

2020

## Eliminating Achievement and Opportunity Gaps: Supporting Black Girls as Mathematicians

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Eliminating Achievement and Opportunity Gaps: Supporting Black Girls as Mathematicians

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Master of Arts in Education – Differentiated Instruction

ED 590: Research & Complete Capstone, Cohort 868

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June 18, 2020

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### Abstract

The research examined achievement and opportunity gaps for Black girls in the discipline of mathematics. Initiatives for mathematics programs were emphasized in secondary schools to encourage students to pursue degrees and careers in mathematics for economic advancement but failed to include certain minority groups. Researchers found underrepresentation of Black girls and women in mathematics programs, at the secondary and post-secondary level, and mathematics-related careers. Upon further investigation, researchers concluded there were achievement and opportunity gaps for Black girls in mathematics. This study was unique from other achievement studies that focused solely on gender or race because of Black girls' double jeopardy. The purpose of the literature review was to determine how educators could close the gaps for Black girls in mathematics. While the literature review was inconclusive due to the limited research of Black girls in mathematics, there was evidence of how educators could support Black girls in mathematics by demolishing negative stereotypes of Black girls, increase positive socialization in class, and develop positive racial and math identities.

*Keywords:* achievement gap, opportunity gap, Black girls, mathematics

## Eliminating Achievement and Opportunity Gaps: Supporting Black Girls as Mathematicians

### **Chapter One: Introduction**

Science, technology, engineering, and mathematics (STEM) programs have widely expanded within public schools across the country. These programs were made to improve student academic achievement and inspire students to pursue careers within those areas. While initiatives evolved in high schools to better prepare students to pursue STEM careers and to be future STEM leaders, institutions needed to consider underrepresented groups of students. Educators needed to consider achievement and opportunity gaps of minority groups within the discipline of mathematics. The magnitude of achievement and opportunity gaps for minority groups based on race or gender was identified in numerous studies (Chambers, Walpole, & Outlaw, 2016; Joseph, Hailu, & Matthews, 2019; Pringle, Brkich, Adams, West-Olatunii, & Archer-Banks, 2012; Young, Young, & Capraro, 2017a; Young, Young, & Ford, 2017). Additionally, some studies specifically focused on achievement and opportunity gaps for Black girls in mathematics where researchers discussed the perceptions of Black females as mathematics learners, and the hindrances to their success throughout their educational careers.

#### **Scope of Research**

The literature review examined how factors, such as negative stereotypes, socialization, and identity development, impacted achievement, and opportunity gaps within mathematics for Black girls. The review explored ways to support Black girls throughout their academic careers in the area of mathematics, beginning in secondary education with opportunities for advancement in post-secondary institutions. The studies selected mainly focused on the experiences of Black girls throughout secondary mathematics programs. Additional studies focused on Black women's post-secondary mathematics experiences providing an insight into the

connection between early access to mathematics programs and the pursuit of mathematical careers. Overall, the purpose of the literature review was to understand the achievement and opportunity gaps alongside negative stereotypes, socialization, and identity development to provide ways for educators to eliminate gaps and support Black girls in the domain of mathematics.

### **Importance of the Study**

Researchers identified a limited number of Black women earning mathematics degrees (Alexander & Hermann, 2015; Borum & Walker, 2012; Pringle et al., 2012; Young, Young, & Capraro, 2017a; Young, Young, & Ford, 2017). People with mathematics degrees and in mathematics-related careers earned substantial salaries. Therefore, if more Black women had careers in mathematics-related careers, with substantial salaries, economic disparities by race and gender could decrease (Stearns et al., 2016). United States Joint Committee on STEM Education declared in 2012 that there was a shortage of STEM workers; Alexander and Hermann (2015) believed the underrepresentation of Black women earning STEM degrees and continuing with STEM professions contributed to the problem. Based on data from 2009, the National Science Foundation identified an underrepresentation of Black women in mathematics undergraduate and graduate programs (as cited in Pringle et al., 2012). In 2004, Freeman noted that while the majority of undergraduate students are women, a small fraction of Black women major in STEM degrees (as cited in Borum & Walker, 2012).

Borum and Walker (2012) sought to understand why Black women do not continue their education in mathematics and further sought to find strategies that would support the continuation of education towards mathematics degrees. In the study, Black women with mathematics degrees discussed how their experience of mathematics in secondary schools

impacted their advancement. Given their results, Alexander and Hermann (2015) attributed racial discrimination to the lower graduation rates for Black women in post-secondary mathematics education. Young, Young, and Ford (2017) concluded that Black girls who were identified as gifted during school were underrepresented in STEM degrees and careers. Therefore, research aimed to investigate if the lack of Black women earning mathematical degrees was due to underachievement or underrepresentation throughout academic careers starting in secondary schools.

### **Research Question**

The research question presented was, in light of what is known about differentiated instruction, how can professional educators reduce achievement and opportunity gaps for Black girls in the discipline of mathematics? The program essential question examined differentiated instruction as a tool for educators to effectively teach each student. For educators to differentiate instruction and effectively teach each student, educators must understand the impact of achievement and opportunity gaps and how to support Black girls in mathematics.

### **Definition of Terms**

The terms provided and defined were to clarify the meaning of each phrase for the specific purpose of the following research. The terms selected were repeatedly used and necessary to understand the perspective of the literature review. The terms defined are the achievement gap, double jeopardy, and underrepresentation.

**Achievement gap.** The achievement gap defined for the review of literature referred to the difference between White and Black students' standardized test scores and graduation rates (Wiggan, 2014). White students' scores and graduation rates were higher compared to the scores and graduation rates of Black peers. White girls outperformed Black girls in standardized

mathematics assessments (Young, Young, & Ford, 2017). Performance in eighth-grade algebra could predict future mathematics achievement and continuation of STEM degrees in college (Young, Young, & Capraro, 2017a). Young, Young, and Capraro (2017a) used data from the National Assessment of Educational Progress (NAEP) to determine 16% of Black girls were proficient in eighth-grade mathematics. Additionally, 48% of Black girls performed below the basic level. NAEP used categorized achievement based on a scale of basic, proficient, and advanced. Therefore, the majority of Black girls performed below basic standards for mathematics by eighth grade. Black girls were underperforming compared to White peers, which could be due to a lack of opportunities.

**Double jeopardy.** For the literature review, double jeopardy was defined as racism and sexism that Black girls faced throughout their academic careers and mathematics programs. Double jeopardy, also described as dually marginalized, affected Black girls because they faced sexism and racism (Evans-Winters, 2014; Young, Eco-Tolliver, Young, & Ford, 2017; Young, Young, & Ford 2019). Black girls have dealt with unique obstacles because of both their gender and racial identities, which caused them to face additional peer pressure (Evans-Winters, 2014; Young et al., 2019). With the intersectionality of being Black and being female, Black girls were underrepresented in mathematics programs as a result of double jeopardy.

