

Towards Equity for Students and Teachers of Colour: Insights into Pedagogies, Emotions and Initiatives in Science Education

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Abstract: In this paper, we reviewed recent literature on equity pedagogies and initiatives for students of colour as well as the role of teachers' emotions in science education, especially for teachers of colour within K-12 contexts. Our review was guided by two questions: a) how do conceptualization of equity inform the design and implementation of equity-oriented initiatives to promote academic success among students of colour and b) how can emotions be leveraged to understand identity construction of science teachers of colour to further inform equity initiatives? Our findings reveal that, while equity initiatives have gained prominence in education, there are varied meanings and understandings of equity that inform how equity pedagogies and initiatives are developed and enacted. The study has important implications for educators, researchers and policymakers. It provides a comprehensive overview of the current debates about equity pedagogies, initiatives and the role of emotions in fostering the identity of science teachers of colour.

Keywords: Science Teachers of Colour, Students of Colour, Teachers' Emotions, Equitable Pedagogies, Equity Initiatives

Background and Context

The debate around the effectiveness of equity pedagogies and initiatives in benefiting students, particularly students of colour has sparked discussions in recent years. Scholars argue that these initiatives are essential for addressing systemic barriers and promoting academic success among students of colour, who have historically faced challenges in education (Gay, 2018). These initiatives seek to create a more inclusive learning environment by addressing biases, promoting cultural responsiveness, and providing targeted support services that empower students of colour to succeed in their academic endeavours. Research has consistently shown that equity initiatives lead to improved academic outcomes, increased student engagement, and enhanced sense of belonging among students of colour (Hammond, 2020; Nagaoka et al., 2015; Perez, 2019). Moreover, studies have highlighted the importance of equitable teaching practices (Bartell et al., 2017) and culturally responsive teaching practices (Avraamidou, 2019; Gay, 2018), as well as promoting inclusive school climates to develop and sustain a more equitable learning environment for all students (Harper, 2018).

In addition, science identity-based research, which explores how individuals develop and negotiate their sense of self in relation to science, is gradually expanding towards the equity discourse around the experiences of students and teachers of colour (Avraamidou, 2019; Zhang & Jiang, 2023). According to Danielsson et al. (2023), identity-based research in understanding the unique socio-cultural experiences of students and teachers in science is crucial. This recognition raises a question of how we can better understand the multi-layered experiences of students and teachers of colour as they learn and teach science. In this paper, we have accordingly reviewed scholarly literature on equity issues in education and provided our synthesis of how educators and researchers can better support students and teachers of colour by promoting equitable teaching and learning. Hence, we ask the following questions: a) How do conceptualizations of equity inform the design and implementation of equity-oriented initiatives to promote academic success among students of colour; b) How can emotions be leveraged to understand the identity construction of science teachers of colour to further inform equity initiatives?

To address these guiding questions, in this review paper, first we have stated how three of the authors come together to engage in discourses on equity issues in science education. We then articulated three broad segments to synthesize the findings from our review of the literature. The segments are as follows: a) conceptualizations of equity and equitable pedagogical practices; b) emotions as a tool to understand identity construction of science teachers of colour; and c) equity initiatives for students of colour in Canada.

Positionality

To better appreciate why we engage in conversations about equity pedagogies and initiatives targeting students and teachers of colour, it is important to recognize our positionalities and how we come to this work. We are all students of colour from the Global South, with our formal education taking place in the Global South and Canada. In our professional experience, we have all worked in K-12 education space as educators. Additionally, we have all witnessed

the challenges teachers of colour face in a patriarchal context which have deeply informed our understanding of the socio-cultural dynamics that influence how emotions are intertwined with identities of science education. Furthermore, our work in K-12 education context has provided us with valuable insights to the unique challenges students of colour encounter, from navigating academic expectations to dealing with subtle and overt forms of discrimination in schools. Our educational and professional experiences have deepened and informed our commitment to advocating for educational equity and policy initiatives that amplify the voices of both students and teachers of colour.

