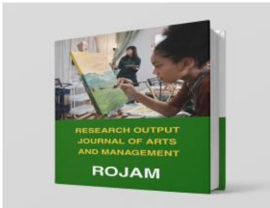

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Empowering Girls in Stem Education: Strategies to Address Gender Disparities

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ABSTRACT

Despite significant advancements in gender equality, girls remain underrepresented in STEM (Science, Technology, Engineering, and Mathematics) fields. This paper explores the persistent gender disparities in STEM education, particularly among middle school-aged girls, and proposes strategies to address these imbalances. Factors contributing to the gender gap include societal stereotypes, lack of confidence, and inadequate role models. By integrating inclusive curricula, promoting positive role models, and encouraging hands-on, real-world STEM applications, educators and policymakers can foster greater interest and competence in STEM among girls. This paper also discusses the role of organizations and community efforts in supporting girls' STEM education. The proposed strategies aim to empower girls to pursue STEM careers, thereby contributing to economic growth and innovation.

Keywords: Gender Disparities, STEM Education, Girls in STEM, Role Models, Inclusive Curriculum.

INTRODUCTION

Worldwide, increasing awareness, acceptance, and support of female involvement in STEM education has been getting attention. The acronym, STEM, encompasses the subjects of science, technology, engineering, and math. STEM education has received little research attention regarding gender disparity and career selection for middle school-aged adolescent girls. Girls are at a disadvantage based on factors outside of educational institutions, such as gender stereotypes built and reinforced by society. The stereotype is that girls are less competent in math and sciences than their male classmates, contributing to a lack of confidence and self-perception as being capable or competent in STEM. Even with comparable scores in math and sciences, girls translate their lower scores into lowered belief in their abilities. Even factors such as gender norms demonstrating girls as nurturing rather than career-oriented emphasize the need for intervention in early adolescent education [1, 2]. Several different strategies can legitimately be utilized to address the gender disparity on skills and interest in STEM subjects. First, school counselors can integrate a career curriculum that shows a variety of careers, especially many STEM careers, and further encourage students to think about their future selves. Career selection integrates a variety of identity, competence, interest, and utility of careers that are highly interlinked. Second, school counselors need to educate parents, educators, and students about growth mindset and the detrimental effects gender differential treatment can have on self-perception. Finally, national organizations such as "Girls Who Code," "American Association of University Women," and "STEMettes" work towards networking adolescent girls to a collaborative network of STEM females to serve as mentors [3].

BACKGROUND AND IMPORTANCE OF STEM EDUCATION FOR GIRLS

STEAM, which integrates art and design into science, technology, engineering, and mathematics, has emerged as a response to the growing economic competitiveness associated with STEM. It intends to foster adaptability, creativity, innovation, and more capable future professionals. STEAM investment has expanded internationally, with many countries embedding STEAM-related inputs into their education systems. Girls have been historically underrepresented in STEM-related academia despite recent attempts to increase their participation. Given the rapid development of technology within any modern economy, relevant and high-quality education in STEM fields is crucial for both genders. Investment in girls' education and women's empowerment has gained more attention over the past decades. The enactment of the Millennium Development Goals and later the Sustainable Development Goals emphasized tackling gender-equity in education and employment opportunities [4, 5]. The importance of STEM education for girls is paramount for their future, as education offers both opportunities and barriers. In the past, girls' education was considered unimportant and invested less compared to boys; thus, they remained at an inferior social status disadvantage, preventing them from attaining valuable education. Following the early efforts to promote girls' education, such as the girls' school movement in the 19th century, there was a gradual shift towards gender-equity education during the second half of the 20th century, along with the emergence of the United Nations. With important early states such as the Convention on the Elimination of All Forms of Discrimination against Women (CEDAW) and its subsequent ratification by 187 countries, the understanding of gender-equity challenges gradually shifted from building more schools to topics such as curriculum, textbook, and distribution of teachers and facilities. Despite the positive movements towards promoting girls' education, significant disparities remain in many developing countries [6].

GENDER DISPARITIES IN STEM EDUCATION

Gender disparities in education have been widely documented, with girls particularly disadvantaged in traditionally gender-tracked fields such as science, technology, engineering, and mathematics (STEM). Although girls outperform boys academically in all subjects in adolescence, they are equally underrepresented in higher education STEM fields. Critical points in the gendered education process are identified at which girls' interests, achievements, and aspirations in STEM become compromised relative to boys' during elementary and high school. Because education is inherently social, the focus is placed on investigating girls' relative underperformance in STEM during precollege education. This exploration is informed philosophically and theoretically by the contribution of sociology to notions of culture, structure, agency, and knowledge production. Girls' experiences in education and society that affect their relationship to/gender tracking in the culture of education, science, and mathematics are uncovered [7, 8]. A complementary study is designed to focus on a micro-analysis of one additional critical space in the education process: the social construction of girls' gender and educational identities within the culture of school mathematics as played out in the classroom at the local level. Here, the mathematics classroom is recognized as a socializing institution within which structural inequities in society are mirrored and girls' sense of agency, identity, and competence in mathematics are directly affected by teachers' actions as well as by peer group dynamics. The project examines the everyday classroom interactional dynamics that work to construct girls' gender and educational identities in mathematics as low-ability students or, conversely, boys' identities as high-ability math students [9].

