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CRITICAL READS

Leveling the Playing Field: Addressing the Culture of Urban Mathematics Education in *Black, Brown, Bruised: How Racialized STEM Education Stifles Innovation*

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In *Black, Brown, Bruised: How Racialized STEM Education Stifles Innovation* by Ebony Omotola McGee (2020), the author focuses on the stories of underrepresented, racial minoritized (URM) students that have found success in the fields of science, technology, engineering and mathematics (STEM) rather than the two-thirds of URM students who begin their education in STEM programs and then drop out. Understanding experiences of URMs who succeed academically "enables a deep appreciation of what it means for students of color to be academically successful in places where their numbers are few and negative beliefs about their ability prevail" (McGee, 2020, p. 1). As a White cis-gender woman and an African American cis-gender woman who are educators and emerging scholars in the field, our discourse is based on honest conversations about our own differing experiences and perspectives. We situate ourselves in a place in which McGee describes as "a keen desire to work for racial and global justice" (p. 79), and this book review is based on our own understanding of the inequities in the field of STEM education and the effects of these inequities on mathematics education.

We came together to read this text in the midst of the COVID-19 global pandemic, welcoming candid conversations and research initiatives that this text would inevitably inspire. The disproportional impact of the COVID-19 pandemic on minority groups illuminated issues of inequity that extend into various realms of reality for minoritized groups of people. For example, we noted the impact that access to healthcare had on the vulnerabilities of minority groups of people to the effects of the pandemic. Furthermore, there was an undeniable difference between the ability of some Americans to transition to working from home and virtual learning for their

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children, compared to others that continued to work in person due to the essentiality of their positions, inaccessibility to childcare, or lack of resources needed for virtual learning. This issue is a social one determined by demographic criteria such as education, income, ethnicity, and marital status. Social identities impact the risk and exposure of minority groups to the virus compared to those from more dominant groups. We noted the theme of inequity in reference to the pandemic and how social identities and societal factors similarly affect STEM experiences and mathematics education.

Working together as a part of a STEM education research lab team, we found ourselves having many conversations about the underrepresentation of minorities in our field. Jami, who just graduated from her PhD program, was living in a racially divided southeastern U.S. city and working with primarily Black and Hispanic middle and high school mathematics students. She saw firsthand the inequities in the K–12 educational system and spent many nights trying to come up with ways to increase the opportunities for her students. Tynetta, a Black woman in her third year of her PhD program with three young Black children of her own, has a research interest specifically focused on Black women in STEM because of her personal experience while pursuing a STEM degree. She experienced the minority-related obstacles firsthand as a person of color and as a woman, an experience characterized as the "double-bind." We committed to reading this text together, to have open and honest conversations, and to share both personal experiences with ourselves, our children, and our students. We value the importance of discourse between a White woman and a Black woman in STEM.

We invite the reader to join us in this conversation of recognizing the hardships and embracing the success of URMs in mathematics and other fields of STEM while continuing to learn how we as educators work to alleviate the leaks in the STEM pipeline by supporting URMs and the unique burdens that characterize their experiences.

The Leaky Pipeline: A Thematic Analysis

Black, Brown, Bruised: How Racialized STEM Education Stifles Innovation is divided into six chapters, each of which focuses on the personal accounts of URMs that have had academic success in STEM in order to "hear the voices of scholars of color as they feel their way through a forbidding STEM educational landscape" (McGee, 2020, p. 3). The structure of the book is designed to take readers from understanding the current discriminatory culture of STEM to practical suggestions to acknowledge and eliminate structural barriers facing URMs. We discuss the book in three overarching themes: Dealing with Structural Racism, Equity Ethics and Community Support, and Practical Guide for Leaders. These themes were derived by the authors to organize the six chapters into the three overarching ideas. The authors

group the first three chapters of the book within the theme of "Dealing with Structural Racism," as McGee uses these three chapters to emphasize male dominance and lack of diversity in STEM fields (Chapter 1), identify structures in place that perpetuate racism (Chapter 2), and describe the building blocks of racial discrimination and the detriments of self-coping mechanisms (Chapter 3). McGee then shifts her focus to what the authors have classified as "Equity Ethics and Community Support" in the next two chapters, as she details identity- and culture-based strategies in STEM that work for minority students and identifies current efforts that have increased URM participation. The final chapter of the book provides STEM leadership with the next steps for structural change and is classified by the authors of this review as "A Practical Guide for Leaders." We have organized this review thematically, identifying points of our critique within a summary of the text.