**Underrepresentation.** Underrepresentation was defined as disproportionately low involvement of Black girls in opportunities that could advance their achievement within mathematics, and increased the opportunity gap between White and Black students. Young, Young, and Ford (2017) identified that Black girls were underrepresented in gifted programs. Doctorate participants from Borum's and Walker's (2012) study suggested advanced courses and enrichment opportunities were positive factors in continuing education in mathematics. In 2014,

Ford determined that nationally Black girls were underrepresented in gifted education by nearly 40% (as cited in Young, Young, & Ford, 2017). Underrepresentation led to a widening opportunity gap because Black girls were not provided opportunities such as after-school programs, access to tutors, and qualified educators as compared to White peers.

### **Summary**

Institutions expanded STEM programs in public schools to inspire students to choose careers within those fields and reduce the shortage of STEM workers. With the expansion of STEM programs, schools needed to consider underrepresented minority groups, especially Black girls. The shortage of STEM workers could be reduced by increasing the number of Black girls represented in mathematics programs, which would allow them to obtain careers within the discipline. For Black girls to be represented, educators must differentiate instruction to eliminate achievement and opportunity gaps. Previous research focused on gaps related to only race or only gender, but Black girls faced both through double jeopardy and there needed to be additional studies to understand difficulties experienced by Black girls in mathematics and ways to combat hindrances.

Chapter two, the literature review, analyzed research of the double jeopardy Black girls experience that caused achievement and opportunity gaps. The literature identified the magnitude of the gaps, and researchers diverged on why the gaps widen and how to close the gaps in the future. Chapter two examined the similarities and differences throughout the literature. A research summary described the main points of the literature review and a reflection on the importance of the topic was provided in chapter three. Discussions and applications, chapter four, identified insights from the research and recommendations for educators and researchers. The research question addressed throughout the chapters was in light of what is known about

differentiated instruction, and asked how could professional educators reduce achievement and opportunity gaps for Black girls in the discipline of mathematics? Chapter two reviewed research that aligned with the research question, to understand the experiences of Black girls in mathematics programs.

### **Chapter Two: Literature Review**

Previous educational research examined achievement and opportunity gaps focusing on the groups of White girls and Black boys in all academic areas; therefore, research was limited specifically for Black girls in mathematics (Chambers et al., 2016; Joseph et al., 2019; Pringle et al., 2012; Young, Young, & Capraro, 2017a; Young, Young, & Ford, 2017). Some researchers argued that Black boys were more vulnerable in education settings as opposed to Black girls (Evans, Copping, Rowley, & Kurtz-Costes, 2011). Young, Young, and Capraro (2017a) determined Black girls academically outperformed Black boys, yet continued to underperform compared to White girls. Some researchers might have focused on Black boys instead of Black girls for the above reasons while identifying gaps. However, instead of looking at Black girls' unique intersectionality, Black girls were under-identified in research and placed in categories of race or gender. Due to double jeopardy, Black girls had unique experiences and challenges that required specific examination from researchers to understand how achievement and opportunity gaps affected them in the domain of mathematics. Multiple researchers agreed Black girls cannot be categorized solely based on gender or race because of double jeopardy due to racism and sexism they faced throughout their educational careers (Evans et al., 2011; McGee & Bentley, 2017; Stearns et al., 2016; Young, Young, & Capraro, 2017a; Young, Young, & Capraro, 2017b; Young, Young, & Ford, 2017). The following literature review focused on research specifically related to Black girls' experiences in mathematics from secondary school and consequently the

participation or lack of participation in post-secondary mathematics. Identified throughout literature were achievement and opportunity gaps, negative perceptions, socialization, and Black girls' identities that affected their mathematics experiences.

### **Gaps in Mathematics**

Researchers agreed that Black girls faced disproportionate achievement and opportunity gaps (Alexander & Hermann, 2015; Borum & Walker, 2012; Chambers et al., 2016; Evans et al., 2011; Graham & Morales-Chicas, 2015; Joseph et al., 2019; McGee & Bentley, 2017; Pringle et al., 2012; Young, Young, & Capraro, 2017b; Young, Young, & Ford, 2017). However, while opportunities and achievement were related, the achievement gap was not solely based on a lack of opportunities. A quantitative study by Young, Young, and Ford (2017) compared gifted programs to traditional classrooms and the achievement of Black and White girls confirmed an achievement gap. White girls, regardless of access to gifted education, outperformed Black girls, both those in gifted programs and traditional programs, on the standardized mathematics assessments. Additionally, Black girls scored lower on mathematics standardized assessment regardless of school being racially segregated or not segregated (Pringle et al., 2012). Therefore, with opportunities across socio-economic levels and gifted programs, Black girls continued to underachieve. Black girls' achievement was examined to understand the implications for their participation in post-secondary mathematics.

**Achievement gap.** Black girls should access post-secondary institutions to obtain careers in mathematics. Researchers found a strong association with high school mathematics performance and post-secondary enrollment (Chambers et al., 2016). Early achievement led to later mathematics success (Young, Young, & Ford, 2017). Conversely, other researchers found the mathematics achievement gap widened throughout secondary education (Pringle et al., 2012;

Young, Young, & Capraro, 2017b). Black girls' mathematics standardized test scores were lower than White counterparts (Chambers et al., 2016; Joseph et al., 2019). Based on high school data including different socio-economic levels, fifty percent of Black girls' standardized mathematics scores were considered low (Chambers et al., 2016). Their scores also decreased between their sophomore year and senior year, even for students who were taking recommended mathematics courses in high school. Alexander and Hermann (2015) determined the achievement gap continued into graduate-level programs with low retention and graduation rates for Black women in mathematics. While researchers agreed there was an achievement gap, some researchers focused on a positive lens of Black girls' achievement in mathematics by examining within-group data.

*An alternative view of the achievement gap.* Young, Young, and Capraro (2017b) used NAEP data to compare within-group mathematics achievement for middle grades. The researchers argued comparing White girls and Black girls in terms of achievement were problematic. White girls and Black girls could not be adequately compared in terms of achievement because they cannot be appropriately matched in comparison groups. Additionally, comparisons of achievement with White and Black students continued racial stereotypes with the idea that White learners were ultimately the mathematics learners. The study compared the within-group data of Black girls' achievement for eighth grade between different years. Between 2005 and 2015, Black girls scored significantly higher overall and across mathematics domains. Black girls improved in the domain of algebra, and algebra success was a predictor for college readiness (Young, Young, & Capraro, 2017b). While proficiency did not increase, the scores showed consistent growth and proved Black girls were capable of mathematics success. Young, Young, and Ford (2017) argued to close the achievement gap Black girls' performance needed to

increase at a higher rate than the achievement of White students. Ultimately, while Black girls underachieve compared to White girls, Black girls showed strengths in mathematics and when provided opportunities their achievement could increase at a higher rate.

