

2023

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Recommended Citation

Ponte, Vanessa; Cian, Heidi; Dou, Remy; and Guerrero, Brenda (2023) "Marginalized Youths Constructing Identities: A Literature Review of STEM Discourses," *FIU Undergraduate Research Journal*: Vol. 1: Iss. 1, Article 5.

DOI: 10.25148/URJ.010324

Available at: <https://digitalcommons.fiu.edu/undergraduate-journal/vol1/iss1/5>

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Marginalized Youths Constructing Identities: A Literature Review of STEM Discourses

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Colonialism gave rise to cultures of power, positioning non-white traditions and cultures as “inferior” including knowledge and education practices (Rosa & Mensah, 2021). As such, many children identifying with marginalized ethnic, racial, and/or gender groups, encounter sometimes contradictory and often deconstructive messaging from their educational and social orbits about their personal alignment with STEM (Cian et al., 2022). Consequently, minoritized learners are often faced with a requirement that, in order to persevere, they must adopt characteristics that the cultures of power in STEM embrace, such as girls pursuing physics disassociating themselves from femininity and highlighting masculinity in the way they present themselves (Francis et al., 2016). Furthermore, youths of color find themselves using survival strategies, such as “acting white” (McGee, 2016), in order to join STEM communities, which may result in dissonance with one’s cultural identities. In this literature review, I will unpack empirical research that illustrates how the STEM identity of youths is influenced by interactions with significant persons in the home and the school. The aim of this literature review is to inform future research in STEM identity development of youth who identify with communities marginalized in STEM spaces.

Keywords: *cultures of power, intersectionality, femininity, youths, STEM*

Cultures of Power in STEM

In western countries, colonization provided European men with the opportunity to declare their race as “superior” while positioning foreign knowledge, people, and education practices as “inferior” (Rosa & Mensah, 2021). Consequently, colonization gave rise to “dichotomies such as modern/colonial, civilized/barbarian, Western/Orient, scientific/traditional” (Rosa & Mensah, 2021, p. 504). The resulting systems developed by the colonizers institutionalize their spoken and unspoken norms, behavioral expectations, and values. An unseen hierarchy exists whereby only White, masculine norms, behaviors, and values are accepted as legitimate across almost every aspect of our society, including spaces (e.g., professions, schools, industry) categorized within the banner of STEM (Rosa & Mensah, 2021). These colonizing influences are also apparent in the construction of the discipline of science. For instance, Ong (2005) describes the cultural origins of science, pointing to research that shows purposeful association of masculinity with performances that are encouraged in scientific pursuits, such as objectivity and steadfast assurance of one’s intellect. The myth of science as culturally neutral has reinforced this perspective, even as individuals who describe themselves as scientists distinguish themselves from others using cultural criteria such as gender performance (Gonsalves, 2014; Ottemo et al., 2021).

The institutionalization of western science norms, practices, and values in educational policies, standards, classroom practices (e.g., Aschbacher et al., 2010; McGee, 2016), and informal learning institutions (e.g., Dawson, 2014) created environments that force “others” to conform to the behaviors, norms, and values of dominant groups (Cian et al., 2022, pp. 60-61). The lived experiences of marginalized youths are excluded while they are simultaneously asked to engage in STEM practices. STEM spaces are therefore dominated by the norms and cultures of the White, masculine subject (Collins & Bilge, 2016; Ladson-Billings & Tate, 1995). This divergent legitimization of specific norms, behaviors, and values creates what this article refers to as “cultures of power” (Mensah & Jackson, 2018). This literature review is focused on examining research that has described the experiences learners have within these cultures of power. While the origins of the marginalizing culture are an important piece of this story, they have been documented elsewhere (e.g., Keller, 1985; Schiebinger, 2000) and are thus not extensively detailed here. Through this work, we explore cultures of power in the context of youth and young adults within formal and informal educational systems, while honing in on articulations of femininity, racialization, and intersectionality in STEM.