Perspectives and Conceptualization of Equity in Education

The review of the extant literature shows that while equity is recognized as a core value in education, it is understood in different ways by different stakeholders. These differing conceptualizations of equity have important implications for developing and implementing equity pedagogies and initiatives. For example, recent research indicates that equity should not be confused with concepts such as equality (Gutierrez, 2013; Takyi et al., 2021). Indeed, Takyi et al. (2021) argue that portraying educational equity as equality, where all students have equal access to resources and are treated the same, undermines the concept of equity, which involves providing tailored support to students according to their specific needs. The concept of equity in education involves offering tailored support and opportunities to students, irrespective of their gender, cultural background, or race, to ensure that they attain competence in their education (Bartell et al., 2017). Thus, equity refers to offering personalized assistance and opportunity to students to help them achieve their educational objectives. From this perspective, the first step to developing and implementing equity initiatives is to identify the needs of students. Once the needs of students are identified, educators can then develop tailored interventions to support these students. By adopting this perspective, educators can then initiate equity programs that truly benefit the intended recipients.

Other scholars adopt the social justice perspective of equity and explore equity initiatives by addressing systemic structures that operate as obstacles for students to attain their academic goals (Aincow, 2020; Calabrese Barton & Tan, 2018). In this conceptualization, discourse concerning equity encompasses the systematic identification and elimination of obstacles that hinder participation, engagement, and success of students (Chapman & Ainscow, 2019). These discussions and initiatives focus on promoting fairness, inclusivity, and opportunities for all students regardless of their background, abilities, or circumstances (Louie, 2017). Also, it centres students vulnerable to marginalization, exclusion, or academic underperformance (e.g., students of colour). Organizing equity initiatives from this perspective can support students of colour to thrive in their education by disrupting existing structures that serve as barriers to these students. We contend that focusing on equity initiatives is vital to challenging the structures that sustain inequities in K-12 education. Educators and policymakers are increasingly prioritizing these initiatives to support the success and well-being of all students, especially students of colour. However, equitable pedagogical practices have received less attention. In the following section, we explore different perspectives on equitable pedagogies and discuss how to support teachers in developing and implementing them.

Equitable Pedagogies in K-12 Education

Equitable pedagogies are essential for creating an inclusive learning environment that supports the diverse needs of all students and make learning accessible for all students (Kuttner, 2016; Tan & Thorius, 2019). To address the disparities in K-12 spaces, educators must move beyond one-size-fits-all approaches and instead adopt pedagogical practices that recognize and value students' unique cultural and educational experiences. We conceptualize *equitable pedagogies* as pedagogical practices informed and shaped by an understanding of students' unique cultural and educational experiences. We draw upon Gutiérrez's (2009) four key dimensions of equitable pedagogical practices: a) *access* (i.e., resources available to students to learn and a classroom environment that allows for full participation); b) *achievement* (i.e., participation in class work and improving students overall scores to gain acceptance to college); c) *identity* (i.e., the balance between learning school subjects and students' cultural, racial, linguistic, and gendered resources); and d) *power* (e.g., giving students a voice in the classroom). These dimensions can inform the pedagogical practices that acknowledge the lived experiences of students of colour. For instance, implicit biases in teacher expectations often limit access and produces inequities. Additionally, in terms of achievement, dominant narratives in science education usually portray students of colour as "underachievers," failing to consider how systemic racism, microaggressions, and a lack of culturally responsive teaching impact performance. Furthermore, traditional approaches to teaching science often disregard the cultural and lived experiences of students of colour, leading many to internalize a belief that they do not belong in science. Finally, the dimension of power seeks to challenge traditional

approaches to science, which position students of colour as passive recipients of knowledge rather than active creators or critics, emphasizing that science is not culturally neutral but has historically been used to maintain systems of privilege, and it also has the potential to disrupt these systems. Gutiérrez (2009) argued that by attending to these dimensions, educators can address equity holistically with educational spaces.

