Beyond the Numbers: An Analysis of the Under-representation of Black Women in STEM fields

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Abstract

This paper examines the lack of Black women in STEM fields and how systemic racism contributes to it. Education is intended to be a way to develop and nurture young minds and lives. For many students of color, specifically Black girls, due to their socioeconomic status they attend schools with little resources. The systemic racism that causes Black girls to attend underfunded and under resourced schools, also causes them to face educator bias, and have a lack of confidence fueled by lack of representation. Educator bias limits Black girls from opportunities that could expose them to STEM like gifted education and Algebra 1. Lack of representation causes Black girls to experience stereotype threat, lack of self-efficacy.

Introduction

"African-American students are gifted and brilliant. They do not have a culture of poverty but a culture of richness that can be brought into classrooms to facilitate learning" (Delpit 5).

Education is a stepping stone in the lives of many Americans, but not all schools are equipped with the same resources and qualified teachers. Schools with high concentrations of low-income and minority students receive fewer instructional resources than schools with mostly white and higher-income students (Hammond 2).

The impact of the lack of resources in underfunded schools shows up in the performance of the students that it serves. In regards to school performance, the achievement gap between students of color and their peers only grows as time goes on. The National Assessment of Educational Progress (NAEP) 2005 science scores indicate that 18% of fourth-grade white students scored below basic proficiency, but a staggering 62% of fourth-grade students of color

scored below basic proficiency in science (Grigg, Lauko & Broadway, 2006). This is just one example of the achievement gap in test scores.

From a young age, many Black students, specifically Black girls, are not exposed to math and science due to a lack of resources in the schools that are meant to nurture them. Additionally, teachers have stereotypes about Black girls that hinder their success. Since the 1960s, America has become a global STEM leader, yet African-American underrepresentation persists in STEM undergraduate, graduate, and occupational programs (Leaper, et al, 2012; MacPhee, Farro & Canetto, 2013). Due to a lack of affirmation and confidence in Black girls that is fueled by lack of representation, African-American women comprise 6% of the American population, but disproportionately make up only 1.8% of the STEM workforce (Spelke 2005).

Thesis Statement

- Systemic racism in the education sector during K-12 schooling is the root cause of the under-representation of Black women in STEM fields. This manifests through severe underfunding and under-resourcing of schools, educator bias, and lack of representation, and therefore confidence, among Black girls and women.

Research Question

- How does systemic racism in the educational system contribute to the under-representation of Black women in STEM fields and what policies can combat it to increase representation?

Terminology

The following terms are a key part of understanding this paper: achievement gap is defined as observed, persistent disparities in measures of educational performance among subgroups of U.S. students, especially groups defined by socioeconomic status, race/ethnicity, and gender (EdGlossary). STEM refers to the fields of science, technology, engineering, and

mathematics. This paper discusses gifted education because gifted education issues are essential in the STEM pipeline discussion; it is through gifted education that students are “socialized” to take advanced STEM courses (Collins 3). Gifted education is is a broad group of special practices, procedures, and theories used in the education of children who have been identified as gifted or talented. Self-efficacy refers to an individual's belief in his or her capacity to execute behaviors necessary to produce specific performance attainments (Bandura, 1977, 1986, 1997). STEM identity is composed of competence, performance, and recognition (Kane 2011). STEM identity is fueled by learning opportunities that enhance early exposure to science so young girls can see themselves as a “scientist”. Stereotype threat refers to the risk of confirming negative stereotypes about an individual’s racial, ethnic, or cultural group (EdGlossary).

Methodology and Literature Review

This research paper is a secondary research study that was conducted through the analysis of literature as well as statistics and demographics from multiple sources. The majority of this paper was collected through pieces of literature found in the Duke Library and Google Scholar. To provide historical context, I analyzed a report on the ties between poverty and educational inequality by *The Civil Rights Project*, and how it disproportionately affects students of color. The main source of statistics came from a summary of elementary science achievement and a report on how gifted education is linked with the lack of Black girls that pursue STEM fields. To understand the experiences of Black girls in STEM education that range from elementary school to college, I read numerous papers that discussed these experiences in-depth and their subsequent effects on the identity and confidence of Black girls and women.

Limitations

Limitations in this paper can be found in its format as a literature review. In this paper, other research papers related to the topic were analyzed and synthesized, so the paper is compiled from pre-existing data and statistics.

Synthesis of Findings

Underfunding and Under-resourcing of Impoverished Schools

The lack of Black girls in the field of STEM stems primarily from a place that is supposed to teach them valuable skills and give them a foundation for the rest of their life: schools. Black students are more likely to be educated in schools in lower socioeconomic areas. According to National Equity Atlas, In about half of the largest 100 cities, most African American and Latino students attend schools where at least 75 percent of all students qualify as poor or low-income under federal guidelines. Due to this, they are more often than not on the receiving end of a school that simply does not have enough resources to lead them to their fullest potential.