FACTORS CONTRIBUTING TO GENDER DISPARITIES

Despite continued efforts to narrow the gender gap in STEM fields, women remain significantly underrepresented in overweight and high-tier occupations. The overall percentage of women in the labor force has increased, but they only account for 8% of engineers, while women of color comprise less than 4%. Greater female participation in STEM education is vital, as an increase of women in STEM careers contributes to economic growth and innovation, workplace diversity, and elevated social status for women and girls. A proliferation of interest in and research devoted to STEM education and career disparity for women, particularly girls, has led to an understanding of numerous factors that encourage and discourage female participation and success in STEM fields [10, 11]. Pressures for females to conform to stereotypical gender roles begin early in childhood and develop steadily after puberty, peaking in late adolescence. Perceptions of competence in science and math correlate with performance gender gaps, rather than differences in actual capability. Gender socialization affects course selection and aspirations to pursue STEM fields. Even when selecting the same courses, females are less likely to continue on a STEM path in college or employment. Across ethnic and socioeconomic backgrounds, girls report lower levels of comfort in math and science than boys. Today's adolescent girls are taught that femininity and compliance to gender norms equate with weakness, fragility, and inferiority in intelligence, academic performance, and competence in traditionally male-dominant fields. Girls who conform to gender norms experience lower beliefs in academic and mathematics competency. Academic sexism in mathematics and science, hostile and discriminatory treatment of female students and professionals, also alters these beliefs and exposes them to harrowing experiences of sexual harassment and discrimination that deters further pursuit of math and science classes and careers [12].

STRATEGIES TO ENCOURAGE GIRLS' PARTICIPATION IN STEM

Despite girls starting school with equal interest or capability in science and mathematics, a variety of reasons account for the widening inequality gap - perhaps demotivation due to an unpleasant experience in early math, an overwhelming fear of failure, or too many negative responses to an interest in science. There is a known cycle chain that this all leads to - STEM subject drops, which means fewer resumes for university courses, which leads to fewer graduates for STEM careers, which compounds the scarcity of girls in STEM fields [13]. To encourage and increase girls' participation in STEM fields, it starts with promoting social norms that encourage girls to explore interests in STEM. Research shows that what girls need, more than anything else, is to participate in positive role model experiences with STEM. Girls have more interest in engineering and technology careers and report higher efficacy in math when they are exposed to someone with a STEM job actively pursuing it. Next is to create relevant activities that initiate interests in STEM. Activities need to reflect real-world scientific and mathematical problem-solving skills where girls can integrate their creativity. Tactile and personalized hands-on approaches were also found to positively affect interest and favorability in conducting the exploration. Another measure is planning engagement tactics that influence participation in the pipeline [14].

PROMOTING POSITIVE ROLE MODELS

Role models act as a mirror reflecting the possibility of other choices. After exposure to members of minority groups who are successfully employed in fields outside the home sphere, many girls have greater interest and a shift in their assessment of their own career perspectives. This shift is beneficial for individuals and societies. Young women who pursue careers in male-dominated smart industries and thus enter markets characterized by a skills shortage often earn relatively high wages. Women's choices towards these jobs also have a positive effect on overall labor productivity in the economy because male-dominated industries benefit less from the natural gender specialization within the overall workforce [15, 16]. The increased interest in technological and engineering courses among girls with strong math and science competence is thus a win-win situation. Unfortunately, the "role model effect" among girls is not a panacea combating their underrepresentation in STEM fields. Gender-related social schema and gender-related stereotypes still promote a protective agenda on behalf of women and girls. Success stories such as an employment at the New York Time and The Washington Posts in the 2016 American Presidential elections at the expense of hiring female data scientists and engineers to monitor political ads propagate still existing beliefs that personal choices in careers respond to different abilities and predispositions of men and women. In addition, the role of positive role models departs from further traditional patterns as well [17].

INCLUSIVE CURRICULUM AND TEACHING METHODS

An inclusive curriculum and teaching methods play a critical role in creating conditions for all girls to engage in learning STEM (science, technology, engineering, and mathematics) concepts. To stimulate girls' partnership in STEM, educators should change the curriculum and teaching methods to promote the relevance of learning experiences to real-world applications. Making STEM and girls' partnership in STEM relevant is important for girls' self-efficacy and environmental support, motivation to pursue STEM, and attitudes towards learning STEM. Educators can develop an inclusive curriculum and teaching methods that incorporate real-world applications in several ways, including: [18, 1].