We also draw upon the works of Bartell et al. (2017) and Moschkovich (2013) to frame equitable pedagogical practices for students of colour as pedagogical practices that: a) support students' reasoning and conceptual understanding; b) provide ample opportunities for students of colour to participate in every aspect of classroom activities (e.g., the teacher makes a conscious effort to ensure that students' voices are heard and amplified); c) utilize multiple resources and diverse ways of engaging in classroom discourses; and d) view students' home experiences as valuable resources, where teachers leverage these experiences as tools to deepen engagement rather than treating them as barriers. Enacting these equitable pedagogical practices therefore requires that teachers develop skills and strategies for engaging, supporting and orchestrating discussions in the classroom that support all students (Kazemi & Stipek, 2009; Stein et al., 2008), particularly students of colour, in meaningful learning. Developing equitable pedagogies also connects with how teachers of colour shape their identity as science teachers. Given the complexity of their socio-cultural experiences, it is important to understand how emotions shape their identity as teachers.

Emotion as a Tool to Understand Identity Construction of Science Teachers of Colour

The socio-cultural and contextual experiences in learning and teaching science may serve to design and implement equitable science pedagogy in different parts of the world (Avraamidou, 2019). Among a wide range of unique experiences, understanding emotional experiences of science teachers around the globe is an emerging field in science identity-based research. There remains a scarcity of research specifically examining the role of emotions and the mechanisms through which they influence the identity construction of science teachers of colour in different contexts. In this section, we highlight the link between the emotions of science teachers of colour and the multiple layers of their identity formation. It contributes to addressing this less known gap and aims to synthesize relevant literature on how understanding the emotional dimensions can support the formation of science identities of teachers of colour.

Emotions, Identity, Learning and Science Teachers

Research has emphasized how individuals' emotions (i.e., motivation, interest, and attitudes) toward science influence their learning outcomes and the formation of their science identities (Ferguson et al., 2023). For example, positive attitudes towards science, motivation to learn science, and interest in the field are often seen as the key indicators to pursuing a career in science teaching (Avraamidou, 2019). In discussing the importance of science teachers' emotions, Rivera Maulucci (2013) stated that "emotions influence the goals teachers set and indicate the intensity of their relationships to ideas, to their beliefs about science, to others, and to science teaching" (p. 137). The author contended that an exploration of the links between emotions, identity, and social justice is especially important in science education because the interplay of emotions and identity "captures the ways our beliefs about the world, school, classroom, and science may conflict with how they are" (p. 125). In her research involving an Afro Caribbean preservice teachers, she investigated how the teacher's evolving perspective on social justice over time was reflected in the emotions she felt throughout this process. The study's outcomes demonstrated the pervasive role of emotions - such as frustration, desire, empathy, and resilience- and emotional effort in every aspect of teaching for social justice. It also emphasized the link between teachers' sense of belonging, their contemplation of justice-related topics, and their reactions to such issues. These findings illustrate how emotions can be in a dialectical relationship with the formation of a teacher's identity, including the identity of teachers of colour.

The role of emotion in science identity is further emphasized by studies exploring how affective experiences, such as feelings of belonging or empowerment, can lead to unique learning opportunities. For example, in a participatory design study involving video game design through Minecraft, the affective strengths experienced by participants through shared action led to the emergence of unique learning opportunities, such as collaborative problem-solving, and critical thinking (Ehret & Hollett, 2016). Similarly, in an afterschool science club, collective emotions -such as excitement, pride, and frustration- were demonstrated through collaborative discussions and creative problem-solving during a joint video production. These affectively charged associations can be key to co-designing science learning and identity work (Avraamidou, 2023). Drawing on these examples of mutual emotions, it helps us to understand how the emotions of teachers from diverse backgrounds are not just a backdrop to learning; rather, they are central to the process of becoming a science person.