The achievement gap between Black students and their white peers starts before the students even enter the classroom. Race is deeply and systematically linked to many forms of inequality in background, treatment, expectations, and opportunities. From an educational perspective, perhaps the most important of those linkages are with the level of concentrated poverty in a school. A comprehensive federal study of children across the country entering kindergarten shows very large differences in the acquisition of skills invaluable for school success long before the children ever enter a schoolhouse (Orfield and Lee 5). Children of color are not entering school with the same skills as their white peers. When they enter school, the gap between them is made larger by the underfunding and under-resourcing of their respective schools.

A big part of a students' education is the teachers that guide them through their education. Schools with a majority of low-income and minority students are not equipped with

quality teachers. Aside from challenges posed by students' backgrounds, high poverty schools tend to struggle with attracting and retaining good teachers (Orifield and Lee 17). Due to the massive responsibility associated with educating students of color who are already behind their peers, teachers are burnt out and there is a high turnover rate. Teachers in urban schools, serving predominantly minority and low-income students, experience significantly greater stress and lower job satisfaction compared to their colleagues serving students in higher income, suburban, and rural settings (Markow, Moessner, & Horowitz, 2006). They experience more stress because of limited resources, overcrowding, chronic disruptive student behavior, and high-pressure accountability policies. Due to high teacher turnover, quality teachers are not always able to be attained. For example, California schools with high concentrations of minority enrollments are less likely to have credentialed math or science teachers (Orifield and Lee 17).

When it comes to the education of Black girls, due to the lack of resources and the stress of teachers education in the sciences and math are not always given the attention they deserve. Many of the teachers serving Black girls reported a lack of continuing education and preparation to teach science. Additionally, almost 80% of teachers reported teaching science less than four hours per week. This is less than an hour per day in a five-day school week. (Young, Feile, and Young 14 -15). When it comes to the quality of the STEM education that students in high poverty and low poverty schools receive there is a stark difference. According to data from the U.S. Department of Education, 47 percent of fourth graders at high-poverty schools do a hands-on experiment once per week, compared to 61 percent of students in low-poverty schools. Furthermore, 62 percent of eighth grade teachers at high poverty schools report having the resources they need to teach math, while 79 percent of their low-poverty-district counterparts do.

Black girls are not exposed to the world of science at a young age, because the schools that educate them are riddled with problems that cause education in science and math to be overlooked. A crucial part of the STEM identity that can successfully guide students through their STEM education is exposure to the field. If Black girls are not exposed to STEM at a young age, then they will never gain an important part of the identity that will help them navigate the world of STEM.

Educator Bias

Due to stereotypes and implicit biases that exist about Black girls, the educators that are supposed to have their best interests at heart commonly have biases against them. Through gifted education, Black girls are put in a position to one day take advanced STEM courses. However, Black students are substantially underrepresented in gifted education. While comprising 19% of students in schools, they only represent 10% of gifted education (Collins 3).

Black girls are not being identified for gifted education at a substantial rate. This is not due to them being incapable of success in these courses, but it stems from teachers misunderstanding their ability. Campbell suggests that Black girls that ask questions and routinely participate may overwhelm teachers who could then misinterpret their zeal for that of a student that does not fully understand the material (Collins 3). Due to stereotypes that exist about Black girls when they show that they are smart and intelligent in class, it is misunderstood as them not understanding the material.

The consequences of Black girls not being labeled as “gifted” have impacts that follow them to middle school and high school. Algebra 1 has become the gateway course that prevents access to more advanced math courses in high school if not taken in middle school (Sawchuck, 2018). Black students are disproportionately underrepresented in algebra in middle school and overrepresented in algebra as late as junior and senior year in high school. In some

cases, it is not that Black students aren't capable of these courses but those in authority act as gatekeepers of their success. Teachers may not recommend Black students for advanced classes for inappropriate reasons. For example, in a school at which students' grades were evaluated at the end of each quarter to determine which students should be moved into higher math courses, a Black student who excelled in her general-level algebra course was not moved up. Her teacher justified this decision by saying she needed this student to remain in the general-level course because she was a good role model for other students in this predominantly Black and Latino class (Walker 49). Examples such as this one show that racism is so deeply ingrained in society that it acts as a gatekeeper for success for Black girls. They are held back from their future because of societal perceptions that are rooted in racist ideology.

A study by the National Assessment of Education Progress found that white-sounding names were rated significantly higher — both by white teachers and by teachers of color — than those of Black- and Hispanic-sounding names. Non-white teachers' estimations of students' mathematical ability also favored white students — both boys and girls — over students of color, and white teachers' estimations of students' mathematical ability favored boys over girls. This study gets at the core of educator bias that exists for Black girls. Black girls have to deal with biases and stereotypes for both of the intersecting parts of their identities when it concerns race and gender.