**Opportunity gap.** Black girls did not reach their academic abilities when they were not provided with sufficient opportunities (Young, Young, & Capraro, 2017b). White and Asian students attended after-school and summer programs more often than Black girls (Pringle et al., 2012). With secondary experiences influencing college choices, Black girls required additional opportunities in mathematics (Stearns et al., 2016). Other barriers such as housing segregation and inequitable schools led to lack of supplies, technology, experienced educators, and rigorous curriculum that may have reduced the likelihood of Black girls' enrollment in post-secondary institutions (Chambers et al., 2016; Joseph et al., 2019; Pringle et al., 2012; Young, Young, & Capraro, 2017b). Additionally, the lack of college information accessible to Black girls decreased the likelihood of attending college and inequitable schools lacked counselors for providing such information (Chambers et al., 2016). The opportunity gap was evident from secondary to post-secondary institutions including gifted programs and resulted in the overall underrepresentation of Black girls.

**Advanced and gifted programs.** Readiness for careers in mathematics has been related to the completion of advanced mathematics courses (Young, Young, & Ford, 2017). Therefore, Black girls should have had the opportunity to take advanced courses to be prepared for post-secondary and careers in mathematics. White and Asian students were more likely to be in advanced mathematics courses in ninth grade than Black students (Graham & Morales-Chicas, 2015). Programs were often based on referrals, and White girls were more likely to be referred to advanced and gifted programs than Black girls (Joseph et al., 2019; Young, Young, & Ford,

2017). Black girls' participation in gifted programs resulted in greater achievement, twice the effect size, in mathematics than compared to Black girls in traditional classrooms (Young, Young, & Ford, 2017). When given access to advanced and gifted programs, Black girls were better prepared for post-secondary courses in mathematics.

*Underrepresentation.* People in math-related careers had higher incomes and the underrepresentation of Black women in STEM fields prolongs economic and social inequalities (Stearns et al., 2016). Black women were underrepresented in mathematics careers, not because of less achievement or lack of talent but because of a lack of opportunities (McGee & Bentley, 2017; Pringle et al., 2010). Young, Young, and Ford (2017) argued underrepresentation in careers resulted from insufficient preparation, therefore, secondary and post-secondary education were imperative for Black girls. Once again, Black girls were underrepresented in mathematics in secondary and post-secondary education. In general, more women were attending college but fewer Black women were earning mathematics degrees (Alexander & Hermann, 2015; Borum & Walker, 2012). A strong predictor of increased performance and persistence in mathematics was access to eighth-grade algebra (Young, Young, & Capraro, 2017a). Completion of the high level of mathematics courses in high school was a significant factor for attendance at post-secondary institutions and early access to algebra allowed the opportunity to take classes beyond Algebra II (Chambers et al., 2016). Algebra II was a minimum requirement for most colleges, and 78% of Black girls took Algebra II or higher-level mathematics courses yet other groups took higher-leveled mathematics more often. If Black girls were represented in secondary and post-secondary mathematics education, they would have had opportunities to pursue degrees and careers in mathematics.

Underrepresentation and lack of access to advanced and gifted programs contributed to the opportunity gap. Achievement and opportunity gaps were evident across research impacting Black girls in mathematics. Multiple factors widened the gaps such as negative stereotypes, lack of socialization, and weak development of identities.

### **Negative Stereotypes**

With double jeopardy, Black girls faced negative stereotypes due to their race and gender. Graham and Morales-Chicas (2015) determined, based on questionnaires completed by ninth graders, that negative stereotypes affected math anxiety and students' belief on the importance of mathematics. Negative stereotypes such as White and Asian students were better at mathematics normalized achievement and opportunity gaps of Black girls in mathematics (McGee & Bentley, 2017). Negative stereotypes were toxic and affected Black girls in mathematics environments because of perceptions from peers and educators.

**Environments.** To combat achievement and opportunity gaps, Black girls needed to participate in mathematics environments, yet stereotypes caused limited access to such environments. In a qualitative study, Black women in college mathematics programs were interviewed and expressed avoiding spaces they felt unsafe (McGee & Bentley, 2017). Certain mathematics environments felt like unsafe spaces for Black women. Researchers regarded college mathematics programs as unwelcoming environments that were competitive and non-nurturing (Alexander & Hermann, 2015; Borum & Walker, 2012). During interviews, participants stated mathematics was historically for elite White men, and women did not have a positive entrance in programs (Borum & Walker, 2012). With beliefs of mathematics reserved for White men, Black girls and women needed supportive and rigorous mathematics

environments. Peers' stereotypes of Black girls negatively affected the girls' involvement in mathematics environments.

**Peers.** Negative stereotypes about Black girls in mathematics were developed by their peers. In surveys from racially diverse high schools, students believed White students were better than Black students in all academic areas (Evans et al., 2011). Additionally, the magnitude of peers' belief that Black students underperformed in comparison to White students was the largest in mathematics and science compared to literacy. These stereotypes that Black students were not mathematics learners were perpetuated by peers in high schools and continued into post-secondary institutions. Black women in graduate mathematics programs reported negative stereotypes from peers (McGee & Bentley, 2017). White peers expressed their belief that historically Black colleges and Universities (HBCUs) were not as rigorous and those who attended HBCUs were not as smart. Peers envisioned graduate Black women who attended HBCUs as undergraduates as less knowledgeable than those who attended predominantly White institutions. From secondary to post-secondary, Black girls and women experienced negative stereotypes from peers and educators.

**Educators.** Educators' stereotypical views and perceptions of Black girls were based on mathematics achievement and behavior. Educators lacked self-awareness and did not see themselves as facilitating Black girls' advancement in mathematics (Pringle et al., 2012). Yet, educators impacted Black girls' advancement; negative stereotypes from educators eventually hindered the girls' advancement. In qualitative studies, secondary educators had low confidence in Black girls doing well in mathematics post-secondary (Joseph et al., 2019; Pringle et al., 2012). Many educators believed STEM degrees were more likely for boys (Pringle et al., 2012). They thought Black girls did not have skills for mathematics, and Black girls were interested in

writing and reading over mathematics. Similar stereotypes carried into post-secondary institutions. Black women were advised to major in other areas, outside of mathematics, because professors believed mathematics majors were not suitable for the Black women (Borum & Walker, 2012). Black women felt the faculty continued the culture of racial segregation in the mathematics programs (McGee & Bentley, 2017). When Black women sought counsel, the faculty suggested that the Black women dismiss their experiences of racism and sexism because faculty thought the experiences were insignificant. Educators and faculty supported negative stereotypes throughout institutions, and educators held strong beliefs on behavior management.