Dealing With Structural Racism

In the opening chapter of the book, McGee (2020) identifies STEM culture as "individualist, ultracompetitive, overwhelmingly White (with some tokenized Asians), mostly heterosexual, militaristically grounded, middle-to upper-class, nationalist, able-bodied" (pp. 20–21). The discriminatory and racist nature of STEM culture is evidenced in hegemonic practices focused on preparation of a STEM workforce, anchored in concerns for global competition, national security, and militarization (Takeuchi et al., 2020). It is in our own experiences that the White supremacy within STEM culture is prevalent. McGee (2020) argues that this STEM culture contrasts a mindset of group solidarity and collective work that is commonly found in Black, Latinx, and Indigenous communities. Additionally, the current STEM culture and the underrepresentation of Black, Latinx, and Indigenous people in STEM leads to missing critical contributors, which permeates the continued pattern of structural bias within the field. As a result, many students of color feel isolated, invisible, marginalized, and lack belongingness (Mack et al., 2019). Discrimination and reduced participation of URMs in STEM fields result in limited quantity and diversity of intellectual capital available in these fields (Ballenger et al., in press; McKim et al., 2017; Nilsson, 2017). Consequently, "STEM and STEMers' abilities [are hampered, preventing them from being] as ingenious and imaginative as they can be, thereby stifling innovation in these fields" (McGee, 2020, p. 20). These consequences are not only detrimental to individuals but have greater effects at the macro level.

When the voices of the leaders in the field only represent one specific demographic, we wonder how this affects students that are not a part of that demographic. McGee (2020) points out URM students' feelings of isolation and marginalization, but we are left wondering how diverse leadership teams support URM students and enhance programs as a whole. Furthermore, we want to know the effect it has on STEM innovation. While McGee begins the text with the notion that racism and discrimination prevent ingenuity and the production of products and services beyond

our wildest dreams (i.e., flying cars in *The Jetsons*), she fails to consider STEM environments that are largely diverse and known for STEM minority success. For example, faculty at Spelman College have established a STEM climate that supports the belief that all students can achieve their goals and all students can be academically successful, even implementing a common curriculum that has been developed to encourage attainment of minorities with changes in instructional approaches that promote success (Perna et al., 2009). This inclusive culture exists in STEM environments at many Historically Black Colleges and Universities (HBCUs; McGee, 2020; Perna et al., 2009; Tate & Linn, 2005). To avoid dismissal of the achievable vision of flying cars or the like, important to consider are the accomplishments and inventions of minorities that inhabit areas where diversity and inclusion exists. While some STEM spaces are successful at establishing inclusion, STEM culture largely remains discriminatory, marginalizing minorities.

To promote anti-oppressive and humane mathematics education agendas, scholars have created *funds of knowledge* (González et al., 2005; Kiyama & Rios-Aguilar, 2018; Moll et al., 1992). McGee (2020) identifies funds of knowledge as "an antideficit framework that unearths and leverages knowledge produced in the cultural-historical experiences of Latinx students' families and communities" (p. 23). The idea of funds of knowledge could have been further explored to examine the communal functioning of other minority groups, and the funds of knowledge that URMs bring to the STEM field are not recognized. Further consideration of URM groups beyond Latinx would have strengthened a *pedagogy of solidarity* (McGee, 2020), or a unity of URM communities to combat White supremacy in STEM culture. Additionally, although McGee recognizes that scholars in the field have come together to leverage their individual and collective expertise, voicing their ideas and concerns related to the field of mathematics, there are no explicit examples supporting the change or lack of change due to their contributions. Having an example could empower readers and give them a practical guide to voice their own ideas and concerns in their STEM field and institutions.

In the second chapter, McGee (2020) details how underrepresentation of both students and faculty in STEM disciplines is just one aspect of structural racism. Many aspects of structural racism lead many URM students to leave the field, including but not limited to racial stereotypes, lack of opportunities, and unwelcoming institutional climates (Beasley & Fischer, 2012; Rainey et al., 2018; Riegle-Crumb et al., 2019). Maurice, for example, had a strong interest in engineering and was proficient in mathematics and science but explained that during an engineering summer internship as a high school student, he was treated like an "affirmative action, token Negro" and was consistently challenged and questioned about his ability to do his job (McGee, 2020, p. 34). Unfortunately, it was at a young age that Maurice learned that his hard work and intellect was not enough to prevent him from experiencing racism. This experience led him away from furthering his education in the field of engineering.

