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Obstacles Women and Historically Marginalized Racial and Ethnic Groups (HMREG) Face in the Computer Science Field

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OBSTACLES WOMEN AND HISTORICALLY MARGINALIZED RACIAL AND ETHNIC GROUPS (HMREG) FACE IN THE COMPUTER SCIENCE FIELD

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Abstract

This article approaches the problem of underrepresentation of women and marginalized ethnic groups in the computer science fields from a developmental learning perspective. It proposes that systemic social barriers need to be addressed to overcome the bias toward women in the technological fields. The article surmises that even though stereotypes have changed in the past few decades, Gender Socialization which begins at birth and intensifies through adolescence contributes to inequalities of education, employment, and empowerment in adult life. It suggests that changing the educational paradigm beginning in early education, may result in more inclusive diverse perspectives, increase representation of women, and improve access to technological opportunities for all. That adapting education using holistic and culturally responsive teaching methods will positively transform the learning experiences of marginalized populations in technology education. The need for teacher preparation programs and role models are reviewed. The article discusses the importance of fair working conditions that will support and value the contributions of women in the media and technology fields.

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Introduction

Margolis and Fisher (2003) proposed that the Gender Socialization (GS) construct is at the core of the obstacles that women face in the Computer Science (CS) field. These obstacles include but are not limited to women's experiences and perceptions in the CS male-dominated field, limited opportunities, racial bias, gender discrimination, and stereotypes. Scholars utilizing the GS framework understand the impact of gender from a developmental approach. They propose that gender socialization which contributes to inequalities in education, employment, and well-being begins at birth and increases in adolescence through later life (Balvin, 2017).

From the Gender Socialization perspective, it can be argued that women have faced and still face various professional and educational obstacles that have contributed to underrepresentation in Computer Science in the U.S (Butterfield & Crews, 2020; Lunn et al., 2021). These obstacles include racial bias, gender discrimination, marginalization, hostile working and learning environments, inept Computer Science curriculum, and shortage of role models, to name a few barriers (Butterfield & Crews, 2020; Lunn et al., 2021; Margolis & Fisher, 2003).

Lack of "opportunities for girls to participate in out-of-school CS learning that is relevant to their interests, builds confidence and provides foundational CS knowledge" is another barrier (Current Perspectives and Continuing Challenges in Computer Science Education in U.S. K-12 Schools, 2020). From a Gender Socialization perspective, according to Margolis and Fisher's (2003) views and research findings, systemic barriers need to be addressed for women to succeed in computing. What has slightly changed in the past decades in terms of obstacles that women face in CS concerns stereotypes (Butterfield & Crews, 2020). Butterfield and Crews' longitudinal study's findings suggested "that the issues related to stereotypes are less of a problem than they may have been in the past. Although stereotypes still exist, their negative impact appears to be less impactful" in recent years (p. 24). Butterfield and Crews (2020) also argued there is still underrepresentation of women in CS, indicating that "the decline in female participation in this area is a cause for significant concern" (p. 24). These recent findings are in line with Margolis and Fisher's (2003) statement that "the shortage of people of color in the computing profession is even more dire than the shortage of women" (p. 10). Therefore, from a scholar-practitioner viewpoint, it can be articulated that little has changed besides the fact that "there has been a shift

in literature" about the significance of changing in paradigm with respect to more "calls to action" to remove barriers in CS that prevent women, especially women of color to enter and succeed in Computer Science careers (Lunn et al., 2021, p. 2).

Improving conditions for Women and Historically Marginalized Racial and Ethnic Groups from Elementary to Higher Education

As noted above, scholars utilizing the GS framework understand the impact of gender from a developmental approach, proposing that "Gender Socialization begins at birth, intensifies during adolescence and contributes to gender inequalities in education, employment, income, empowerment, and other significant outcomes of well-being during adolescence and later in life" (Balvin, 2017). From this perspective, it can also be argued that in order to address the gender gap in CS, it is critical to examine the experiences of girls and Historically Marginalized Racial and Ethnic Groups (HMREG) with CS in elementary school and the impact of these experiences in post-secondary education and beyond.