Emotion, Identity, Context, and Practice of Teaching

The emotional experiences of teachers of colour are deeply rooted in the sociopolitical and cultural contexts in which they teach (Zembylas, 2003). For example, in a Western context, a science teacher of colour might feel emotionally marginalized if their contributions are not valued or if they are perceived as less competent due to racial or cultural biases. These incidents can lead to an internalized struggle, where the teacher's emotional responses influence their sense of self and their approach to teaching science. Conversely, the teacher may feel a strong emotional connection to promoting inclusive science education that reflects diverse perspectives. Such emotional experiences can lead to variations in their identity as teachers, affecting their sense of belonging and efficacy as educators (Zembylas, 2005). This complexity highlights the significance of digging deep into the emotional dimensions of teaching, particularly for science teachers who navigate multiple layers of identity.

Drawing on Zembylas's work, Avraamidou (2020) helps us to understand why we need to pay attention to emotion in understanding science identity. The author states, "science identity is emotional given that it involves processes of becoming which are associated with visions of self, goals, aspirations, beliefs, and enculturation in specific social, historical, and geographical contexts" (p. 337). This argument is helpful to understand how teachers' identity work can be considered as emotional, because developing identities among teachers of colour may involve a journey of transformation, linked to their self-perceptions, ambitions, hopes, convictions, and integration into the context of where they teach or practice teaching.

To further dig into our understanding of practicing teaching, Vea's (2020) concept of "emotional configuration" suggests that emotions are not just a personal preference; they are dynamic, socially situated experiences that occur through practice. These configurations are shaped by identity and power dynamics, meaning that emotions can either enable or constrain specific forms of identity work in science teaching. The impact of sociocultural factors on emotional experiences is further highlighted by Lanouette (2022), who showed how emotions can generate or constrain learning opportunities and identity work in science, depending on the socio-political configurations of practices and place. For teachers of colour, this means their emotional experiences in the field of science are not just personal but are deeply influenced by the broader socio-cultural context, which can either support or hinder their professional identity construction. Leveraging this emotional understanding allows science educators to adopt more empathetic and contextual approaches to equity initiatives, which, in turn, can create more supportive learning environments for students of colour. In the next section, Oluwatoyin shares her experience working as a Graduation Coach in Ontario, Canada.

Equity Initiatives Targeting Students of Colour: Graduation Coach Program

Equity initiatives in education are essential for creating equitable learning environments that support diverse student groups. One such initiative for K-12 students of colour is the Graduation Coach program. In this section, Oluwatoyin shares her experience and insights into the Graduation Coach Program in Ontario, Canada. The introduction of the graduation coach program is a significant policy shift toward acknowledging and integrating the unique experiences and contributions of Black students into the mainstream curriculum. This program is a Ministry of Education initiative designed to provide intensive support to Black, African and Caribbean students and their families. The main goal is to provide the support students need to pass their courses, graduate from high school, and successfully transition into their chosen post-secondary pathway. Under the direction of the school Board and school administration, the Graduation Coach program provides tailored culturally responsive support and addresses service delivery gaps to facilitate the engagement, well-being, and academic achievement of students of colour.

In my role as a graduation coach for Black students, I have witnessed firsthand the disparities that exist within the educational system. These students often face systemic barriers that hinder their academic progress and overall well-being. These barriers can manifest in various forms, including implicit biases, microaggressions, a lack of representation in the curriculum, and limited access to resources and support systems. Addressing these challenges requires a multifaceted approach that involves not only direct support for students but also systemic changes within schools. As a graduation coach, my primary responsibility is to provide direct support to Black students. This support includes academic advising, mentorship, and advocacy. I work closely with students to identify their strengths, interests, and goals. I then provide tailored support to help them navigate the educational system, overcome any challenges they face and plan for their future. Moreover, my role necessitates a deep understanding of the historical and contemporary challenges faced by Black students, as well as the ability to navigate complex institutional

structures. In my work, I strive to build trusting relationships, advocate for equitable policies, and provide targeted interventions to support students' academic and social-emotional development.