According to McGee (2020), racism in education systems is perpetuated by the structures that protect them. She describes the "feelings of powerlessness, invisibility, loss of integrity, or pressure to represent one's group" (p. 38) as psychological race-related stressors that lead to racial battle fatigue. Although she identifies these feelings, it leaves us wondering how we as educational leaders support URMs in urban mathematics education when our structures lead to psychological and behavioral responses that are debilitating. Psychological support is critical, as seen through the experiences of successful URMs in STEM and specifically at HBCUs that McGee shares. It is important that we learn from these successes.

McGee (2020) dives into the personal accounts of URMs who have found success in STEM despite pervasive structural racism. Stereotypes and racial microaggressions not only made it more difficult to be successful but also affected the health of the students that McGee interviewed. Common patterns included "self-blame and self-questioning (imposter syndrome), overworking in the hope of having their competence recognized, going into survival mode, experiencing racial battle fatigue and being unemployed as a direct result of being denied opportunities by White or Asian principal investigators" (McGee, 2020, p. 57). Although in survival mode, the success stories of URM students recognized that personal experiences helped them survive, as they had become conditioned to hostile environments throughout their entire academic careers. Additionally, those who had success found a way to form functional mathematics and STEM identities.

McGee (2020) references Tinesha and Rob, students who found internal motivation and embraced mathematics, mastering mathematics despite persistent acts of racism and their conditioned ability to cope with them. Their coping strategies included working on self-discovery and self-definition. They both joined organizations that celebrated Black STEM students' identities and achievements and also associated with like-minded mentors. Tinesha and Rob were fortunate to operate from a position of strength, minimizing psychological damage (McGee, 2020). Coping mechanisms are common responses to the negative experiences minorities face in STEM environments. Coping strategies are not interventions at all, though they have shown to be influential to STEM persistence (Alexander & Hermann, 2016; Carlone & Johnson, 2007; McGee & Bentley, 2017; Watkins & Mensah, 2019). We wonder what can be done in educational environments to support URMs and prevent them from needing coping strategies to lessen the blunt force of racism as they pursue their educational journeys.

Equity Ethics and Community Support

Through the examples in the book, we can see that structural racism makes it more difficult for URMs to find success in STEM. One pattern that McGee (2020) found with students of color who did find success is that they wanted to serve their communities and the world. She described this as a key motivator and called it an

equity ethic, defined as "a set of values that includes a principled concern for justice, particularly racial justice, for addressing racial inequities, and for the well-being of people suffering under various inequities" (p. 76). In the stories shared, she also identified equity ethic as a cultural phenomenon, as Black, Latinx, and Indigenous cultures tend to emphasize the importance of family and community, whereas American culture tends to be more individualistic. Supporting this claim, a study found that mathematics classes at two HBCUs adopted a communal and kinship structure, resulting in markedly increased student motivation (McGee, 2020; Taylor et al., 2008). Adopting a structure characterized by personal interactions, sharing of information, and mutual support of peers supported the cultural experiences of the students and seemed to have increased their motivation. As students of color are motivated by their own equity ethic and become empowered, this communal and kinship structure results in increased STEM interest and relatability to STEM subjects (Hollins, 1996; McGee, 2020; Tytler, 2007).

McGee (2020) concludes that structuring STEM education to encourage equity ethic (such as giving students the opportunities to apply their skills to humanitarian projects and incorporate community service learning), establishing learning communities for collaborative learning, and recognizing the cultures and experiences of each unique student will attract more URMs to the field. She expands on the idea of equity ethic by identifying effective educational approaches for URMs in STEM in Chapter 5. She begins by describing the importance of a welcoming environment through learning centers, workshops and seminars for study skills and career support, career and financial counseling, and academic counseling. We identify this as a way for the structure of the program to demonstrate equity ethic and provide community support to URM students and believe it is important to learn from programs that have been successful.

In three examples identified as successful programs that support students of color, community support was also a common theme. All programs focused on teamwork, collaborative learning, and building a community. The Mathematics Workshop Program at the University of California specifically focused on increasing the number of African American and Latinx students. Through the emphasis on "group learning, efficient studying, and a community whose members share an interest in mathematics" (McGee, 2020, p. 103), the program found that participating Black and Latinx students had more academic success than their nonparticipant URM, White, and Asian classmates. Although not mentioned in the book, after further research we found that the Mathematics Workshop Program was only in existence from 1978 to 1984. Although the program achieved dramatic results, including the first African American and first female student at Berkeley to be awarded a Rhodes Scholarship, it was short lived, leaving us wondering why it is no longer in existence and why McGee does not mention this.