Femininity and the Culture of STEM

Whether conscious or not, bias exists in scientific communities that contributes to the lack of participation by women in STEM. Although previous research suggests that lack of interest is a primary cause for women choosing against working in STEM fields, Cundiff et al. (2013) suggest that personal interest is oftentimes a reflection of situational factors (Ceci & Williams, 2010; Ferriman et al., 2009). It wasn’t until the late 1980s that the National Institutes of Health made it mandatory for female subjects to be included in medical research, where appropriate. Prior to this, some medical studies completely omitted women (Schiebinger, 2000). Experiences of women in STEM have similarly been reflected, with individuals who embody sociocultural feminine attributes being less likely to be associated with the attributes of

those that are typically found inhabiting STEM spaces due to their misalignment with STEM's masculine cultures of power (Banchefsky et al., 2016). For example, Wong's (2015) interviews with adolescents in the United Kingdom revealed that more than half of student participants clearly articulated the masculine characteristics of the jobs they perceived to have more relation to STEM. One student stated that it would be "weird" to see a "female scientist" in cartoons (p. 991).

Yet, research also finds that individuals' unconscious prejudices and expectations are so deeply embedded that they are unseen by their holder even when attesting to the contrary. Ottemo et al. (2021) showed that college students in Sweden and Canada described their science fields as gender neutral but still separate science from femininity. For instance, women pursuing science majors differentiated themselves from "other girls" (pp. 1026-1027). Gonsalves (2014) found similar perceptions were held by Canadian doctoral physics students. Francis et al. (2016) examined students' perceptions of individuals associated with hyper-femininity (i.e., "girly girls") and their possible alignment with STEM. Many participants, aged 15 to 16 years old, articulated that the notion of "girly girls" not doing science was "rubbish" (p. 1102). This inclusive notion of "girly girls" participation in STEM was also declared by a parent of a participant, referencing how his daughter engages in many activities typically perceived as feminine while maintaining interest in science. However, one-third of female student participants and over half of male participants agreed that "girly girls" are less likely to pursue physics than a less feminine girl.

To complicate matters, strong documentation indicates that individuals that do align with hyper(femininity) are indeed less likely to pursue physics (Gonsalves, 2014), while girls who do pursue physics and perform at an A-level disassociate themselves from femininity and may consciously highlight masculinity in the way they present themselves (Archer et al., forthcoming). A male student named Gus suggested that a stereotype exists where "girly girls" are depicted in the media (e.g., movies) as not being extremely intelligent, whereas the "not-so-popular" girls are depicted as the ones who are good at science (Francis et al., 2016, p. 1103). Another male participant, Buddy, negatively correlated socialization and free time with the possibility of being able to pursue science. Buddy stated that in order to be identified as a "girly girl," a girl must invest a lot of time into their physical appearance and social circles, which, in turn, would not allow for the "focused concentration" he perceived necessary in order to tackle the difficulties that a pursuit in science provides (Francis et al., 2016).

Some female participants also reproduced these conceptualizations of science as masculine despite many of them attesting that *all* individuals are welcome to pursue science (Francis et al., 2016). They expressed that female students that are "girly" are interested in "girly" careers, that is, those that social messaging depicts as feminine career paths (e.g., fashion, beauty, make-up, spa). Special emphasis was placed on the likelihood of "girly girls" not wanting to do physical labor or "dirty work," which was then directly associated with careers in engineering (Francis et al., 2016, p. 1104). Through their discourses, these participants associate STEM fields with masculinity, highlighting that in pursuit of STEM interests, "pre-prepared knowledge" is valued rather than "skills," and suggesting that heightened femininity excludes ability to concentrate, participation in "dirty work," and intelligence (Francis et al., 2016, p. 1103).