Educators had negative stereotypes related to Black girls' behavior in mathematics classes. Many educators complained of Black girls being disruptive in secondary classrooms (Joseph et al., 2019; Pringle et al., 2012). Talking was considered disruptive and problematic, while researchers noted Black girls' behavior was not unlike non-Black peers (Pringle et al., 2012). Some educators believed that the mathematics classroom was not suitable for dialogue while research determined that dialogue and socialization were important for Black girls to be successful in mathematics courses (Alexander & Hermann, 2015; Borum & Walker, 2012; Graham & Morales-Chicas, 2015; Joseph et al., 2019; Pringle et al., 2012).

### **Socialization**

Black girls' interactions with peers, educators, and mentors affected their academic achievement as they faced negative and positive experiences. Socialization in school has been important for all learners especially Black girls who needed positive interactions in schools. Without positive social interactions, Black girls felt excluded and it led to isolation (Borum & Walker, 2012; McGee & Bentley, 2017). Isolation included working alone and leaving mathematics programs in college. McGee and Bentley (2017) found that Black girls

academically performed higher when working with a group. Interactions with peers, educators, and mentors made a difference between isolation and group success.

**Peers.** Joseph et al. (2019) determined Black girls were collective learners, meaning they liked learning with others and working with peers. Additionally, through collaborative work, Black girls felt they could show their peers their mathematics knowledge and understanding. Black girls liked class discussions and learning with others (Alexander & Hermann, 2015). While negative experiences were detrimental to their collective learning model, evidence showed Black girls' desire to work with their peers.

Black girls experienced racism from their peers which was exacerbated when there was only one Black girl in their higher-leveled mathematics or honors mathematics courses (Borum & Walker, 2012). Peers expressed negative racial stereotypes to Black girls during class and peers' sense of superiority led to Black girls isolating and questioning their abilities (Alexander & Hermann, 2015). Black girls would contribute to class discussions and sometimes felt ignored by their peers and educators. In predominantly White schools, Black girls were left out of study groups. While Black girls faced negative experiences with peers the positive experiences supported their academic achievement.

Black girls felt they belonged in mathematics classes with a representation of peers of the same race, for academic and social support (Graham & Morales-Chicas, 2015). Though, a strong multicultural climate lessened the negative effects of a few classmates of the same race in the class. To increase positive socialization, Borum and Walker (2012) identified positive experiences for Black girls in smaller class sizes that allowed peers to get to know one another and felt like a family dynamic. A pre-freshman summer program at a college allowed peers to get to know each other (Borum & Walker, 2012). Black girls enjoyed the program especially for

the socialization aspect with their new peers at their new school. Peers were available for positive academic and social support, and educators also had similar effects.

**Educators.** When Black girls experienced positive interactions with their educators, they felt their needs were addressed. Yet, negative interactions affected Black girls' involvement in mathematics class (Joseph et al., 2019). Similarly to interactions with peers, Black girls felt ignored by educators during class discussions and lack of support resulted in Black girls feeling less intelligent (Alexander & Hermann, 2015). This trend continued in graduate programs, Black women reported minimal interactions between students and faculty (Borum & Walker, 2012). In ninth grade classrooms, educators that yelled and were punitive for wrong answers would cause Black girls to shut down (Joseph et al., 2019). Positive interactions with educators led to increased engagement.

Small class sizes provided students the opportunity to connect with their peers and also with their educators. Black girls with one-on-one interactions with their educators felt they were given attention and their needs were met (Joseph et al., 2019). Educators that were humorous and approachable made the mathematics classroom feel safe. A safe classroom allowed for more positive math discussions and Black girls participated in more mathematics activities during discussions (Joseph et al., 2019; Pringle et al., 2012). In a quantitative study, positive feedback and reassurance from educators encouraged high achievement for Black girls (Stearns et al., 2016). Black girls, given tools and support from educators, were successful in mathematics classes. Mentors were able to provide additional support and socialization.

**Mentors.** Black girls enjoyed mentorship for their advancement in mathematics (Alexander & Hermann, 2015; McGee & Bentley, 2017). Borum and Walker (2017) reported that Black women remembered their mentors and needed an informal and nonthreatening

relationship with their mentors. Secondary educators thought it would be good for Black girls to be exposed to successful minorities in mathematics (Pringle et al., 2010). Evans-Winters (2014) recognized the importance of female mentors. Resilient Black girls had at least one adult that fostered positive relationships in the community and supported academic success. Though, if a student could not be mentored by a minority figure, then researchers suggested mentors be gender and race-conscious (McGee & Bentley, 2017). Ford and Whiting (2010) found Black girls benefited from multicultural counseling, especially with mentors who had similar experiences. Those mentors could help Black girls develop positive racial identities (Anderson & Martin, 2018; Ford & Whiting, 2010; Mayes & Hines, 2014).

Peers, educators, and mentors made an impact on Black girls and women in mathematics. Negative racial stereotypes and racism led to isolation and feelings of inadequacy. Small class sizes and getting to know each other resulted in positive experiences and increased engagement. Black girls needed positive relationships with adults, educators, and mentors to form their racial and math identities.

### **Identities**

Black girls developed their identity by their thoughts of themselves and also from what parents, educators, and peers positioned them as (Joseph et al., 2019; Stearns et al., 2016; Young, Young, & Capraro, 2017a). Black girls' identity development affected their academic achievement. They needed positive racial and mathematics identities to achieve in mathematics at higher levels. Conclusively, peers and educators affected Black girls' identities.

**Racial identity.** A positive identity improved school performance for Black girls, and a positive racial identity was imperative for overall health and academic achievement (Mayes & Hines, 2014; Scott, 2014). Throughout secondary school, students began to understand their

identity and continued to develop throughout college. For Black girls to be successful in mathematics, which was a profession that was historically dominated by White males, a strong racial identity was required (Borum & Walker, 2012).

It was difficult for Black girls to be in academic environments with predominantly White people because they felt they did not fit in (Ford & Whiting, 2010). There was isolation because of being the only Black person in a gifted program (Anderson & Martin, 2018; Mayes & Hines, 2014). In predominately White classes, Black girls were made to feel inferior compared to their peers (Anderson & Martin, 2018). Black girls reported feeling there was a divide, an "us" versus "them" with White students (Alexander & Hermann, 2015). Black girls faced racial discrimination and responded in different ways. Some Black girls felt they needed to unite with their Black peers and support them (McGee & Bentley, 2017). Other Black girls felt they needed to focus their efforts on academics and prove people wrong about negative stereotypes towards Black girls. Overall, researchers reported Black girls had to prove their intelligence and override negative stereotypes (Alexander & Hermann, 2015; Borum & Walker, 2012). As a result, the extra effort to prove themselves caused additional stress for Black girls (McGee & Bentley, 2017). The pressure of being Black in predominantly White classes weighed on Black girls.