McGee (2020) also identifies mentoring as a crucial component of URMs' success when implemented appropriately. She defines successful mentoring as when mentors provide "emotional support, accountability, the skills and strategies they needed to negotiate higher education, and a way of understanding themselves in relation to race-and class-based systems of inequity" (p. 106). We found her detailed list a practical guide for institutions. Additionally, we want to emphasize the importance for "faculty members from dominant groups [to] acknowledge the existence of unequal power relationships, discrimination, stereotyping, and oppression of URM groups" (McGee, 2020, p. 110). It is not until this acknowledgement that we feel that White faculty members can build successful relationships and learn about their URM mentees' personal histories and goals. Although the importance for dominant groups to acknowledge the marginalized positions of URMs is present in the text, there are no recommendations made for how to address this with the dominant group. We would have liked to have seen McGee give specific examples for how institutions can work with their faculty to ensure understanding and strategies to best mentor URMs. Without these specific examples, minority faculty are left with the responsibility to mentor URMs along with other designated and voluntary service work. While mentorship between URMs and faculty members with common race and gender have been shown to be effective in providing support in STEM environments (Borum & Walker, 2012; Hanson, 2004; Jackson, 2013; Lockett et al., 2018), worth noting is the limited availability of university faculty that are from historically marginalized groups and the burden this places on those that are in faculty positions (Armstrong & Jovanovic, 2017; McGee, 2020).

Learning from the success stories can enhance teacher education programs and ultimately support students prior to higher education. In the success stories, we have seen patterns of efforts to provide support, embrace culture, and promote positive STEM identity development. If teacher education programs are training the newest generation of teachers to be successful mentors to URMs and to provide a classroom environment that promotes equity by embracing each student's culture as well as self-discovery, there is a possibility that this shift in STEM culture will encourage the success of URMs.

Practical Guide for Leaders

Throughout the book, McGee (2020) not only shares the struggles of URMs that have been successful in the field of STEM but acknowledged the perseverance that each individual demonstrated to be successful in a system that was designed to exclude them. In the concluding chapter, she identifies seven practical steps to encourage and support students of color to enter the fields of STEM. She claims the following practices will not only increase their graduation rates but also their comfort, safety, and health:

1. Hire more faculty of color in STEM faculty positions
2. Implement identity-conscious STEM mentoring programs
3. Hire counselors of color who specialize in the trauma experienced by STEM higher education students (and faculty)
4. Create pathways for people of color to pursue STEM entrepreneurship
5. Retain STEM faculty and industry leaders
6. Acknowledge the work of STEM research educators
7. Respect and properly fund HBCUs, HSIs, and Tribal Colleges as the leaders of URM STEM student success (pp. 126–132)

These are important steps to take because, as McGee (2020) states, "diversity becomes key to excellence" (p. 134). These steps are relevant to us personally. As members of the STEM Education Innovation Lab at Mercer University, we see the benefits of implementing these steps. Six out of seven faculty members on our STEM education research team are faculty of color. All faculty members implement an identity-conscious mentoring framework to mentor the graduate and postdoctoral fellows. Additionally, we are given the opportunity to engage in the work of and interact with STEM educators and researchers of color. Our team of graduate students have had success both in the classroom and with their own personal research interests. We credit this to the support of the faculty on our research team.

In addition to providing practical steps for higher education, McGee (2020) also provides recommendations for the STEM community, STEM departments, and policy makers. STEM communities should self-examine and closely look at existing diversity models and determine how well they are working. STEM department leaders must examine their own departments to determine if additional steps need to be taken to "develop, extend, and sustain equity-centered practices" and "work to increase their cultural competency and use their learning to inform programs, initiatives, and decisions" (McGee, 2020, p. 135). Finally, policy makers should promote equitable teaching practices and development by "hold[ing] universities accountable for maintaining quality standards to enact policy that mandates tackling institutional bias" (McGee, 2020, p. 136).