Addresses Systemic Inequities through the Graduation Coach Program

Research has consistently shown that students of colour face significant barriers within the education system, including lower academic expectations, disproportionate disciplinary actions, and limited access to advanced coursework (Ladson-Billings, 2009; Milner, 2015). These barriers contribute to achievement gaps and hinder the long-term success of students of colour. The Graduation Coach program aims to directly confront and mitigate these inequities by providing targeted interventions. This targeted intervention is crucial in promoting educational equity and ensuring that all students have the opportunity to succeed.

The Graduation Coach program is led by Graduation Coaches. These Coaches provide essential support that is often lacking in traditional school settings. By offering personalized academic advising, mentorship, and advocacy, they help students navigate the educational system and overcome challenges. This support is important for students who may not have access to resources and guidance at home (Banks, 2015). This personalized approach ensures that students receive the individualized attention they need to thrive. This holistic support system is vital for fostering resilience and perseverance among students.

Strong relationships between students and educators are crucial for academic success. Graduation Coaches play a key role in building these relationships, fostering trust, and providing a sense of belonging for students. Serving as a liaison between students, educators, and community organizations, Graduation Coaches advocate for Black students' needs while fostering an identity-affirming and supportive environment. This aligns with Epstein's (2011) emphasis on trust and belonging as essential components of a motivating learning environment. By building strong, respectful relationships and understanding students' unique aspirations, Graduation Coaches provide targeted guidance that empowers students to succeed and fosters a deeper connection to their school community. Moreover, graduation coaches' involvement in equity-focused professional learning communities (PLCs), can help educators develop and implement equitable teaching practices that address the needs of students of colour.

Research on similar programs has demonstrated their effectiveness in improving student outcomes. For example, studies have shown that mentoring and support programs for students of colour can lead to higher graduation rates, improved academic performance, and increased college enrolment (Henderson & Mapp, 2002). The Graduation Coach program builds on this evidence, providing targeted support to address the specific needs of Black students. The positive impact of the program is evident in improved student outcomes, including higher graduation rates, better academic performance, and increased college enrolment. These results highlight the importance of providing targeted support to address the unique challenges faced by students of colour and highlight the value of the Graduation Coach program in promoting educational equity.

Conclusions and Educational Significance

This paper contributes to the advancement of our understanding of equitable pedagogies and initiatives for students of colour as well as the role of emotions in constructing the identity of teachers of colour in science education. The review of the literature reveals that recent studies have made attempts to distinguish equity and equality. Most scholars agree that when equity is conflated with equality, we inadvertently perpetuate inequities in education and equity-oriented initiatives and further create disparities. Also, various conceptualizations and understandings of equity and equitable pedagogies exist in the literature. For example, we found that some scholars conceptualize equity as a means of offering personalized assistance and opportunities to students to help them achieve their educational goals. This perspective of equity leads to initiatives that target marginalized students such as students of colour and racialized students. Others conceptualized equity from the social justice perspective and discussed equity in relation to addressing systemic structures and barriers that operate as obstacles for students of colour to limit their participation, engagement and achievement.

We also found that equitable practices informed and shaped by an understanding of the unique cultural and educational experiences of students of colour are essential for their engagement and success in their education. Understanding these various conceptualizations of equity and equitable pedagogies is essential for planning, developing, implementing and evaluating equity-oriented initiatives to support students of colour. The review further

highlights the role of emotions in science education and how these are deeply intertwined with the experiences of marginalization and empowerment. By gaining knowledge about these affective experiences of teachers of colour, policymakers and educators can design and implement contextual equity initiatives for both teachers and students. What's more, as we continue to develop and implement these initiatives, we must remain committed to amplifying the voices of students and teachers of colour, ensuring that their experiences and perspectives are at the forefront of educational policy and practice.

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