Many Black girls struggled with stereotypes against them based on their race and these negative stereotypes impacted their academic achievement (Anderson & Martin, 2018). Some Black girls feared failing because they felt, due to their race, they needed to show they could do well. As a result, they felt overwhelmed and did not do work (Anderson & Martin, 2018). Furthermore, if they did make mistakes, Black girls felt people would view their mistakes as a reflection of their race or gender. Academic achievement had a serious impact on self-esteem development (Evans-Winters, 2014). Black girls were stressed with identifying as Black and

proving to others their academic abilities, and made achievement more difficult and furthered hurt their self-esteem. Therefore, positive racial identity was required for self-esteem and supporting their academic achievement.

Racial identity types ranged from distancing oneself from the Black community to being anti-White (Ford & Whiting, 2010; Scott, 2014). With being in certain areas of racial identity, some Black girls did not get along with White educators or authority (Ford & Whiting, 2010). With racial tension, some Black girls did not want their educators' help. Many Black girls were not able to identify with their educators because their educators did not match their race (Young, Young, & Ford, 2019). A different area of racial identity development was worrying about acting White.

Black girls did not want to lose their Black identity and felt by participating in gifted programs they would look like they were acting White (Ford & Whiting, 2010). There was peer pressure to have high grades while not losing their Black identity. While developing their racial identity, Black girls did not perform to their level of ability to avoid peer pressure and being called White by their Black peers (Ford & Whiting, 2010). Anderson and Martin (2018) thought the pressures from different angles led to perfectionism and ultimately caused Black girls to underachieve. Ford and Whiting (2010) observed gifted Black girls trying to fit in with their Black peers leading to underachievement and ultimately removal from gifted classes. Black girls were removed from gifted programs not because of their ability or intelligence but because of the pressure to act a certain way due to their race.

Black girls developed positive racial identities with cultural pride and positive experiences. Borum and Walker (2012) interviewed graduate Black women and determined they felt their most positive experiences were with Black peers at HBCUs. Across the literature, Black

girls were identified as resilient because of the discrimination they faced as Black people (McGee & Bentley, 2017; Young, Young, & Capraro, 2017a). As students were developing their racial identity, educators must understand the different pressures from their White and Black peers that affect their identity and academic achievement. Evans-Winters (2014) recognized academic achievement for Black girls with a strong bicultural identity, being able to identify with Black culture and academic culture. Understanding their racial identity was imperative to form Black girls' mathematics identities.

**Math identity.** Academic achievement was related to the self-math concept, a positive math identity was important for Black girls to feel and be successful in mathematics classrooms (Evans et al., 2010). Black girls started secondary mathematics programs believing in their math abilities, with biases due to double jeopardy, their confidence eroded throughout high school (Alexander & Hermann, 2015; Chambers et al., 2016). Barriers because of race and gender undermined Black girls' confidence in their math abilities. In a quantitative study, Chambers et al. (2016) found Black girls' confidence in their math abilities declined throughout high school and resulted in changing STEM degree aspirations. Math confidence continued to erode in post-secondary programs when professors told Black women to major in other areas (Borum & Walker, 2012). Black girls and women who sought after mathematics degrees and careers required strong math identities to face barriers and increase self-efficacy.

Black girls had significantly higher self-concept in reading and writing over mathematics and science (Evans et al., 2010). While Evans et al. (2010) believed Black boys to be more vulnerable in all academic areas, Graham and Morales-Chicas (2015) noted that Black girls had weaker math identities. Black girls reported more math anxiety than Black boys (Graham & Morales-Chicas, 2015). Based on questionnaires, Black girls reported feeling less

belonging in mathematics class, lower perceived competence in mathematics, and mathematics being less important. In Graham's and Morales-Chicas's study (2015), those with more positive self-views in mathematics were Black girls in advanced courses. They felt they belonged and perceived advanced courses as more important. With race continuing to impact math identity, the study was completed at a diverse school which meant more students of color would be in advanced classes (Graham & Morales-Chicas, 2015).

Race impacted Black girls' math identity. In mathematics classes with more representation of students of color, Black girls felt they belonged (Graham & Morales-Chicas, 2015). Joseph et al. (2019) explained a sense of belonging and identity in mathematics classes was difficult to develop for Black girls when mathematics was thought of as a White male academic area. Some Black girls reported underrepresentation in classes led their passion to continue in mathematics to inspire other people of color (McGee & Bentley, 2017). Others felt the need to overcompensate to prove double jeopardy biases wrong. Sense of belonging, representation, and self-efficacy were important in developing strong math identities for Black girls.

Self-efficacy, defined as a belief in their ability and motivation, was necessary for Black girls to develop a math identity. A lack of self-efficacy hindered Black girls and women from pursuing mathematics degrees and careers (Borum & Walker, 2012). Chamber et al. (2016) used longitudinal data following Black girls through secondary school and college enrollment and found self-efficacy to play a major role in college enrollment. Black girls' self-efficacy decreased over time between sophomore and senior year of high school. High math self-efficacy associated with enrollment at post-secondary institutions and was a factor to attend four-year colleges (Chambers et al., 2016). If self-efficacy increased through high school, more Black girls changed

their minds from wanting to attend a two-year to wanting to attend a four-year college. Educators and parents had a role to increase self-efficacy and math identity to encourage Black girls in mathematics.

Educators supported or hindered mathematics development, with pedagogy being a large factor impacting Black girls' math identity (Pringle et al., 2012). Black girls appreciated educators that explained mathematics problems in different ways instead of being punitive for wrong answers (Joseph et al., 2019). Some educators made Black girls feel "stupid" in mathematics if they made mistakes and hindered their math identity development. Joseph et al. (2019) recognized Black girls had strong self-awareness in mathematics such as noticing if they performed mathematics tasks more slowly than peers, so Black girls' math identity struggled to develop with educators that emphasized speed. Math identity strengthened when educators emphasized that girls were mathematicians, held high expectations for mathematics knowledge, and developed mathematics competence (Young, Young, & Capraro, 2017a). Additionally, educators who provided verbal praise supported strong math identity development (Stearns et al., 2016). Creating a safe space and socialization to develop math identity was imperative for Black girls. Safe spaces for mathematics were outside the classroom too. Parents helped develop Black girls' math identity by focusing on cultural funds of knowledge and provided them with real-world opportunities (Young, Young, & Capraro, 2017a). Mathematics experiences with their parents led to developing self-concept and influenced achievement in mathematics. Educators, parents, and Black girls could support the development of strong math identities that lead to mathematics careers.

## **Conclusion**

Early preparation in mathematics was essential to develop a positive math identity, which supported Black girls' confidence and perception of ability (Young, Young, & Ford, 2017). Black girls faced double jeopardy, biases from peers, and educators that influenced their interest to pursue mathematics degrees and careers. Ultimately, Black girls possessed mathematics talents that cannot be overlooked by themselves, peers, educators, or parents (Young, Young, & Ford, 2017). With an understanding of achievement and opportunity gaps, need for dismantling negative stereotypes, positive socialization, and robust development of racial and math identities Black girls would be equipped for strong mathematical careers as summarized in chapter three.

