Refocusing science professional learning: social justice at the heart

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Abstract
This paper emerges from a reflection inspired by Kristen A. Searle et al.’s Whiteness at work in the elementary classroom: A case study. Through the lens of Whiteness, the authors explored how a White male elementary teacher, who engaged in an integrated technology professional development, implemented culturally responsive teaching. Unfortunately, the teacher was described as falling short of achieving the pedagogy and practice set out by the professional development. With this, we were left to wonder how the outcome of the study would have differed, if the authors chose to focus on social justice education, rather than make it a companion to their professional development on integrated technology. Therefore, in this piece, we explore how science teacher education, like the one presented in Kristen A. Searle et al.’s work, would look if it prioritized the development of socially just science teachers.

Keywords Social justice · Teacher education · Identity

Increasing representation and equitable practices in science education have been focal concepts for decades now, especially gaining traction at the beginning of the twenty-first century, as the STEM workforce boomed (National Science Board 2015; National Science Foundation 2019). Unfortunately, as Kristen A. Searle, Tofel-Grehl, Hawkman, Suarez and MacDonald (2021) state, the field of science education in the USA has chiefly continued to perpetuate inequities for both educators and students. This is evident in the demographics of the science educator workforce and the number of students of color pursuing science-related opportunities. Additionally, a close examination of common science curricula...
implemented in classrooms across America illustrates the lack of representation of the knowledge, role models, and philosophies from people of color (Le and Matias 2019). With this in mind, we appreciate the work of Kristen A. Searle, Tofel-Grehl, Hawkman, Suarez and MacDonald (2021) as they aimed to support teachers in developing culturally responsive pedagogies and understand how teacher identity plays a role in this development. We wonder, however, how the outcome of the study would have differed, if the authors chose to focus on social justice education, rather than make it a companion to their professional development on integrated technology. Situating this in the larger field of science education, we ask: what would science teacher education look like if it prioritized the development of socially just science teachers?

**History of science and science education**

We root our beliefs that social justice should be the center of science teacher education in the history of science in the USA. The US story is directed by the divisional processes occurring during periods of colonization. “Colonial processes divided the world between conquered and colonizer, master and slave, White and non-White (i.e., other). It included the development of an ideology, and a process of spreading that ideology (mostly through education), to justify colonization” (Zamudio, Russell, Rios and Bridgeman 2011, p. 4). Colonialism was founded on the White man’s desire to prove superiority and spread Western ideologies. This came with it a burst in exploration, a demand for conquest, and the nurturing of the science of race (Willinsky 1998). The social implications of colonialism have been pervasive (Zamudio, Russell, Rios and Bridgeman 2011), as we continue to “work within systems that have [been] inherited but not necessarily dismantled and dis-owned” (Jennings and Jones-Rizzi 2017, p. 70). The sciences, therefore, have become particularly truculent toward Black, Brown, and Indigenous Peoples (Hanson 2009). Racial tendencies in the sciences have caused people of color to feel alienated, incapable of producing scientific knowledge, and less likely to develop science aspirations and identities (Rosa and Mensah 2021; Tytler 2014). The overwhelming presence of Western ideologies in science bleeds into the approaches and messages conveyed in science education. The lack of diversity in science education creates a space for dominant Western ideologies to be positioned at the core of curriculum, ethics, pedagogy, and teaching practice (Matias, Montoya and Nishi 2016; Sammel 2009). School has become “not only the place to learn arithmetic; it is also the place to learn zealotry” (Cohen 1971, p. 42).

As science educators and teacher educators, we are left asking ourselves how we can approach and dismantle systems of oppression, which are deeply rooted and not easily overcome with legislation. We need to explore ways in which science educators can become part of the solution, which would require a decolonial epistemic shift in science teaching and learning (Aveling 2012; Mignolo 2007). Such a shift promotes ways of “knowing and being before the colonizers’ invasions” (Rosa and Mensah 2021, p. 504). It calls on educators to develop “a deep understanding of and commitment to the principles and practices of social justice pedagogy” (Aveling 2012, p. 114). Teachers, however, are rarely equipped with social justice pedagogy or to engage in social justice work. This is especially true for White educators, as whiteness is often deemed invisible to those who benefit from it. “As human subjects, we tend to find it much simpler to talk about social justice than to ‘do’ social justice” (Berry 2000, p. 132). It is necessary then, that science teacher education leans into the idea of preparing socially
just educators in the sciences. We need to understand how teachers develop social justice educator identities and how that can be married to a developing science teacher identity.