To transform the educational landscape and close the gender gap, Margolis and Fisher (2003) proposed that "cultural and curricular revolution is required to change computer science so that the valuable contributions and perspectives of women are respected within the discipline" (p. 6). While it is critical to acknowledge that some CS organizations, such as Code with Google | Google for Education, are now attempting to close equity gaps in CS education by "providing grant funding to nonprofits, building programs to expand access to computer science education, and helping train more female and underrepresented students in computational thinking" (*Code with Google | Google for Education, 2021)*; recent research from Lunn and colleagues argued that, "Despite initiatives to remediate enrollment and persistence of underrepresented groups in computing, women in computing have not seen substantial increases" (Lunn et al., 2021, p. 19).

Rahman (2016) noted, "how the undergraduate computing world has become highly androcentric in the past decades" (p. 15). While Margolis and Fisher's (2003) views stem from the Gender Socialization construct, another lens that could shed light on the obstacles affecting women at different age groups is Critical Feminism. Mumby's (2019) view on Critical Feminism states that societies and organizations are gendered, where gender is socially constructed and operated through power relations. According to Mumby, Feminism is a "discourse of empowerment" in which reality is viewed as being socially constructed by gender-based

communication that has mainly excluded the participation of women in institutions and organizations (p. 359). This paradigm may be particularly true in education at large, starting in primary grades and how all these parameters and constructs suggest that there is only one way of knowing. This only way of knowing is often "highly androcentric" and doesn't acknowledge an awareness and of the value of HMREG knowledge and ways of knowing. This is where elementary educators must challenge the known homosocial reproduction construct starting in the primary grades by empowering young girls and HMREG with CS role models and curricular experiences with which they may relate. Challenging the present social-educational paradigm in the primary grade levels may result in more women and HMREG empowerment and, consequently, minimize the obstacles women and HMREG face in the Computer Science field of post-secondary education and beyond. When we have more women, diversity, and more representation in underrepresented areas, we may develop more inclusive and less biased technology and thus have more representative and fair technology for all.

Historically Marginalized Racial and Ethnic Groups underrepresented in CS.

Given that Code.org no longer uses "the term 'underrepresented minorities' to describe students from non-white and Asian backgrounds, after an internal review found this language was both too vague and offensive" (*Using more inclusive language at Code.org*, 2020). In an effort to use-more inclusive language, for the purpose of this discussion, the term "historically marginalized racial and ethnic groups" will be used to refer to groups underrepresented in CS. (*Using more inclusive language at Code.org*, 2020).

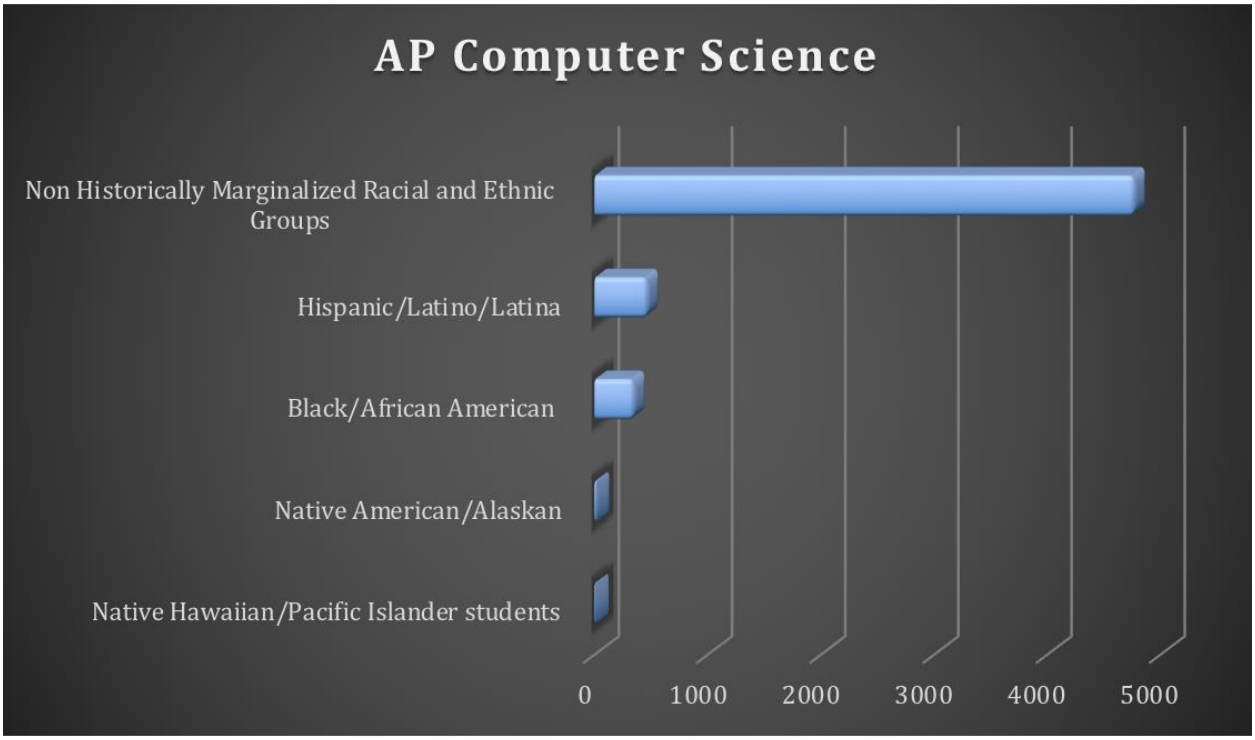
Therefore, the obstacles Historically Marginalized Racial and Ethnic Groups (HMREG) underrepresented in CS face in the field are even more concerning than those confronted by women. While qualitative research should not be generalized, it is fair to argue that HMREG not only address issues related to biases but also discrimination at various levels that range from microaggressions to racial profiling. Margolis and colleagues (2008) study, and research findings, stemmed from Margolis and Fisher's (2003) concerns related to race as another layer that impacted the paradigm of representation in the CS field during the study of gender.