Consequently, in their association with feminine attributes, “girly girls” are likely to be discounted by peers in their probability of success in STEM fields. Davina, a White British/European female student, communicated that the pursuit of physics “has nothing to do with the fact that you are male” and that “girliness” does not have “anything to do with” it, positioning herself as an example of a girl in physics. Yet, she also expressed differences between herself and her female peers, suggesting that she is “probably more science-y” than them and therefore has “a lot more male friends than most of [her peers]” (Francis et al., 2016, p. 1105). Davina goes on to explicitly associate her ability to surround herself with more male friends with having more of a male “state of mind,” attributing this characteristic to playing a part in her success in physics.

Research highlights not only the forces young girls’ face to personify traditional male characteristics in order to pursue STEM careers, but also their embrace of roles historically and traditionally assigned to women, whether consciously or unconsciously. This includes antiquated notions that women are expected to adopt the role of primary caregiver in the home, while absence is excused for men in order to “provide” for their family (Thompson & Walker, 1989, pp. 850-851). Jana, a fifth-grade girl who identified as African American, suggested to her friends during a community-based science club meeting that they should “think seriously before they have children” due to their aspirations of pursuing an engineering career (Tan et al., 2013, p. 1159). Jana held a perception of an inability for coexistence between motherhood and a male-dominated career path, attributing this to a potential lack of free time. Their discourse suggests that boys and men are advantaged in their choice of a STEM career path in the sense that they do not have to choose between having children and pursuing their career of choice. Jana’s statement also assumes an impossibility or extreme unlikelihood for gender roles to differ.

The Racialization of STEM

The exclusion of STEM spaces is not limited to traditional notions of gender. The historical proliferation of scientific cultures and practices from western Europe (i.e., westernization) at and through U.S. STEM institutions continue to define achievement or success in science. The norms and cultures of middle-class White men with access to educational opportunities and resources that align with westernized systems dictate the science community (Mensah & Jackson, 2018; Cian et al., 2022). Strong documentation and evidence exist demonstrating that learners of color have been traditionally marginalized in these spaces (King & Pringle, 2018; McGee, 2016). Because of this marginalization, said learners of color experience an increased difficulty in associating themselves with STEM in contrast to those that are historically accepted in STEM spaces.

Disciplinary identity research—the extent to which an individual sees themselves as a member of a particular discipline (e.g., physics, math)—points to youths’ self-dissociation with STEM fields particularly when their bodies and lived experiences differ from the dominant bodies and experiences of those inhabiting STEM spaces (Dawson, 2019). In both formal and informal learning contexts, children are evaluated against standards defined by the White subject. Both in their self-evaluation and in the evaluation of their peers and teachers, they learn whether or not they align with westernized forms of science and for all intents and

purposes, science itself (Dou & Cian, 2022). As described by Dawson (2014), when asked about his views of informal science education, Thomas, an individual identifying as Sierra Leonean, proposed that “...people think you have to go there [a museum] a certain way, or do a certain thing when you get there or maybe like, it doesn’t fit in with your culture kind of thing...so maybe that holds people back” (p. 990). Thomas identified a system where marginalized individuals that are interested in science feel the need to align themselves with the cultural norms of those expected to be found in STEM settings. Similarly, McGee (2016) sheds light on an undergraduate student who described himself as Hispanic, coming from a “spiritually rich” lower-class community. This student articulated that one of his professors told him to “forget where he came from” and embrace his more “respectable lifestyle” (p. 1644).

Suggestions such as these from individuals who inhabit STEM spaces are often encountered by racialized youth interested in STEM fields, who feel pressure to conform to the cultural expectations of those fields (O’Connell & McKinnon, 2021). Consequently, “acting White” is a phrase sometimes used by individuals from racialized communities when describing peers who adopt what are perceived as “White” and “respectable” characteristics in order for them to fit into certain STEM contexts (McGee, 2016; Tyson et al., 2008). “The burden of acting White” was introduced by Signithia Fordham and John Ogbu (1986) when they found that succeeding in domains that are typically perceived to be characteristic of White individuals sometimes leads to a sense of devaluing one’s cultural identity when in conflict. “Acting White” is almost interchangeable with the term “frontin,” as described in a study expanding on racial stereotype management strategies that Black students adopt when interacting with STEM environments (McGee, 2016). These students “fronted” when they perceived a necessity to minimize or alter their own racialized identities or culture in order to prove themselves as a STEM person. Used as a survival strategy, Black students felt the need to “front” in order to succeed in the harsh world of discriminatory sciences when they deliberately neglected their own identities.