**Professional learning response to science inequities**

The call for professional learning that addresses inequities in science education is not a new initiative (Cochran-Smith 1991). Significant scholars in education have provided frameworks for teaching socially just science such as Culturally Relevant Pedagogy (Ladson-Billings 1995), Culturally Responsive Teaching (Gay 2000), and Culturally Sustaining Pedagogy (Paris and Alim 2014). Science teacher education, however, continues to be confronted with the denial of the existence of racism in schools, resistance to change, and shallow approaches to social justice (Matias, Montoya and Nishi 2016; Sleeter 2017). “The main paradox of racism is that the rejection of the other is a response to the anxiety caused by the gradual erasure of differences between the dominant population and minority groups” (Schaub 2019, pp. 11–13). Conversations around race, prejudice, and bias can be difficult for individuals to engage with, especially White educators and professional development facilitators who have benefited from performing whiteness (Matias, Montoya and Nishi 2016). The resulting action is often to refuse examinations and discussions around privilege, power, and race to maintain White supremacy. Science teacher education programs, then, typically do not provide opportunities for students to have conversations around race and racism or to learn about the effect of racism on education equity (Mensah 2019). As a result, science teachers are less equipped to provide equitable learning experiences for their students or appropriately advocate for social justice (Aveling 2012). “If conversations about the impact of race and racism in science education are not happening, and if science teachers continue to avoid these discussions, then the educational debt alluded to earlier will persist” (Mensah 2019, p. 174).

When opportunities for science educators to participate in critical work do exist, they are usually presented as electives and will often perpetuate overgeneralizations and simplifications of social justice concepts and practices (Hambacher and Ginn 2021; Mensah 2019). Educators and facilitators, for example, will demonstrate an emotional resistance or refusal to say the word race and will instead substitute another word like culture (Matias, Montoya and Nishi 2016). Additionally, many courses or professional development experiences will promote the celebration of heroes and holidays as equitable teaching practices (Mensah 2013). While these are important strategies, they remain at the basic level of the educational equity goals for all students (Mensah and Larson 2017). These basic level approaches are an issue, as they can perpetuate stereotypes and the stagnancy of social justice progress (Mensah 2019). Further, basic level approaches can lead teachers and teacher educators to believe that “proclaiming an antiracist orientation signals a commitment to social justice, despite the myriad of ways that we all continue to act within and be acted upon by a white supremacist system” (Hambacher and Ginn 2021, p. 331). To combat the sustained inequities and issues in science professional learning, the development of socially just science teachers needs to be centered. Teachers must explore their own identities and positions in our historically and socially racialized world (Aveling 2012).
Socially just science education

The term social justice, and other expressions related to equity and diversity, are often used interchangeably leading to ambiguity and limited progress (Ridgeway 2019; Rodriguez and Morrison 2019). It is necessary, then, to articulate the meaning of social justice and to maintain the “spirit” of that definition within one’s work. For our work, we lean on Alexandra Dimick (2012), who defines social justice in education as:

The realization that society often operates unjustly through institutions and power relationships that promote or reinforce (and some may argue thrive upon) different forms of social inequalities, such as race, class, income, or gender inequalities. (p. 992)

We work through the lens of social justice, rather than Whiteness as Kristen A. Searle, Tofel-Grehl, Hawkman, Suarez and MacDonald (2021) chiefly did, to be more inclusive of the historical, institutional, and community factors that sustain inequities in education (Sammel 2009; Sleeter 2017). We view Whiteness as part of the larger social justice aims in education (Aveling 2012).

With science historically functioning as a mechanism to authenticate race and racism, it is imperative that science education adopt a critical perspective. Prioritizing social justice in science teacher education can support science educators in enhancing equity at the classroom, school, and community levels (Rivera Maulucci 2013). We draw upon scholars whose work illustrates what it means to integrate social justice into science education and in particular the science classroom. The work of Angela Calabrese Barton, Ermer, Burkett and Osborne (2003) outlines four overarching tenants for teaching for social justice in the science classroom. They explain the need to disrupt power structures in science spaces, utilize student resources to make science more relevant, use science as a tool for social change, and build science communities for students. Bhaskar Upadhyay (2010) offers similar principles to socially just science teaching: meeting the needs of individual students, acknowledging and valuing student experiences, and opposing institutional inequities and oppression. Similarly, furthering our understanding, Ruchi Agarwal, Epstein, Oppenheim, Oyler and Sonu (2010) argue that teaching for social justice must support students to develop a critical awareness of injustices present in society, question dominant narratives, learn from multiple perspectives, and engage as active members of the community. While these scholars, and many others, provide perspectives into the myriad of approaches to socially just science teaching, there is a shared call to social action and transformation at the pinnacle of the implementation. From these scholars, social action and engagement are the defining features of socially just science teaching.