## **Chapter Three: Summary**

Black girls' success in mathematics was obstructed because of negative stereotypes, lack of positive socialization, and poor development of racial and math identities. The research examined the common themes concerning achievement and opportunity gaps. Chapter three summarized the problem, importance, and the literature review for educators to understand Black girls' experiences in mathematics.

## **Review of the Proposed Problem**

The program essential question was for educators to understand how to differentiate instruction to effectively teach all learners. With evidence of achievement and opportunity gaps, Black girls were not effectively taught in mathematics, therefore, educators needed to differentiate curriculum to meet Black girls' needs. The research question investigated was, in light of what is known about differentiated instruction, how can professional educators reduce achievement and opportunity gaps for Black girls in the discipline of mathematics? This topic

was important to explore because of the underrepresentation of Black girls and women in mathematics.

### **Importance of the Topic**

The literature confirmed the underrepresentation of Black women earning mathematics degrees (Alexander & Hermann, 2015; Borum & Walker, 2012; Pringle et al., 2012; Young, Young, & Capraro, 2017a; Young, Young, & Ford, 2017). Mathematics degrees led to jobs in STEM fields; as noted by the United States Joint Committee of STEM Education there was a shortage of STEM workers which could be solved in part with increasing the representation of Black women in mathematics (Stearns et al., 2016). Within the STEM field, workers earned substantial salaries, and given the economic inequalities from gender and race, Black women could have earned more by obtaining mathematics degrees and related careers (Stearns et al., 2016). To increase the representation of Black women with mathematics degrees and within mathematics-related careers, educational institutions needed to close achievement and opportunity gaps. Chambers et al. (2016) emphasized high school mathematics performance as an indicator of post-secondary enrollment. Effective and early preparation in mathematics throughout secondary school led to positive math identity and later mathematics success (Young, Young, & Ford, 2017). Educators needed to understand achievement and opportunity gaps in addition to negative stereotypes, socialization, and identities to effectively support Black girls to continue education in mathematics and pursue careers.

### **Summary of the Main Points of the Literature Review**

Achievement and opportunity gaps for Black girls and women were evidence for the lack of educational support in mathematics. Upon further research, the literature identified

negative stereotypes, lack of positive socialization, and identity development affecting Black girls and women in mathematics.

Across the literature, researchers concluded that there were achievement and opportunity gaps for Black girls in mathematics (Alexander & Hermann, 2015; Borum & Walker, 2012; Chambers et al., 2016; Evans et al., 2011; Graham & Morales-Chicas, 2015; Joseph et al., 2019; McGee & Bentley, 2017; Pringle et al., 2012; Young, Young, & Capraro, 2017b; Young, Young, & Ford, 2017). The achievement gap was apparent based on mathematics standardized test scores; Black girls' scores were lower than White girls' scores (Chambers et al., 2016; Joseph et al., 2019). The achievement gap in mathematics continued into graduate-level programs, where the data expressed the low retention and graduation rates of Black women compared to White counterparts (Alexander & Hermann, 2015). Young, Young, and Capraro (2017b) provided a perspective that Black girls made growth in the algebra portion of standardized assessment, a predictor for college readiness, yet needed to make growth at a higher rate than White students to close the achievement gap. Black girls required additional opportunities to make sufficient progress. Young, Young, and Ford (2017) discovered Black girls who participated in gifted programs achieved greater than compared to Black girls in traditional classrooms. Though, White students were more likely to participate and were referred by educators for advanced and gifted programs than Black girls (Graham & Morales-Chicas, 2015; Joseph et al., 2019; Young, Young, & Ford, 2017). Other hindrances affected Black girls' opportunities in mathematics such as inequitable schools with a lack of resources and less experienced educators (Chambers et al., 2016; Joseph et al., 2019; Pringle et al., 2012; Young, Young, & Capraro, 2017b). The achievement and opportunity gaps were perpetuated by negative stereotypes, lack of positive socialization, and poor development of identities.

Black girls and women in mathematics faced negative stereotypes in educational environments--by both their peers and educators. Black women in college mathematics programs stated the environment was unwelcoming (Alexander & Hermann, 2015; Borum & Walker, 2012). Black women believed the faculty continued racial segregation in mathematics programs (McGee & Bentley, 2017). Negative stereotypes started before college; secondary educators admitted they had low confidence in Black girls continuing mathematics post-secondary (Joseph et al., 2019; Pringle et al., 2012). Educators considered Black girls to be disruptive in the mathematics classroom. Though, researchers observed and did not believe Black girls' behavior to be unlike non-Black peers (Pringle et al., 2012). Peers had negative stereotypes; they believed White students were better at mathematics than Black students in high school (Evans et al., 2011). Peers in graduate mathematics programs also had negative stereotypes against Black women (Borum & Walker, 2012; McGee & Bentley, 2017). Negative stereotypes connected to the lack of positive socialization between Black girls and women to their peers, educators, and mentors.

Black girls and women enjoyed learning with others and class discussions, therefore, socialization with peers and educators was imperative (Alexander & Hermann, 2015; Joseph et al., 2019). When Black girls and women experienced negative interactions, they felt excluded and then would isolate from their peers and educators (Borum & Walker, 2012; McGee & Bentley, 2017). Smaller class sizes allowed Black girls and women to socialize with their peers and educators and resulted in a sense of belonging (Borum & Walker, 2012). With safe mathematics classrooms and positive feedback from educators, Black girls' engagement in the class increased (Joseph et al., 2019; Pringle et al., 2012; Stearns et al., 2016). Additionally, Black girls enjoyed working with mentors to support their achievement in mathematics (Alexander &

Hermann, 2015; McGee & Bentley, 2017). Evans-Winters (2014) believed it was important for mentors to be women while McGee and Bentley (2017) determined mentors that were gender and race-conscious were also effective. Mentorship supported socialization needs and the development of positive racial identity (Anderson & Martin, 2018; Ford & Whiting, 2010; Mayes & Hines, 2014).