As Margolis and colleagues (2008) explained, even after African Americans have access to pools, "they would have to enter the hostile white neighborhoods and consequently be at risk in the pools" (p. 19). Thus, it is not only about providing access and opportunities to HMREG

underrepresented in CS, but also about positively transforming the conditions and learning experiences for HMREG to be relevant and relatable. The transformation of learning experiences at various CS levels must be addressed in tandem with issues of access and opportunities as a holistic issue.

According to Code.org Massachusetts's schools appear to face similar obstacles related to those articulated by Margolis and colleagues (2013) as it concerns the representation of Historically Marginalized Racial and Ethnic Groups underrepresented in CS. From the 5,590 exams that were taken in AP Computer Science by high school students in the state, Hispanic/Latino/Latina students took 462 exams, Black/African American students took 343 exams, Native American/Alaskan students took 16 exams, and Native Hawaiian/Pacific Islander students took only 5 exams (*Support K-12 Computer Science Education in Massachusetts Computer science in Massachusetts*, 2020). Figure 1 provides an illustration of the ethnic and racial composition of students that took AP Computer Science exams in Massachusetts in 2020.

Figure 1: AP Computer Science exams in Massachusetts: Racial and Ethnic Overview



Data source: Code.org: Support K-12 Computer Science Education in Massachusetts Computer science in Massachusetts, 2020.

Lack of teachers as role models is also a barrier that may be observed in Massachusetts. According to Code.org, "Teacher preparation programs in Massachusetts did not graduate a single new teacher prepared to teach computer science in 2018." (*Support K-12 Computer Science Education in Massachusetts Computer science in Massachusetts*, 2020).

Diversity, Equity, and Inclusion lenses (DEI)

Undeniably, it is important to provide better conditions for women and Historically Marginalized Racial and Ethnic Groups underrepresented in CS. These conditions should not be limited to opportunities. If women and/or HMREG underrepresented in CS choose to enter the field, they must be supported, valued and mentored, so that they stay. While the authors do not believe in imposing anything on anyone in terms of what career path to pursue, we think schools must seek ways to provide conditions and experiences for girls and HMREG to enter and stay in CS. Such conditions and experiences are fundamental to students who would not have access otherwise at home, for several reasons, to have enough experience to make informed decisions as to what career to choose. This change in paradigm could result in more women and HMREG entering and persisting in post-secondary education in the field of Computer Science. As educators continue to embrace CS and integrate technology into their practice, adopting culturally responsive approaches to evaluate Computer Science resources is particularly important. It is critical that they develop strategies, explore frameworks, and create guidelines to examine CS selection and integration with Diversity, Equity, and Inclusion lenses (DEI). (*Diversity, Equity, and Inclusion*, 2021).

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