

There is no equity in a vacuum: On the importance of historical, political, and moral considerations in science education

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Abstract

As a response to Fortney and Atwood's "Teaching with understanding while teaching for understanding" (this issue), this paper challenges definitions of equity that do not explicitly deal with oppression and injustice. I argue that in order to address the problem of inequity at its roots, we must re-center the historical, political, and moral dimensions of equity to disrupt dominant assumptions about the goals of science education. The justice-centered approach I advocate requires understanding inequity as one component of social injustice and necessitates that science education be linked with larger movements for social change.

Keywords equity • social justice • sociopolitical • historicity

In a recent lecture to an audience of math and science teacher educators, Rochelle Gutiérrez questioned whether the term *equity* remains useful. Gutierrez (2018) argued that the failure of science, technology, engineering, and mathematics (STEM) educators to engage honestly with the historical, political, and moral dimensions of equity reinforces problematic deficit, technocratic, or universalist views. Indeed, the field of science education has a particularly strong tendency to depoliticize or neutralize conversations that challenge injustice or oppression. In order for conversations about equity or social justice to be consequential, it is imperative that we define what we mean by these popular terms or we risk rendering them meaningless. For that reason, this CSSE forum presents an important opportunity to discuss and debate the meaning of equity in science education.

Brian Fortney and Erin Atwood's article gives us an entry point into this conversation by presenting a definition of equity, "as an experience where everyone learns and where understanding is indicated by creative participation utilizing learned content in a complex and dynamic way" (p. 2). Fortney and Atwood's notion of equity emphasizes the terms *interactive*, *dynamic*, and *complex*. In emphasizing interactivity, Fortney and Atwood describe an equitable classroom as deeply dialogic. The emphases on dynamism and complexity refer to the context-specific nuances of enacting equity in science education. These are important characteristics of equitable teaching that are often omitted from conversations that focus on "best practices." Fortney and Atwood push back on universalist and deficit conceptions of equity by reminding us

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This review essay addresses issues raised in Brian Fortney and Erin Atwood's paper entitled: *Teaching with understanding while teaching for understanding*.

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to learn from our students, welcome their ways of knowing and being into our classroom, and be responsive to their context.

Fortney and Atwood's insistence that teachers (and teacher educators) examine their own epistemological stances and embrace those of their students demonstrates a commitment to understand the subtle ways in which normalizing practices and discourses uphold inequity in science classrooms. Fortney and Atwood deserve credit for their willingness to be self-critical, humble, and acknowledge their privilege. However, the focus on the complexity and subtleties of inequity in his article may obscure the more obvious and urgent questions of inequity in science education. In this response, I problematize equity as an isolated goal by challenging science educators to continually seek purpose for their work within the broader context. This requires re-centering the historical, political, and moral dimensions of equity in our conversation.

Historical

If equity is our goal, it is important that we understand that inequity is not a problem that developed recently or by accident. Inequity is not indicative of the failure of schools, but an indication that the "architects" of the US school system erected oppressive structures that have been continuously reinforced even as there has always been resistance (Watkins 1993; 2001). The maintenance of inequity in society has always been one of the primary functions of schools in the United States. Whereas Fortney and Atwood astutely emphasize valuing students' various epistemologies, US schools have always served the explicit purpose of "deculturalization" or stripping nondominant students of their culture (Spring 2003). This process has been most oppressive and egregious in Indigenous, Black, and Latinx communities. Understanding this historical context challenges us to view Fortney and Atwood's definition of equity differently because it means that we will inevitably find ourselves fighting against the impacts of generations of oppressive schooling. How does defining equity as interactive, dynamic, and complex account for this historical context? In science education, taking students' ways of knowing seriously is a good start, but how do we deal with the inevitable contradictions created by the fact that success in school science is predicated on assuming the narrow epistemologies of hegemonic science?

Whereas Fortney and Atwood also prioritize "creative participation," US schools have always served the role of preparing compliant workers (Apple 2004). The mechanisms of school have always served to sort young people into slots that reproduce the class structure (Bowles and Gintis 1976). The creativity allowed by the mainstream curriculum has been directly related to the socioeconomic status of the students (Anyon 1980). Teachers, especially in economically dispossessed communities, will find that the structures of schooling, from high stakes standardized tests to zero tolerance discipline policies, do not support "creative participation." A new wave of STEM schools in urban districts like Chicago and New York even marginalize learning science in order to prioritize inculcating workplace skills (Morales-Doyle and Gutstein in press).