1. Authentic Contexts: Integrating community topics in the curriculum allows girls to connect new concepts learned in school to the lived experiences outside school. Girls' partnership in community research empowers them in seeing the relevance of learning STEM concepts while making real-life problem solving doable for them. When girls are engaged in partnership with community members while participating in authentic inquiry, they can theoretically understand the complexity of issues in the community while developing relevant on-the-job skills [19].

2. Intriguing and Unusual Contexts: A unique or unusual context sparks students' interest. Girls may be motivated to participate in STEM learning opportunities because they are attracted to the context of learning experiences (e.g., programming and designing games) rather than a focus on STEM per se. Once girls are engaged, they are likely to participate actively and learn STEM concepts [20].

3. Challenging Contexts: Learning STEM concepts in challenging contexts offers opportunities for girls to participate in sophisticated aspects of problem solving (e.g., analyzing data and predicting the outcome of an experiment) and designing experiments while partnering with physical science experts. This involvement enhances their learning of STEM concepts while understanding the elements of STEM partnership. By changing the curriculum and teaching methods to promote relevance, educators can create more equitable learning conditions for girls, facilitate girls' engagement in learning STEM concepts, and encourage girls to pursue STEM [21, 22].

INTEGRATING REAL-WORLD APPLICATIONS

Curricular and pedagogical transformations at the elementary school level are necessary to ameliorate girls' STEM deficiencies. This study therefore discusses a specific strategy: integration of real-world applications (RWA) into the curriculum and teaching methods. RWA is defined as integration of real-world examples, objects, or activities with thematic connection into curricular topics and teaching processes. RWA has the potential to address girls' particular difficulties in understanding and accepted relevance of authentic science. The appeal of RWA to girls' interests and experiences might prevent them from losing engagement in school science and mathematics. Effective integration of RWA into the curriculum might also enhance any student's learning and understanding of authenticity [23]. Girls' interests and experience concerning REAs are connected with prior learning, personal lives, and nature. In contrast, boys' interests and experience are connected with technical, practical applications, and media. Integration of RWA might broaden girls' interests and experience, including those related to technology. There are also gender differences in understanding the authenticity of science. Hence, RWA might address girls' difficulties in understanding the relevance of authentic science. Girls generally consider social relationship voices and positive effects of scientific activities, as well as environmental protection, while boys' considerations are effector emphasis, economic gain, and power. According to this study, RWA might also empower students' agency concerning large-scale authentic scientific issues, important for society and girls themselves [24].

FUTURE DIRECTIONS

Gender disparities in education, specifically in STEM education, have been prevalent in society since the early 1960s. Some of the reasons for these gender disparities are rooted in social, economic, cultural, and political views, which influence persistence and attainment. As a result, policies and practices that address these barriers are sought after and reported by many countries. Unfortunately, while many policies or programs have been implemented for years, the current landscape continues to show the 'leaky pipeline' story: the higher the educational ladder, the fewer girls and women continue STEM. In America, girls generally perform similarly well in math and science as boys. Even in elementary school, girls favor math and science as a potential career option while sustaining interest and confidence. However, this shifts with early adolescence, and the gender differences grow larger throughout middle and high school. By graduation, women earn just 20% of the bachelor's degrees in physics, engineering, and computer science. In the workforce, although women receive a greater number of STEM degrees than men, they hold many less lucrative math-intensive occupations. These numbers do not align with the growing need for skilled STEM employees. In response to this need and the underrepresentation of females in STEM academia and occupations, educators and community organizations provide programs and instruction intended to foster an interest in STEM among girls [25, 26]. Concerned with girls growing apathy toward math or science and the continued gender disparity seen in college education and the workforce, many initiatives have been developed to empower girls and to stem the tide of discouraging girls from pursuing an interest in these disciplines. Programs such as math clubs, outreach programs by universities or companies, and after-school groups have been implemented. Professional organizations have been formed exclusively for females in STEM jobs, and organizations seeking to connect girls with math and science role models have been developed. While well intentioned, these initiatives vary significantly in the methods by which they address the problem and much less in their impact on societal outcomes. Federal funding is generally allocated to large competitive grants for interventions with strategic objectives on a national level. Many of these interventions feature technology as the focal point, such as multimedia programming. On the local level, many initiatives arise from institutions of higher learning or businesses, such as science fairs, family math nights, museum workshops, and educational materials [27].

CONCLUSION

Addressing gender disparities in STEM education is essential for achieving gender equality and harnessing the full potential of the workforce. By implementing targeted strategies such as promoting positive role models, creating inclusive curricula, and integrating real-world applications, educators can inspire and empower girls to pursue STEM fields. These efforts must be supported by broader societal changes and community initiatives that challenge stereotypes and encourage girls to see themselves as capable and competent in STEM. Closing the gender gap in STEM will not only benefit the girls themselves but also contribute to economic growth, innovation, and a more equitable society.

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