Racial and math identities were imperative for Black girls to develop to continue their advancement in mathematics. Academic achievement was improved with a positive racial identity (Mayes & Hines, 2014; Scott, 2014). Due to double jeopardy, Black girls had to prove their intelligence and override negative stereotypes (Alexander & Hermann, 2015; Borum & Walker, 2012). Without a strong racial identity, Black girls were peer pressured to not act like White people, therefore they did not perform to their level of ability in mathematics (Ford & Whiting, 2010). Negative stereotypes and peer pressure were difficulties Black girls faced, but researchers noted Black girls were resilient because of their race (McGee & Bentley, 2017; Young, Young, & Capraro, 2017a). With resiliency and strong racial identity, Black girls academically achieved because they could connect with academics in conjunction with their racial identity (Evans-Winters, 2014). A positive math identity was important for Black girls to academically achieve (Evans et al., 2010). Double jeopardy stereotypes damaged Black girls' confidence in mathematics, though they started secondary school with beliefs in their math abilities (Alexander & Hermann, 2015; Chambers et al., 2016). Alongside confidence, self-efficacy impacted college enrollment and pursuit of mathematics degrees (Chambers et al., 2016; Borum & Walker, 2012). Educators either supported or hindered positive identities for Black girls in mathematics. Culturally responsive pedagogy, high expectations, and development of mathematics competency resulted in positive math identities for Black girls (Pringle et al. 2012;

Young, Young, & Capraro, 2017a). Strong racial and math identities were necessary for Black girls to be successful in secondary and post-secondary mathematics classrooms.

### **Summary**

The literature provided evidence of how educators affected Black girls in mathematics and the widening of achievement and opportunity gaps. Though, there was limited information to support how educators could close achievement and opportunity gaps. The literature suggested strategies for educators to support Black girls and women in mathematics, but there were additional factors like environment, peers, and mentors that also affected achievement and opportunity gaps. The results were inconclusive because of the limited research and a lack of answers to how educators could effectively close achievement and opportunity gaps for Black girls in mathematics. The literature provided insight for educators to understand their involvement in achievement and opportunity gaps, and with further studies, the research question could be answered.

### **Chapter Four: Discussion and Applications**

The results for the research question are inconclusive; however, the literature provides examples and tools for educators to support Black girls in mathematics. In addition to understanding achievement and opportunity gaps, educators need to combat negative stereotypes against Black girls, provide positive socialization, and support the development of Black girls' racial and math identities. Chapter four will continue the discussion to close achievement and opportunity gaps for Black girls in mathematics by examining insights gained from the literature, applications for educators, and recommendations for future studies.

### **Insights Gained from the Research**

Educators who understand achievement and opportunity gaps for Black girls in mathematics can differentiate within the classroom to make an impact on the educational outcomes for their students. Changes that are made within classrooms and schools will impact and close gaps for Black girls to be represented in mathematical careers. Educators can inform their teaching practices by understanding the need for opportunities, combatting negative stereotypes, supporting positive socialization, and development of positive racial and math identities.

Educators must understand the importance of opportunities to support Black girls in mathematics. Access to algebra in eighth grade is a strong predictor of increased performance and persistence in mathematics (Young, Young, & Capraro, 2017). Though, White girls are more likely to be referred to such mathematics programs than Black girls (Joseph et al., 2019). Teacher referral is a factor in providing opportunities to Black girls in mathematics. When referred and given access to gifted classrooms, Black girls in gifted programs outperformed Black girls in traditional programs at a greater magnitude than the comparison of within-group White girls (Young, Young, & Ford, 2017). In order to close achievement and opportunity gaps, educators should understand the need for representation in mathematics programs to support Black girls.

Educator bias has a role in determining who will be referred to advance mathematics programs. Some educators do not advocate to change Black girls' experience in mathematics and educators have lower confidence in Black girls doing well in mathematics compared to White girls and Black boys (Joseph et al., 2019). Educator biases of Black girls being disruptive, loud, and problematic are harmful in the mathematics classrooms (Pringle et al., 2012). Gender stereotypes that STEM degrees are for boys are held by some educators. Educators who focus on

negative stereotypes and classroom management are not supporting Black girls in mathematics (Pringle et al., 2012). Educators must combat biases against Black girls to increase Black girls' engagement in the mathematics classroom.

While some educators may believe the negative stereotype of Black girls being disruptive in class, Black girls engage in mathematics through dialogue and class discussions (Pringle et al., 2012). With smaller class sizes, teachers can communicate with students and the class can create a safe space for Black girls (Borum & Walker, 2012; Joseph et al., 2019). Black girls are encouraged by positive feedback and reassurance from educators causing high achievement (Stearns et al., 2016). Black girls struggle to succeed in mathematics classrooms that educators yell, ignore students, or struggle to connect content to real-world examples (Alexander & Hermann, 2015; Joseph et al., 2019; Pringle et al., 2012). Educators need to support positive socialization and the development of positive identities.

While in secondary school, educators will notice students are developing their identities, including racial and math identities. Racial identity can range from separating from the Black community to being against White people (Ford & Whiting, 2010; Scott, 2014). Educators should know that Black girls are resilient because they face double jeopardy (McGee & Bentley, 2017; Young, Young, & Capraro, 2017). While Black girls are resilient, Black girls need additional support from educators given the barriers to success in mathematics that they face. Evans-Winters (2014) concludes positive racial and academic identities will lead to higher achievement. A student's math identity is developed in part of what they think about themselves and from educators' influence (Joseph et al., 2019; Stearns et al., 2016; Young, Young, & Capraro, 2017). Academic achievement relates to self-concept in mathematics (Evans et al., 2010). Double jeopardy influences Black girls' academic interest and math identity; therefore,

educators should support the positive perception of Black girls' ability in mathematics (Young, Young, & Ford, 2017). Educators play a role in the achievement and opportunities given to Black girls in mathematics and must know strategies to move towards closing such gaps.

### **Application**

Educators can apply the literature to their teaching to support Black girls in mathematics. To close the achievement gap, the mathematics performance of Black girls will need to increase at a higher rate than the achievement of White students (Young, Young, & Ford, 2017). Educators will need to differentiate curriculum and instruction to help Black girls achieve at a higher rate. Also, educators will need to advocate and refer Black girls to advance through mathematics programs and gifted programs. Black girls have a low participation rate in mathematics programs and given teacher referrals they will have the opportunity to join (Joseph et al., 2019).

Black girls face double jeopardy biases from educators and peers. Educators can create safe spaces in mathematics classrooms that foster a nurturing and rigorous environment (Borum & Walker, 2012). Humorous and approachable educators create safe spaces for Black girls in mathematics (Joseph et al., 2019). Educators can model and change the narrative that mathematics is for White males and that White students are better at mathematics than Black students (Evans et al., 2010; Pringle et al., 2012). Dismantling negative stereotypes against Black girls is imperative for their success in mathematics classrooms. Positive socialization will help change negative narratives against Black girls in mathematics. Mathematics can be collaborative, including dialogue between students and educators, to benefit the achievement of Black girls (Alexander & Hermann, 2015; Joseph et al., 2019). Supporting Black girls' confidence and sense of belonging in mathematics class causes educators to be part of the positive development of

Black girls' math identities (Pringle et al., 2012). Educators must also support Black girls in their racial identity development. Black girls will face additional pressure in mathematics classrooms because of their race. There will be pressure to be perfect and to avoid acting White (Anderson & Martin, 2018; Ford & Whiting, 2010). Educators will need to address peers that hold biases against Black girls and reduce peer pressure. Otherwise, Black girls will feel isolated from mathematics programs (Anderson & Martin, 2018; Mayes & Hines, 2014). Educators can create an environment for Black girls to positively develop their racial and math identities.