Fortney and Atwood point out that "'Historically, while work with [pre-service teachers] PST has particular challenges, the most difficult to address is the set of expectations of how teaching 'is', and is 'normally done,' because the expectations are grounded with a dominant culture of teaching'" (INSERT PAGE NUMBER HERE?). I would add that it is not simply historical inertia or dominant culture expectations that we must fight, but the active reification of inequitable school policies and practices. Within these contexts, how do we, as teacher educators, prepare

PSTs to carve out spaces for creative participation? Is interactivity, dynamism, and complexity enough? My colleagues and I have argued elsewhere that developing PSTs sociopolitical understandings is a necessary part of this work (Morales-Doyle, Varelas, Segura, and Bernal-Munera under review). Many have argued that teaching for equity within the context of US schools requires teachers to be subversive. Gutierrez (2013) provides preservice math teachers with “strategies for creative insubordination” as a way to prepare them to resist the oppressive context of US schools.

The inequity we see in schools reflects the priorities of a settler colonial state that was founded on genocide and enslavement while making rhetorical claims to equality and democracy. I appreciate Fortney and Atwood’s emphasis on creativity, interactivity, and dynamism. These characteristics and others (like joy, hope, and love) are undoubtedly important to any equity project. But without directly confronting the historical development of inequity as a component of oppression, how do we address the root causes of inequity?

Justice-centered science pedagogy encourages students to consider the historical relationships between scientific development and processes of oppression like settler colonialism and the trans-Atlantic slave trade to challenge the Eurocentrism in mainstream science curriculum. For example, students in my chemistry classes learned how *conquistadores* co-opted the Quecha people’s knowledge of the medicinal properties of the cinchona tree in South America, which was used as a treatment for malaria and facilitated European aggression in Africa (Conner 2005). They also learned how the word *chemistry* is likely an homage to the African metallurgists who shared their knowledge of materials with ancient Greeks (Loyson 2010). This history contrasts with the fact that the people lauded by textbooks for all early innovations in chemistry are European men. Including critical historical contexts challenges students to disrupt deficit views of the problem of inequity by understanding it as a byproduct of, and contributor to, the ongoing projects of white supremacy and settler colonialism.

Political

Fortney and Atwood follow other definitions of equity in describing “an experience where everyone learns.” When it comes to *what* everyone learns, Fortney and Atwood extend beyond many mainstream definitions of equity by arguing against a narrow focus on science content and for expanding what is learned to include “lifeworld experiences.” Fortney and Atwood acknowledge that students will likely have diverse lifeworld experiences, but they do not expand on the factors that might provide students with vastly different lives. In the present political context in the US, these experiences may include state-induced fear or trauma for students of color. During the time that I have been writing this manuscript, police shot and killed Harith Augustus, the latest in a long list of police shootings of Black people in Chicago, the city where I live. The shooting was followed by the brutalization of community members who gathered in protest. Meanwhile, children of migrants remain separated from their parents in detention camps near the US-Mexico border. And Puerto Ricans continue to suffer the impacts of US colonialism in the wake of Hurricane Maria. Science education may (or may not) have something to contribute to students’ understanding of and resistance against these tragic sociopolitical phenomena. Science education may help students imagine and construct a more just world, but the recent emphasis on canonical “natural” phenomena is unlikely to suffice. For example, students’ understanding of racism may be enhanced by learning in biology class that race is a social construct that has been buttressed by scientific racism, which is a product of the field of

biology. Learning about the migration of monarch butterflies might help students understand that migration is natural for organisms, including humans, but that borders are political constructions related to power and imperialism. Learning about hurricanes might help students understand their increasing power and frequency in the context of climate change. It also might help them understand how the damage caused by “natural” disasters is often determined as much by the socioeconomic status of those impacted than it is by the strength of the storm, earthquake, or eruption. I am not advocating scrapping science class in favor of more social studies, but rather a more honest consideration of the interrelationships between the social, political, economic, cultural, and “natural.” Fortney and Atwood’s insistence on teachers being open to multiple epistemologies may provide the kind of openings required to challenge the boundaries that Western thought draws between nature and human activity. But it will take a concerted effort to take advantage of these openings to address the root causes of inequity.

We also have to ask how we achieve equity in public schools when it is reasonable for substantial portions of our students to fear, or at least mistrust the intentions, of representatives of the state (like police or *teachers*)? This question is not meant to suggest that equity is impossible, but it does suggest that equity is not a technical problem and it will not be achieved by teachers who blindly cooperate with their government. With respect to Fortney and Atwood’s recommendation to broaden the content of science classes to include lifeworld experiences, the present political context requires teachers who act with caution, empathy, care, and solidarity. Teaching for equity means that sometimes, in times of crisis, the daily science lesson may have to be put on hold for students to process the events unfolding around them. Furthermore, science teachers need ways to make deep connections between students’ lives and their content areas. In my own teaching practice, these connections are captured by social justice science issues or SJSI (Morales-Doyle 2017). Teaching about SJSI provides an opportunity for students to explore the usefulness, the limitations, and the problems of canonical scientific knowledge while they also ask critical questions about issues of justice and oppression. This approach provides one way to deal with the tensions between sanctioned or canonical knowledge and the epistemic heterogeneity that Fortney and Atwood’s definition of equity seems to embrace.