"Black women and girls exist at the intersection of two primarily underrepresented social identity groups in STEM education and that intersectionality is an essential lens through which Black women and girls emerge as unhidden figures and by which education researchers and practitioners can enhance our understanding of this particular population in the literature" (Ireland 4). Educator bias is especially harmful towards Black girls because two parts of their

identities are associated with negative stereotypes. The education system is not built to understand and build these parts of their identities.

Lack of Representation and Confidence Among Black Girls and Women

Studies have found that Black girls and women have decreased confidence and self-efficacy in STEM fields as they progress throughout their educational careers. Black students do not have confidence because their foundation has not been properly set up regarding a future in STEM education. Based on national early science achievement trends, Black children are at greater risk than their White counterparts of falling behind (Pringle, Brkich, Adams, West-Olatunji, & Archer-Banks, 2012). Subsequently, many Black students failed to make up these gaps and consequently, those who do enter STEM professions do so with less science content knowledge than their peers (Young, Feile and Young 2).

The achievement gap between Black students and their white counterparts early in their education life widens as time goes on, as mentioned in this paper. Black students are aware of these gaps and this negatively affects how prepared they feel when they are in STEM courses with mostly white peers. Concerning academic preparedness, studies found that some Black women had inadequate high school preparation for STEM college courses and that students felt underprepared academically while in STEM programs at predominantly White institutions (Joseph, 2012; Russell & Russell, 2015).

Since educators are unable to see the full potential of Black girls because of educator bias that can harm their psyche and self-efficacy. Black girls consistently doubt their ability in STEM courses. Scholars have found self-ratings of engineering learning outcomes among Black undergraduate women to be significantly lower than those of their White peers—a finding not evident for Black men (Ro & Loya, 2015). Over time, Black high school girls also experience declines in math self-efficacy (Chambers et al., 2016).

Black students in all aspects of their education life are affected by stereotype threat. Due to the stereotypes that exist around them regarding their identities. When high-achieving Black students face an abundance of stereotyped and racialized obstacles, they lose motivation, feel hopeless, and experience increased performance anxiety and stress, which typically leads to a decrease in test scores (Steele & Aronson, 1995; Steele et al., 2002). Stereotype threat is especially rampant in the highly racialized and gendered fields of STEM (Perna et al., 2009).

Recommendations for Future Policies

Despite the lack of Black women in STEM stemming from an ingrained systemic racism issue, policies can be proposed to increase representation.

Quality teachers that are trained in STEM fields are of great importance for students in all schools, but these teachers are a dime a dozen in underfunded and under resourced schools. Policymakers can help address this with training programs. The Obama administration 100Kin10 project leveraged public private partnerships to train 100,000 STEM educators, 40,000 have already been trained by the program (Israel, 2017).

To increase the number of Black girls and women engaging in STEM fields, we need to look at the issue from all aspects. There needs to be mandated STEM education in all schools from a young age. Interventions and instructional practices designed to enhance STEM interest and scientific understanding were more dominant in elementary and secondary schools than higher education contexts (e.g., Buck et al., 2009; Scott & White, 2013). Starting in elementary schools, Black girls need to be developing their STEM identity.

Afterschool programs can also alleviate the burden that underfunded and under resourced schools feel. Funding after school programs are a great way to increase student abilities and engagement. FIRST is an after school robotics program. FIRST students are twice

as likely to major in engineering or science. Further down the line, 45% (twice the national average) of students involved in the FIRST program end up in STEM careers (Israel, 2017).

Inclusive STEM schools that accept students based on an interest in STEM rather than test performance and academic record have been proven to be successful at increasing students of color in STEM fields. Particularly, because some of these schools are specially catered to underrepresented and low-income students. Graduates of inclusive STEM high schools “were more likely to be currently enrolled in a four-year college, had completed more college courses and earned more credits, and were more likely to have declared a STEM major than the graduates of comprehensive high schools” (Israel, 2017).

Conclusion

Black women and girls are not engaging in STEM fields, not due to their lack of interest but, because of systemic racism that contributes to the severe underfunding and under-resourcing of schools, educator bias, and lack of confidence stemming from lack of representation of Black women in STEM. Black girls are not exposed to STEM at a young age because the schools they attend have to deal with a wide range of issues pushing STEM education to the backburner.

The educators that are supposed to have the goal of educating Black girls have stereotypes and implicit biases that disable them from pushing Black girls to their brightest future. They aren’t recommended for gifted education and their overall ability is underestimated. When Black girls are in STEM, they doubt their ability and the overwhelming nature of a system that is not built for them negatively affects them.

Increasing Black women in STEM, will not be easy, due to it stemming from issues that are ingrained so deeply within our society. But, with attention to these efforts, Black girls and women can finally see themselves reflected in the world of STEM.

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