Throughout the literature, nearly all researchers identified achievement or opportunity gaps in mathematics for Black girls (see Appendix). Educators need to support Black girls in mathematics by diminishing negative stereotypes, creating positive socialization, and support the development of positive identities. While there was limited research about negative stereotypes, the theme of socialization was common with a discussion of racism and sexism from peers and educators (see Appendix). Another common theme is identity development; educators affect Black girls' development of racial and math identities. Based on the Article Tracking Matrix, some researchers discuss social-emotional learning and community support to aid in the achievement of Black girls in mathematics (see Appendix). Social-emotional learning and community support are not common themes across the literature for Black girls in mathematics but should be considered for future studies.

### **Recommendation for Future Studies**

Research about Black girls in mathematics is limited because previous research focused on achievement and opportunity gaps of White girls or Black boys (Chambers et al., 2016; Joseph et al., 2019; Pringle et al., 2012; Young, Young, & Capraro, 2017a; Young, Young, & Ford, 2017). Multiple researchers believe those studies cannot inform educators about Black girls

because of double jeopardy (Evans et al., 2011; McGee & Bentley, 2017; Stearns et al., 2016; Young, Young, & Capraro, 2017a; Young, Young, & Capraro, 2017b; Young, Young, & Ford, 2017). With literature being relatively new, more researchers will need to examine how educators can close achievement and opportunity gaps for Black girls in mathematics. There are three recommendations to further study Black girls as mathematicians.

Some researchers reference community support as a tool to support Black girls in mathematics to provide opportunities and increase achievement (Evans-Winter, 2014; Mayes & Hines, 2014; Scott, 2014; Young, Young, & Ford, 2019). Some researchers suggest community members and mentors focus on social-emotional learning for Black girls to succeed in mathematics (Anderson & Martin, 2018; Evans-Winters, 2014). Researchers should fully examine how community members can partner with educators to support Black girls in mathematics. Multiple researchers referenced mentorships to develop positive racial and math identities. The recommendation of future research would be to address how community support affects achievement and opportunities for Black girls in mathematics. It will be necessary to include qualitative and quantitative data to shed light on the effects.

The current research about Black girls in mathematics is mainly qualitative and the quantitative studies primary focus is achievement or opportunities (see Appendix). For future studies, researchers should use a quantitative methodology to examine the impact of negative stereotypes, socialization, and identity development. Also, the quantitative studies used NAEP data about achievement. Given standardized assessments are known to be biased, researchers should use culturally responsive assessments. The development and use of culturally responsive mathematics assessments is a recommendation to understand if the current achievement gap is

due to content knowledge or White cultural knowledge. The achievement gap between Black and White girls is evident at a secondary level and further research is required at an elementary level.

The identified literature focuses on secondary and post-secondary mathematics programs. Young, Young, and Ford (2017) explains that early achievement leads to later STEM success. The research lacks evidence for elementary mathematics programs. If early achievement is important, researchers should identify effective differentiation for Black girls in elementary mathematics classrooms. If researchers identify ways for elementary educators to support Black girls in mathematics it may affect the achievement and opportunity gaps.

The literature provided is inconclusive evidence for the proposed research question, but with further research, educators will know how to support Black girls in mathematics as evidence by closing achievement and opportunity gaps. Three further studies are recommended to analyze the influence of community support, culturally responsive mathematics assessments, and educators at the elementary level. The current literature is applicable for secondary educators to make some change but Black girls in mathematics require more attention.

### **Conclusion**

Black girls deserve to be supported in mathematics classes and cannot be overlooked. Some research focuses on the achievement and opportunity gaps of White girls and Black boys. Results from those studies have not informed educators to support Black girls in mathematics because disparities continue to exist. The literature of this study provides evidence of achievement and opportunity gaps for Black girls in mathematics. Additionally, the literature exposes the need to dismantle negative stereotypes, increase positive socialization, and support the development of racial and math identities. While the results are inconclusive of how educators could close such gaps, the literature provides tools for educators to differentiate for

Black girls in mathematics. Once secondary schools effectively support Black girls in mathematics, Black girls will be equipped to pursue post-secondary mathematics degrees. Through representation in mathematics degrees, Black women can earn mathematics degrees that will lead to STEM careers and economic wealth. Black girls and women have unique experiences and mathematics talents that peers, educators, and society cannot leave unnoticed (Young, Young, & Ford, 2017). Educators can emphasize talents and support Black girls to close achievement and opportunity gaps.

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## Appendix

## Article Tracking Matrix

<b>Articles</b>	<b>Method</b>	<b>Theme 1 Gaps</b>	<b>Theme 2 Negative Stereotypes</b>	<b>Theme 3 Socialization</b>	<b>Theme 4 Identities</b>	<b>Outlier</b>
(Alexander & Hermann, 2015)	Qual	Achievement Opportunity	Environment	Peers Educators Mentors	Racial Math	
(Anderson & Martin, 2018)	Qual	Opportunity		Mentors	Racial	SEL support
(Borum & Walker, 2012)	Qual	Opportunity	Environment Educators	Peers Educators Mentors	Racial Math	
(Chambers, Walpole, & Outlaw, 2016)	Quant	Achievement Opportunity			Math	
(Evans-Winters, 2014)	Qual	Opportunity		Mentors	Racial	Community support; SEL support
(Evans, Copping, Rowley, & Kurtz-Costes, 2011)	Quant	Achievement	Peers		Math	Black boys are more vulnerable
(Ford & Whiting, 2010)	Qual	Opportunity		Mentors	Racial	
(Graham & Morales-Chicas, 2015)	Quant	Opportunity		Peers	Math	
(Joseph, Hailu, & Matthews, 2019)	Qual	Achievement Opportunity	Educators	Peers Educators	Math	
(Mayes & Hines, 2014)	Qual	Opportunity		Mentors	Racial	Community Support

(McGee & Bentley, 2017)	Qual	Opportunity	Environment Educators Peers	Mentors	Racial Math	
(Pringle, Brkich, Adams, West-Olatunii, & Archer-Banks, 2012)	Qual	Achievement Opportunity	Educators	Educators Mentors	Math	
(Scott, 2014)	Qual	Opportunity			Racial	Community support
(Stearns et al., 2016)	Quant	Opportunity		Educators	Math	
(Young, Young, & Capraro, 2017a)	Mixed Methods	Achievement Opportunity			Racial Math	
(Young, Young, & Capraro, 2017b)	Quant	Achievement Opportunity				Positive view for achievement
(Young, Young, & Ford, 2017)	Quant	Opportunity			Math	
(Young, Young, & Ford, 2019)	Qual	Opportunity			Racial	Community support