Moral

Fortney and Atwood’s definition of equity includes students “utilizing learned content in a complex and dynamic way.” This statement begs the question: utilizing learned content *to what end*? Vousoughi and Vakil (2018) describe how the maker movement, which arguably engages students in using scientific and engineering practices in dynamic and complex ways, has received ample support and funding from US military sources. Does Fortney’s definition allow for students using learned content to design weapons or surveillance technology? In one performance expectation, the Next Generation Science Standards call for students to develop best practices for exploiting unconventional fossil fuels. These fuels, like tar sands and oil shales, are known to accelerate climate change and exacerbate global heavy metal contamination. Would such a lesson be equitable if students applied their content knowledge in complex and dynamic ways? When we recognize that inequity is intertwined with the forces of imperialism and capitalism that have caused global warming and global conflict, we are forced to consider the ends and the content of an equitable science education differently.

I am not suggesting that Fortney and Atwood’s definition of equity leads us to these sorts of problematic applications of scientific knowledge. But when we are not explicit about our moral

and political stances, we often position the acquisition and application of scientific knowledge as good in and of themselves. Taking a justice-centered approach, encourages teachers and students to ask questions about the moral and political implications of scientific knowledge production and application (see Szostkowski and Upadhyay in this issue for a more extensive discussion of the relationship between morality and equity). Given the root causes of inequity described above, I argue that we are unlikely to make strides towards equity unless we confront these issues directly.

Achieving Equity Requires Social Transformation

Without social justice, there can be no equity. Thus, an equitable science education must act as a catalyst for social change (Morales-Doyle 2017). For me, equity means that we equip students to survive in the world as it is while we inspire them to imagine and fight for a world in which they and others would thrive. This means that students have access to sanctioned knowledge and institutional opportunities even as they develop critiques of that knowledge, alternate forms of knowledge and techniques to deconstruct and destabilize oppressive institutions. To conclude my response, I offer some critical questions and suggestions about how we might re-center the historical, political, and moral components of equity in science education.

What do we teach about the role of science in our society? With a climate change denier in the top executive position of the US government, it has become popular to position science as a force for sustainability and justice. But the reality is that many scientists and engineers contribute to the ongoing exploitation of fossil fuels in ever evolving ways. For example, STEM professionals continue to develop new ways to exploit so-called unconventional energy sources like petcoke and tar sands that cause more environmental damage than more familiar forms of petroleum and coal. While Indigenous activists fought against the Dakota Access Pipeline, people with degrees in science and engineering drew up the plans that were used to construct it. While science is frequently lauded for saving lives through advances in medicine, it also contributes to *taking* lives by contributing to the development of ever-more-sophisticated weapons. Teaching science for equity necessitates providing students with opportunities and frameworks for understanding the contradictory roles that science plays in our society.

How do we define success in science education? Discourses of equity are often associated with “inclusion” or “diversity” in STEM education. These discourses are predicated on opening opportunities for people who have traditionally been denied access to the “pipeline.” Fortney and Atwood’s focus on lifeworld experiences and epistemic differences accounts for some of the assumptions about assimilation that are encoded in these problematic discourses. But how does it account for the other moral dimensions of how “success” is commonly defined? For example, opportunities in STEM are often framed as escape routes for students from economically dispossessed communities. But this opportunity-to-escape mantra sends deficit messages to students about themselves, their families and their communities, while it arguably exacerbates conditions in their communities by encouraging the youth with the most access to resources to leave their neighbors behind. Furthermore, as my students have pointed out, the common definition of “success” in STEM often includes professional scientists and engineers who work for weapons manufacturers, chronic polluters, or companies who exploit their blue-collar employees (Morales-Doyle 2018). There is nothing equitable about broadening access to these sorts of opportunities. While “economic competitiveness” and “national security” are common rallying cries for more diversity in STEM, our definitions of equity must explicitly stand against

any definition of success in science that contributes to economic inequity, environmental degradation, or imperialist wars.

An equitable science education asks students to consider how they can use scientific knowledge to build collective power for peace, justice, and sustainability. An equitable science education also encourages students to push back against the enterprise of science to open it to new ways of knowing and relating (Bang and Vossoughi 2016). Equity in science education will only be achieved in concert with social change that begets equity in other realms like wealth, housing, health care, environmental conditions, and so on. Thus, the *fight* (and I do mean *fight*) for equity in science education cannot be won without confronting those who benefit from the present inequity. Positive adjectives like *interactive*, *dynamic*, and *complex* must be joined with nouns like love, joy, and hope but also with less comfortable words like *struggle*, *oppression*, and *dissent*. Equity in science education must be conceived as only one small part of the broader struggle for social justice. Therefore, those of us who earn our living as science educators and profess a commitment to equity must humbly participate in these broader sociopolitical struggles in our personal and professional lives.

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