Intersectionality

The phenomenon of intersecting identities, whereby individuals identify with multiple social groups, has been the focus of social identity theory in science education. This theory has been particularly popularized through the framework of intersectionality. The term intersectionality was used by Kimberly Crenshaw (1989) to refer to the experiences of Black women as resulting from their identification as Black and as women. This feminist framework posits that gender and racialized identities shape individual experiences in a multiplicative fashion (as opposed to an additive fashion). Other social identities can come into play in intersectional ways, including classism, racism, sexism, and ableism (Gopaldas, 2013). Youths’ intersectional identities lead to individual experiences of multiple forms of oppression through cultures of power, leaving them more vulnerable to exclusion from STEM.

A case study conducted by Calabrese Barton et al. (2013) examined the unjust positionings that a young Black girl named Diane was defined by through her peers and teachers because of her lack of alignment with traditional expectations of her STEM environment. Despite her inability to complete her work on time and her soft-spoken mannerisms, Diane proved to have learned more in her science class compared to

the students that completed work in an amount of time that was deemed as more efficient. Diane's science teacher publicly evaluated Diane against students who completed their work on time but whose responses were less accurate, while also failing to recognize Diane's intrinsic interest in science. Her evaluation of Diane was grounded on the exaltation of traits traditionally associated with Whiteness and masculinity (i.e., efficiency and assertiveness; Rosa & Mensah, 2021). Engaging in her schoolwork in a manner that was meaningful to Diane led to her consistent positioning as slow and not caring about school success (Calabrese Barton et al., 2013). Diane's science teacher projected historical narratives to her perception of Diane's inability to be a "strong science student" by explaining that she lacked support and extra assistance at home—comments that are based on what is presumed to be true of Black youths who reside in a lower-income, one-parent household (Calabrese Barton et al., 2013). The feedback given as to why Diane does not succeed like the other students was accounted for by racial strife and lack of masculine characteristics, insinuating that there is only one path a student can take in order to become successful in STEM.

Diane was also part of a science club at school and decided to stop attending meetings once "White girls" held a majority of club membership. She then decided to spend her lunch period with her "African American friends" (p. 65). Slowly, Diane's lack of alignment with societal expectations of STEM people contributed to a steady decline in her excitement, interest, and perceived competence levels (Calabrese Barton et al., 2013). Using perceptions of others to shape the way Diane saw herself, she never saw herself as having a STEM identity throughout the case study. Cultures of power play an important role in the way the STEM community not only perceives itself, but also in the way that it welcomes others who are attempting to join the community.

Pseudo-Summary

Although we limit the content of this article to articulations of femininity, racialization, and intersectionality in STEM, this is only a portion of a larger literature review that addresses additional concepts. These include the negative mental health consequences and rejection from one's own community that youths may encounter while attempting to survive in STEM spaces; hierarchies created by perceptions of STEM careers; heteroglossic contradictions articulated by minority youths paving their way in STEM careers; and a summary of research on interventions that have addressed the systemic messaging associated with STEM that children encounter, with attention drawn to areas of need in research and practice that persist and/or have become accentuated in recent years. It is important to note that the factors highlighted in this article do not excuse the overrepresentation of White men in science, and further steps toward increasing diversity and inclusion in STEM fields should be taken. Our aim is for this work to inform future research in the STEM identity development of youth who identify with communities marginalized in STEM spaces.

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