While we see the value in providing practical guides for STEM leaders, departments, communities, and policy makers, we note that McGee (2020) does not discuss how to address these same issues in teacher education programs. We believe that these recommendations should also be applied to urban mathematics education to dismantle structural racism and support the education of URMs at all levels of education. Specifically, we would like to see mathematics departments self-examine and look closely at their existing diversity models as well. By determining the state of their diversity models, mathematic departments can either ensure that equity-centered practices are in place or develop these practices to increase their cultural competence. We would also like to see mathematic departments working alongside

STEM departments to provide community outreach to support the education of URMs at all levels of education, beginning in elementary school.

With a focus on underrepresentation in higher education, we wonder what a focus on recruiting and retaining STEM teachers of color might have looked like in this text. If we recruit and retain STEM teachers of color and have more representation of URM teachers in K–12 school buildings, how might that encourage younger generations to matriculate into STEM programs? How might that encourage URMs to form functional STEM identities at younger ages? Would URMs with frequent STEM teachers of color develop healthier, more effective ways to cope with racism and hostile educational environments? *Black, Brown, Bruised: How Racialized STEM Education Stifles Innovation* sets the groundwork for discourse on URMs in STEM; we hope that this conversation will expand to include urban mathematics education, K–12 STEM education, and teacher education.

We believe shifting our focus to critiquing structures currently in place is necessary and promotes questions that have roots far deeper than experiences in higher education. We wonder how to change the culture of STEM environments to embrace diversity, acknowledge cultural backgrounds, and encourage the success of URMs. As seen throughout the stories shared, it is apparent that systemic racism and structural biases begin far before higher education.

Conclusion

As we began reading the book, neither of us were surprised by what we were reading, as we have seen many of these experiences play out in front of our eyes. However, McGee (2020) calling out structural and institutional racism, discrimination, eugenics, and oppression opened our eyes to the reality that Jami knew existed and that Tynetta experienced firsthand. McGee opens the door to this discourse by sharing the conversations and stories of others through a presentation of commonalities. In this text, readers are forced to see the struggles of URMs in STEM rather than reading over it with sugar-coated terminology. *Black, Brown, Bruised: How Racialized STEM Education Stifles Innovation* encourages readers to have difficult conversations to acknowledge issues in urban mathematics and STEM education and to call for equity and change in these fields.

We engaged in this conversation ourselves. Tynetta shared with Jami that the decision to further her own education and pursue a PhD was not only because of her love of learning but largely centers upon her desire to accomplish more for her family. As a first-generation college graduate, Tynetta paved her own path. Jami, on the other hand, grew up in a family with two parents who are both college graduates. When Jami was in high school, she was never asked the question, "Will you be going to college?" Rather, the question was always "Where are you going to college?" Not only did she grow up seeing college in her future, she also knew she had the support

of her parents who had been to college themselves and grew up understanding the process of continuing into higher education. This cultural capital based on the family she was born into gave Jami an advantage over Tynetta. We engage in this work to help URMs gain the cultural capital to level the playing field.

Additionally, Tynetta knows that more education for her unlocks career opportunities otherwise unobtainable without a terminal degree. However, in most intellectual and professional spaces, including faculty meetings, she feels insignificant, ignored, and overlooked. Despite being one of the most qualified in the room, she is often the only Black woman. She expressed to Jami that her hope is that obtaining a PhD gives her a seat at the table. She said, "My academic journey continues to show me that even still, sometimes education and qualifications aren't enough for a seat at any table. It is unfortunate but a reality that many Tynettas know." Jami wonders if an idea she has shared would have been shut down if it had come from Tynetta. For Jami, it is a hypothetical situation, but for Tynetta it is an unfortunate reality. It is the structural racism that Tynetta has personally experienced and the open and raw conversations she has shared with Jami that motivates us both to engage in this work. These motivates us to continue our research and activism at our own university to promote the success of URMs and implement change. Our hope is that our work is impactful and prevents future URMs in STEM fields from experiencing marginalization or abandonment of the STEM arena and instead fosters them with feelings of inclusion, support, and acknowledgment by all with a seat at the table.

We bring this review to the *Journal of Urban Mathematics Education* to invite urban mathematics educators and researchers to join us in this conversation about the structural and institutional biases that are stifling the success of URMs in STEM disciplines. *Black, Brown, Bruised: How Racialized STEM Education Stifles Innovation* brings to light the academic and psychological struggles URMs must overcome to be successful in STEM education. The ideas expressed should be the starting point for many more conversations that promote action to reimagine and reconstruct the educational system.

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