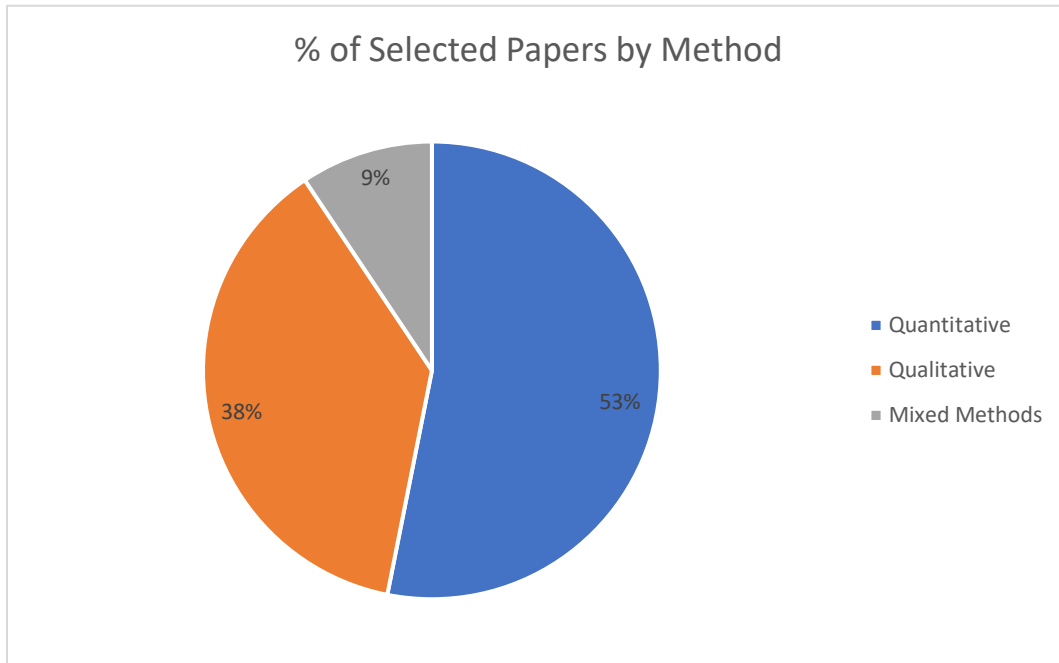


Figure 2. Percentage of Selected Papers by Year

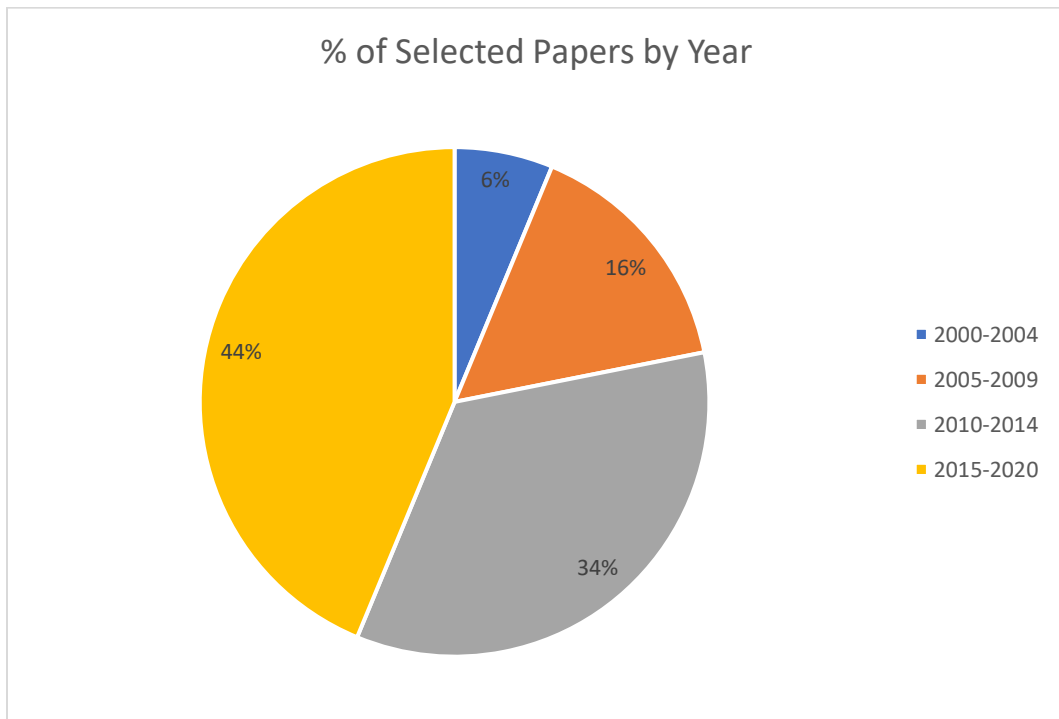


Figure 3. Percentage of Selected Papers by Theme

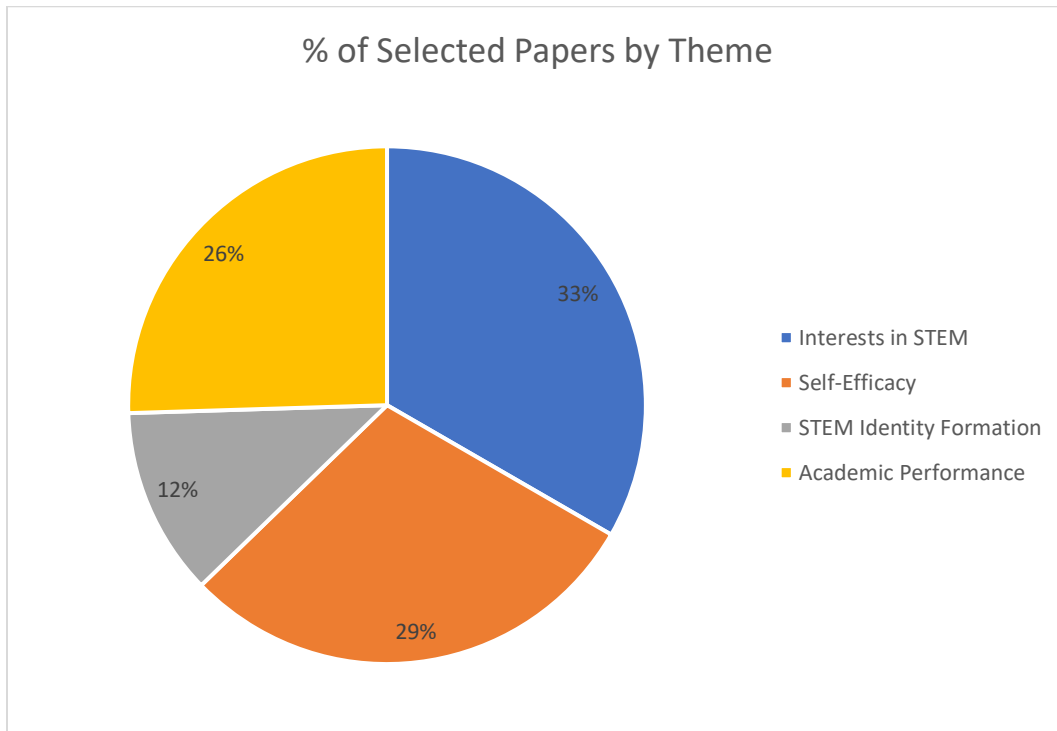


Table 1. Characteristics of selected articles

Author(s)	Year	Title	Method	Population	Theme
Adeyemi ²¹	2013	The social factors influencing undergraduate females to study mathematics and physics	Qualitative	Juniors in the mathematics and physics department	Interests in STEM; Self-Efficacy
Alliman-Brissett & Turner ⁶	2010	Racism, parent support, and math-based career interests, efficacy, and outcome expectations among African American adolescents	Quantitative	Middle school students	Interests in STEM; STEM Identity Formation; Academic Performance
Dou et al. ²²	2019	Early informal STEM experiences and STEM identity: The importance of talking science.	Quantitative	College students	Interests in STEM
Ellington & Frederick ²³	2010	Black high achieving undergraduate mathematics majors discuss success and persistence in mathematics	Qualitative	Junior and senior mathematics majors	Interests in STEM; Self-Efficacy
English-Clarke ²⁴	2011	Things my family told me about math: African American youths' perception and use of racial and mathematical socialization messages	Mixed Methods	Highschool students (9 th and 10 th grade)	Interests in STEM
Espinosa ²⁵	2011	Pipelines and pathways: Women of color in undergraduate STEM majors and the college experiences that contribute to persistence	Quantitative	College students	Interests in STEM; Self-Efficacy
Ferry et al. ²⁶	2000	The role of family context in a social cognitive model for career-related choice behavior: A math and science perspective	Quantitative	College students	Interests in STEM; Self-Efficacy
Fouad et al. ²⁷	2010	Barriers and supports for continuing in mathematics and science: gender and educational level differences	Mixed Methods	Middle, High, and Post-secondary students	Interests in STEM; Academic Performance

