Special issue: Innovative Teaching Personal Essays

Using Socio-Scientific Issues to Engage Students

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I teach a two-semester chemistry class designed for future middle-level (4^{th}-9^{th} grade) teachers of science. With an interest in developing greater scientific literacy among my students, I embed scientific inquiry and the nature of science (NOS) (AAAS, 1990) throughout the course, teaching it both implicitly and explicitly as part of the content.

About a decade ago a student showed me a *Newsweek* article (Peng, 2008). The article compared 1 cup each of Lucky Charms and Kellogg's Granola cereals to decide which was healthier. Somewhat surprising to me was their conclusion that Lucky Charms was healthier based on total calories and fat content, but their basis for comparison was limited. For example, using density would illustrate there was over twice the mass of granola; learning more about each cereal would show that Kellogg's is not an exceptionally healthy variation of granola, containing a large amount of high fructose corn syrup, etc.

I realized this was a great opportunity to get students thinking critically about others' opinions and the evidence supporting them. I had similar goals when they wrote lab reports, but I often noted that they did not always make clear connections between evidence in the lab and their conclusions. Therefore, I first had the students read and discuss the *Newsweek* article in

their work groups and then had them report their level of agreement with the conclusions. I wanted them to focus on the subjective and empirical nature of science along with bias. I instructed them that any answer could be considered correct based on their supporting evidence. I also had them reflect on how they reached their conclusions. Did they form an answer and then try to find data that supported it, or did they read all the data and then attempt to find the conclusion the data supported? I loved hearing students passionately debate and support their opinions. Suddenly, I was aware of another great way to engage students, and it aligned perfectly with many of my goals, especially with regards to incorporating the NOS and scientific literacy.

A colleague clued me in that I was using a socio-scientific issue (SSI) approach, so I set out to learn more. Zeidler and Keefer (2003) equated SSI's with "the consideration of ethical issues and construction of moral judgments about scientific topics via social interaction and discourse" (p.8). Lederman, Antink, and Bartos (2014) demonstrated that SSI's address the nature of scientific knowledge and science content while Sadler, Chambers, and Zeidler (2004) noted the relationship between students conceptualizations of NOS and SSI's. A whole new world was opening up. Science is most often taught as a series of facts, but I had discovered a way to use features of society to make the facts more relevant, and further, to challenge students to think and apply these facts in order to draw conclusions about societal issues and real-world connections that are often ignored, especially in higher education.

Then in 2009 I read an article about an earthquake in L'Aquila, Italy that killed over 300 people. Six scientists and one government official, all part of a government commission, were charged with manslaughter for statements the committee had made suggesting that an earthquake was not immediately likely. I thought, "Doesn't this show a lack of understanding of the NOS and the role scientists play in society? The best a geologist could do is an educated guess, yet

some people think scientists are supposed to know more than they do." I decided this would be a great way to have students actually examine societal expectations for scientists and further review the tenets of the NOS that were previously taught (Lederman, El-Khalick, Bell & Schwartz, 2002). I assigned a series of readings related to the topic and had students answer a series of questions to evaluate their understanding of the NOS and our expectations for scientists. The students liked the earthquake SSI and often were flabbergasted at what they read. Interestingly, they fell on both sides of the issue, though a majority thought that the government overstepped their bounds. Overall, this SSI worked well for the goals of reviewing and applying their understanding of the NOS, but it seemed there was a different level of student engagement. Through research and experience, I came to realize that SSI's work best when they correspond directly to material being covered in class. It makes it easier to address any gaps in background knowledge and tends to be more engaging due to its immediate relevance. Additionally, I noted this project was longer than the one-class discussion of the cereals, and I was not properly allowing for in-class discourse which can increase engagement.

So next, SSI lessons incorporating the Flint Water Crisis were developed as part of a new unit on water treatment. In 2013, attempting to save money, the Flint City Council authorized the process of switching water suppliers. Many mistakes were made resulting in communities being subjected to unsafe drinking water over multiple years. For each of two class periods, students completed a provided reading, then addressed multiple prompts via think-pair-shares where students spend time thinking of their own answer, discuss it in a pair, and finally the pair shares out to the entire class (Simon, 2014). This led to some impressive student discourse. I then had students submit a short final report allowing me to gauge their understanding of the SSI and any conclusions they had reached. We then began the water treatment content, after which I gave a

short survey to obtain additional feedback. I found that students were very engaged in the process, self-reporting more interest in the topic of water treatment as a result of the SSI. They easily made connections to steps in the water treatment cycle where corresponding errors were made in Flint. The majority of students had never heard of the Flint Water Crisis. Some suggested writing their representatives to find out what protections were in place for our local water supply. Notably, it was also more invigorating and engaging for me.

I have sustained the effort of using SSI's in my teaching because it is fun and engaging for students and myself. SSI's address content in a way that connects to a student's personal and ethical background allowing them to construct their learning and knowledge within the relevance that they create. This student-centered approach also allows for more personal interaction with the students and creates a much more engaging environment increasing my effectiveness as a teacher. It is not hard to add an SSI to a lesson. I am currently working on adding another SSI where I plan to focus on students' argumentation. There is a lot of literature on SSI's including the references in this essay. I challenge all readers to try one. I guarantee that you will surprise yourself with the results.

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