Testing the Waters

Using Environmental Justice to Motivate Environmental Science Students

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Responses

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The Next Generation Science Standards (NGSS) promised to motivate students through the practice of science (Achieve Inc., 2013). The NGSS reflect the STEM movement, which aims to build a strong workforce that will usher in prosperity and promise a more secure nation. Over the 11 years that I have been teaching a high school environmental science course, I have developed a more problem-based pedagogy based on environmental issues, such as water pollution, pipeline construction, and climate change, which have proven to be politically charged scientific issues. Unfortunately, a focus on STEM may exclude sociopolitical aspects of science that could encourage students to develop a sense of civic responsibility (Zeidler, 2014).

With a focus on relevance and authenticity, I aim to create lessons that have importance to students now, not just for potential careers or college majors. As any effective teacher would, I hope that all of my students are engaged in learning. I consider the four forms of engagement outlined by Sinatra, Heddy, and Lombardi (2015). The first three forms (behavioral, emotional, and cognitive) depend on the structure of the learning environment, and therefore on lesson design. However, agentic engagement is a fourth type of engagement that demonstrates agency exerted by students, who may actively contribute to their own instruction (Bandura, 2001; Reeve, 2012; Reeve & Tseng, 2011). In considering the agency of my students, I seek to prepare them for immediate empowerment, not future employment. I considered the potential to prepare and even mobilize my environmental science students for action as engaged citizens in a contentious and confusing society. It is worth noting that data collection began at the beginning of the 2016 school year, coinciding with the 2016 Presidential election.

In an ongoing inquiry, I explore the potential for environmental justice to motivate high school environmental science students. In four sections of high school Environmental Science, I measured student dispositions before and after introducing the students to environmental justice (inspired by Martin Luther King, Jr. and fueled by inequity and oppression). I relied on socioscientific issues (SSIs), which Sadler, Chambers, and Zeidler (2004) describe as “social dilemmas with conceptual ties to science” (p. 387).

Using socioscientific issues to teach science, let alone motivate students, is notoriously challenging because of the teachers’ approach to science itself. Science continues to be taught as a politically neutral body of knowledge to be transmitted without values (Hart, 2003). Having learned science this way, science educators continue to teach this way. The resulting hierarchy of knowledge marginalizes those without it (Barton, 2002) and sustains a myth that scientific knowledge is not biased (Laughter & Adams, 2012). The need to challenge this system in an effort to include students in all aspects of the scientific endeavor fuels my work, with an understanding that science teachers’ tendency to sidestep the potentially controversial implications and applications of science effectively alienates and disempowers students (Gayford, 2002).
Testing the Waters: Using Environmental Justice to Motivate Environmental Science Students 

by EJ Karetny

With the help of my students, I am energized by questioning, and potentially dismantling the hegemony of this form of science and science education (Hodson, 2003).

Reflective, critical practice becomes the saving grace. Jorgenson (2011) connected the interests of science teachers who participate in “green pedagogies” to their childhood experiences. These teachers felt comfortable addressing the moral, social, and political aspects of environmental issues, and evolve into “fruiting bodies of dissent” (p. 47). Ladson-Billings (1995) recognized exemplary teachers as those who are committed to teaching and learning with higher purpose. Such teachers believe that all the students are capable of academic success, view pedagogy as a dynamic, evolving art, and saw themselves as members of the community, with their work as a way to give back to the community. My own efforts to promote social justice would be incomplete without a morally transformative approach to teaching and scholarship, and the realization that such teaching practice is in its own right a form of social justice (Dantley & Tillman, 2010).

However, it is the students who are at both front and center in my practice, which fuses research and praxis. For my doctoral research, I measured changes in student dispositions with surveys, as well as conducted interviews with willing participants, who shed light on their learning experiences in the course, including changes in their motivation to learn science. I continued to design lessons with their advice in mind. My goal herein is to share their recommendations for environmental science teachers to infuse socioscientific lessons with environmental justice in an effort to encourage all students to develop their voices for environmental advocacy and sociopolitical action.

Lesson Design

I found that students valued morals in environmental decision-making. Therefore, I expanded our problem-based curriculum to help student reflect on their worldview and develop their environmental ethic. The curricular approach required instructional strategies beyond traditional science education pedagogy, yet remained student-centered and inquiry-based. I encouraged students to ask questions and use evidence to draw conclusions. SSIs served as “phenomena,” defined by the National Research Council (2012) as observable events that students can explain and make sense of by using the three dimensions of the NGSS.