Preparing socially just science educators

Science teacher educators are tasked with preparing both preservice and in-service teachers to enact social justice practices in their classrooms. Social justice in science teacher education centers around teaching and learning science as a social responsibility, moral necessity, and a civil right (Boylan and Woolsey 2015; Chen and Mensah 2018). To demonstrate a commitment to justice in science education, teacher education must create spaces to foster teachers who reject complicity and are willing to push against oppressive structures entrenched in science education (Le and Matias 2019). Within science teacher education,
identity emerges as an approach to explore teacher growth beyond content knowledge and pedagogy (Luehmann 2007). Identity also functions as a tool to understand and support teacher development as social justice science teachers. We choose to define a socially just science teacher as an educator who believes every child is entitled to science learning and engages in a constant struggle for more caring, equitable, and agentic educational experiences at a classroom, school, and societal level (Chen and Mensah 2018; Rivera Maulucci 2013). In other words, a socially just science educator embodies the values of social justice to define their teaching career (Dollarhide, Clevenger, Dogan and Edwards 2016). Like other facets of a teacher’s identity, a social justice science teacher identity develops over time and is influenced by timing, experiences, and educational context (Dollarhide, Clevenger, Dogan and Edwards 2016; Rivera Maulucci 2013).

“In considering the pedagogical implications of this broader understanding of identity, the similarities in the storylines that the beginning teachers develop about themselves are important” (Boylan and Woolsey 2015, p. 69). The way that both preservice and in-service teachers approach learning is directed by their previous experiences and existing positional identity (Moore 2008). For example, “explicitly countering deeply held deficit views can make teachers defensive or shame them into silence, rarely initiating change” (Battey and Franke 2015, p. 435). Resistance emerges as a reaction to feelings of guilt and defensiveness (Cochran-Smith 1991) producing a juxtaposition between the social justice teacher and the resistant teacher (Boylan and Woolsey 2015). A facilitator of socially just science teacher education, then, must consider the conceptual and behavioral starting points of the teachers with whom they are working.

Science teacher education must provide opportunities for preservice and in-service teachers to develop as adaptable, self-aware, and reflective educators (Boylan and Woolsey 2015). Additionally, it is important that teachers recognize implicit forms of racism and understand the role other facets of their identity play in creating equitable science learning spaces for students (Le and Matias 2019). To do this, professional learning experiences should engage teachers in theoretical and practical work that reject the ideologies of deficit thinking and essentialism. This work includes conversations that highlight counter narratives, collaborative development of equitable science curricula, practice implementing socially just science learning for students, and critical reflection of personal and shared science teaching and learning experiences (Battey and Franke 2015). Deep engagement in these experiences over an extended period can support teachers in successfully reimagining and reshaping science education to be more equitable (Le and Matias 2019).

Unfortunately, however, there seems to exist a polarity between the requirements for quality science professional development and the actual implementation (Goodwin and Darity 2019). This may be because facilitators are often preparing teachers for classroom experiences they have never experienced, or there exists a dearth of formal preparation for teacher educators (Berry 2000; Goodwin and Darity 2019). As we argue for socially just science teacher education, therefore, we acknowledge the need for greater alignment between the identity work for both teacher educators and educators (Lauffer and Lauffer 2009). In this case, teacher educators must engage in the same socially just science teaching identity work in which they anticipate engaging preservice and in-service science educators. They should be “politically clear about the enduring history of unequal power relations—clear about how injustice is often reproduced and maintained in schools and committed to dismantling injustice in their spheres of influence” (Hambacher and Ginn 2021, p. 338). To create equitable science learning spaces, it is critical to metamorphose the “institutional structure, culture, and minds of those in charge with interventions that target the institutional level to dismantle racist ideologies” (Le and Matias 2019, p. 24).
Social justice identity development must be at the heart of science teacher professional learning.

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