Friend et al. ⁷	2011	Parental Racial Socialization and the Academic Achievement of African American Children: A Cultural-Ecological Approach.	Quantitative	Elementary school students (5 th grade) and their mothers	STEM Identity Formation; Academic Performance
Garriott et al. ¹⁹	2014	Parental support and underrepresented students' math/science interests: The mediating role of learning experiences	Quantitative	High school students	Interests in STEM
Gibson & Espino ⁴⁸	2016	Uncovering Black Womanhood in Engineering	Qualitative	College students	STEM Identity Formation
Hanson ²⁹	2007	Success in Science Among Young African American Women: The Role of Minority Families	Quantitative	13 – 30-year-old women	Interests in STEM
Jackson & Remillard ⁴⁴	2005	Rethinking parent involvement: African American mothers construct their roles in the mathematics education of their children	Qualitative	Low SES mothers	Self-Efficacy; Academic Performance
Kricorian et al. ³⁰	2020	Factors influencing participation of underrepresented students in STEM fields: matched mentors and mindsets	Quantitative	Undergraduate students, graduate students, and recent graduates	Interests in STEM
Martin ⁸	2006	Mathematics Learning and Participation as Racialized Forms of Experience: African American Parents Speak on the Struggle for Mathematics Literacy	Qualitative	Parents	STEM Identity Formation
McGee ⁴⁵	2015	Robust and Fragile Mathematical Identities: A Framework for Exploring Racialized Experiences and High Achievement Among Black College Students	Qualitative	College students	Self-Efficacy; Academic Performance
McGee & Spencer ³⁵	2015	Black parents as advocates, motivators, and teachers of mathematics	Qualitative	College students	Interests in STEM; Self-Efficacy; Academic Performance
Moakler & Kim ³¹	2014	College major choice in stem: Revisiting confidence and demographic factors	Quantitative	College students (Freshmen)	Interests in STEM

Mohr-Schroeder ³⁶	2017	Parents' Attitudes Toward Mathematics and the Influence on Their Students' Attitudes toward Mathematics: A Quantitative Study	Quantitative		Academic Performance; Self-Efficacy
Olivares & Ceglie ³⁷	2020	The Intergenerational Transmission of Mathematics Attitudes	Mixed Methods	Highschool students and parents	Self-Efficacy; Academic Performance
Quimby et al. ³²	2007	Social cognitive predictors of African American adolescents' career interests	Quantitative	Highschool students	Interests in STEM
Rice ³³	2016	The STEM Pipeline: Recruiting and Retaining African American Female Engineers	Qualitative	College students	Interests in STEM; Academic Performance
Rice & Alfred ⁴³	2014	Personal and Structural Elements of Support for African American Female Engineers	Qualitative	STEM professionals (engineers)	Self-Efficacy
Robinson et al. ³⁸	2016	African-American middle school girls: Influences on attitudes toward computer science	Qualitative	Middle school students	Self-Efficacy
Rodriguez-Planas & Nollenberger ³⁹	2018	Let the girls learn! It is not only about math ... it's about gender social norms	Quantitative	Second-generation immigrants	Self-Efficacy
Schreiber ⁴⁰	2002	Institutional and student factors and their influence on advanced mathematics achievement	Quantitative	Students	Academic performance; Self-Efficacy
Stipanovic & Woo ³⁴	2017	Understanding African American students' experiences in STEM education: An ecological systems approach	Qualitative	Highschool students	Interests in STEM
Strayhorn ⁴⁶	2010	The role of schools, families, and psychological variables on math achievement of Black high school students	Quantitative	Highschool students	Self-Efficacy; Academic Performance
Tao et al. ²⁰	2020	Do African American Male and Female Adolescents Differ in Technological Engagement?: The Effects of Parental Encouragement and Adolescent Technological Confidence	Quantitative	Adolescents and their parents	Interests in STEM; STEM Identity Formation
Turner et al. ⁴¹	2019	SES, Gender, and STEM Career Interests, Goals, and Actions: A Test of SCCT	Quantitative	Highschool students (10 th through 12 th grade)	Self-Efficacy

Walker ⁴⁹	2006	Urban high school students' academic communities and their effects on mathematics success	Qualitative	Highschool students	STEM Identity Formation; Academic Performance
Walker & Dixon ²⁸	2002	Spirituality and academic performance among African American college students	Quantitative	College students	Academic Performance
Young et al. ⁴⁷	2017	Black girls' achievement in middle grades mathematics: How can socializing agents help?	Quantitative	Middle school students	STEM Identity Formation; Academic Performance