I justify a socioscientific approach by rejecting the assumption that all scientists do science in the same way and are motivated by the same things. Therefore, I applied the NRC’s (2012) broad description of science practices, especially the role of critique. Through discussion, discourse, and reflective writing, students explored their positions on issues ranging from pipelines to food deserts, based on their worldviews as well as scientific evidence. Students could develop attitudes predisposing them to environmental literacy, which considers dispositions that include attention to equity and willingness to act, personal responsibility, based in concern for other people and other societies (Hollweg, Taylor, Bybee, Marcinkowski, McBeth, & Zoido, 2011). I aligned the lessons to standards that reflect our approach.

Students began the unit by investigating the three main environmental ethics (anthropocentrism, biocentrism, and ecocentrism), and exploring Dr. Martin Luther King, Jr.’s influence on the environmental movement. I shared daily videos about the Dakota Access Pipeline protests in North Dakota, which reached a fever pitch during this unit and spurred an introduction to the future unit on renewable energy resources. In fact, environmental justice encompassed each environmental issue the students encountered, supporting the outlook that environmental problems connect to greater societal ills mired in inequity and discrimination. In a culminating group project, students designed community gardens in a food desert. Students expressed pride in applying the dispositions and skills they had developed to impact the lives of others, paving the way for units on biodiversity, urbanization, water pollution, energy sources, and climate change that would leverage a justice-based approach to sustainability.
Become the Change Agent You Want Your Students to Be

Science teachers may serve as mentors for civic participation, rather than mere technicians and implementers of educational standards. Consciousness of environmental problems and concern about their impacts on people are hallmarks of environmental literacy (Hollweg, et al., 2011). I contend that teachers should act as ambassadors of eco-consciousness, and proponents of environmental justice. An environmental science classroom built on a socioscientific approach becomes more democratic through both inquiry and discourse.

This transformation starts with the teacher. Science teachers tend to avoid controversial topics because they do not know how to teach them (Gayford, 2002). Their ambivalence disengages students by perpetuating the traditional view that science is value-free. My students wanted teachers to express their opinions in the classroom to show that they care not only about the content they are teaching, but also the issues that they present. Therefore, I recommend standing up for the environment, and for the people at disproportionate risk of being harmed by environmental problems.

A socioscientific approach requires an understanding of, and sensitivity to, students’ backgrounds. Teachers must respect and incorporate students’ worldviews to demonstrate the development of opinions based on argumentation and dispositions. Our students proposed that science teachers model decision-making through argumentation. SSIs enhance these skills by highlighting interactions between environmental problems and societal troubles. As environmental justice invokes diversity and inclusivity, students may develop a unified front towards environmental stewardship that may inspire civic participation. Therefore, teachers who design lessons around SSIs facilitate authentic inquiry-based learning in an increasingly democratic sense. Teaching environmental science requires a critical lens that considers culture, politics, and ethics. Social studies and English teachers provided valuable insight into leading discussions and debates that rarely usually occur in science classrooms. Relevance of SSIs increased through interdisciplinary collaborations.

Invite Change Agents into Your Classroom

Our students admired scientists as change agents who deserve the resources to conduct their research and a voice in policy making. One student declared, “If they have extensive of knowledge of what’s going on, they can definitely help.” In their eyes, scientists monitor environmental health, as well as provide solutions. Through their contemporary vision of scientists, they connected societal problems to environmental challenges as lessons evolved into critiques of inequity, racism, discrimination, and oppression, bolstered by scientific knowledge. Environmental justice solidified their thinking when they learned how the civil rights movement of the 1960s advanced environmental protection as a human rights issue.

Teachers may act as role models reflecting both science and activism, by enacting an ecocentric stance both in and out of the classroom. Teachers may invite guest speakers into the classroom to offer students the chance to connect with environmentalists and other activists. Through TED Talks and online research, our students “met” activists who confront local environmental problems.

Students may build confidence when they realize that they can participate in change efforts. Confidence and motivation reinforce each other when students can see themselves in the work they study (Oyserman & Destin, 2010). Footage of the Dakota Access Pipeline protests inspired conversations about the extent to which students would participate; daily updates of the intensifying protests fueled class dialogues. Lessons became transformative when students can identify with, and as, stakeholders.
Position Students As Change Agents

Through environmental justice, students confronted the social impact of environmental problems. Advocates of environmental justice contend that environmental problems affect marginalized populations more than privileged groups. SSIs provoked civic engagement and other forms of “meaningful involvement” promoted by environmental justice (EPA, 2017). One resolute student described expanding STEM practices to include more pressing concerns:

If you can only teach about how it is being built, I don’t think that would be fair, because I feel like they should be able to know what’s going on in their community. If something was being built in my community, say there was a new water tower being built two streets from my house, I would want to know...how it’s being built and why.

Transcending the design of technological solutions through engineering practices, science becomes transformative when students ask why a problem exists in the first place.

Learning how to write environmental policies enhanced students’ capacity to propose solutions. After researching local environmental problems, each student wrote to a legislator to explain the science behind the problem and offer legitimate solutions. Students expressed genuine concern for their topics, which included pollution-induced asthma, access to nature, and the waste treatment plants in their neighborhoods. By exploring these phenomena, students were authentically engaged in their communities.

Empowering Science Students with Environmental Justice Itself

Eventually, the classroom environment transforms through student participation that mirrors civic engagement, as our pedagogy empowered students to become change agents themselves. One student declared our class “the most outgoing and forward class I’ve had for science so far.” Schindel’s (2012) framework for social justice science education, which includes three types of mutually reinforcing empowerment, (social, political, and academic) validates my approach.

First, social empowerment emerged through the development of a supportive and inclusive classroom in which students felt safe and confident in expressing themselves, and supported each other in doing so. Students realized that their voices could be a strong force for equity and inclusion. Second, students became politically empowered. One student declared, “Environmental science isn’t just about the plants, it’s about you know, different political standing.” Her classmates critiqued inequities surrounding environmental pollution and access to environmental resources. They sided with the Sioux in their efforts to protect their water and sacred lands, and questioned the inequities suffered by African Americans in cities like Camden, NJ, and Philadelphia. Finally, academic empowerment was evident in the development and application of knowledge and skills that support student success in all settings. Students routinely referred to concept maps they created to demonstrate the interconnectedness and interrelatedness of Earth’s spheres, as those phenomena implicated societal problems. Students integrated topics they learned in Environmental Science in their history classes. Written and oral exercises required skills developed in language arts. One student explained, “Science can be anything from political, to social, to environmental, to biology.” The overlap with political empowerment became apparent.

A contest to build a community garden emerged, demonstrating the transformation of the classroom and the mutual reinforcement of the three forms of empowerment during the culminating project. Learning experiences had proved to be truly authentic, as the learning involved complex, realistic tasks (Frey, Schmitt, & Allen, 2012). Motivated to effect positive change, students could take the reins of the lesson and curriculum, and take the learning out of the classroom to effect positive change.
Environmental Justice in the NGSS Era

Students suggested that socioscientific issues should be the focus of a classroom that implements STEM practices, because a solely STEM approach did not appeal to them. One student claimed that traditional assignments offer too much opportunity to disengage. He pictured kids opting out of learning:

I'm not going to build a bridge; I'm not going to be an engineer. I'm not even going to live near a river where there is a bridge...I'm not gonna do the lab. I don't need to do the lab. Why should I do a lab?

By engaging students in issues that matter to them, they have the opportunity to express themselves and to participate authentically through immediate civic action rather than an eventual STEM career. That same student, once empowered, expressed concerns about, and responsibility for, his community's water quality:

I definitely went home and filled my glass with water and looked in it, and was like, “Is there lead in there?” I think I will [test it], just for the sake of other people...I don't want to have that problem so I definitely would test the water just to make sure that it's safe.

His transformative attitude transcends the NGSS' technocentric approach, which values scientific and technological solutions to global challenges like sustainability (Feinstein & Kirchgasler, 2014).

Environmental science education may be incomplete without considering social and ethical dimensions of the phenomena students study. If environmental science is concerned with the interconnectedness and interrelatedness of Earth’s systems, it behooves us to realize that the environment is no longer a natural system that humans have impacted, but rather a social construct that includes natural systems (Hodson, 2003).

Conclusion

“Testing the waters” can mean sampling local water for impurities, as one student became compelled to do. However, we may consider taking risks to motivate students by expanding the NGSS, even if that means mutating or defying it in practice. In the mean time, the students are testing the metaphorical waters of questioning everything they can, including the scientific phenomena, the oppressive forces leading to environmental damage, and the nature of school itself. This research demonstrates the transformative power of social justice education in science classrooms. Furthermore, I suggest using socioscientific issues in physics, biology, and chemistry as well, such that teachers connect practices across disciplines. A sociopolitical approach may motivate students through holistic education that is relevant, realistic, and crucial.

References


