Chapter 15
Metalogue: Preconditions and Resources for Productive Socio-scientific Issues Teaching and Learning

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The Use of Mass Media

Klosterman: It seems natural to include news broadcasts, clips from documentary films, and other media sources to introduce teachers and students to socio-scientific issues (SSI) and to highlight current features of nature of science (NOS). Like the SSI used as contexts in this chapter, media is timely, captures student attention (and therefore qualifies as being "relevant"), and can highlight the different perspectives of individuals concerned with SSI. As someone interested in classroom use of media and how science is represented in the media, I would like to know more about how and why the media clips were selected. In the Severe Acute Respiratory Syndrome (SARS) example, it was clear that multiple perspectives were represented through the clips and the accuracy of the information presented was considered. Was the goal to present an overall picture of the issue? Did the teacher use media for a similar purpose? Did any of the other teachers you observed incorporate media from multiple perspectives within one lesson? What impact, if any, do you think the type or content of media might have on student's decision making around the issues?

Wong: We produced the SARS instructional package intent on making use of the unforgettable SARS story to demonstrate a rich list of NOS elements. In our choice of media clips, we perused all accessible documentaries, news records, interview data of scientists, etc., to represent the historical development of the epidemic and the associated rapid scientific developments. However, I cannot claim that we presented an overall picture of all issues seen in the SARS example. We mainly focused

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on elaborating the details of a series of SSI in the historical development of the epidemics which were closely linked to the series of scientific findings related to the SARS disease. There were other issues on which we did not elaborate (e.g., the delay of government warning about the seriousness of the disease due to the potential economic impacts on tourism-related industries, the suspension of all schools due to parental concerns, and challenges faced by hospitals related to resource allocation). However, for each SSI in our package, we incorporated media clips, pictures, and scientists' interviews, which presented the situation from multiple perspectives.

In the shark skin swimsuits unit developed by Kyle and Wayne, they made use of video clips to help students see a broader view about fairness of sports competitions from different perspectives as seen in Table 14.5. I believe that such information would invite students to be mindful of seeing fairness not limiting to what was used in the sports grounds. However, due to the nature of the role play activity, students were asked to consider the issue from the perspectives of a certain role (spectators, athletes, scientists developed the swimsuits, sponsors of swimsuits). As the key goal of the current projects is to develop teachers' pedagogical content knowledge in teaching NOS in their teaching of science, most teachers used the media to present the relevant historical background of the scientific development (also a key feature of the SARS Story) related to the topics of science that they taught.

Modeling Teacher Practices

Klosterman: I think this chapter does an excellent job of highlighting the importance of modeling for the development of teacher practice. The authors highlight the potential benefits of a three-step sequence to teacher training. The teachers, Wayne and Kyle, were able to effectively address elements of NOS using SSI contexts after first engaging in professional development around NOS and SARS, followed by viewing and discussing models of success, and then developing their own units. Progressively removing levels of support (scaffolding) has proved very successful in a variety of teaching contexts. However, as I was moving through the chapter, I wondered how Wayne and Kyle were so successful at developing their own units after learning about NOS through the SARS unit and viewing exemplars of teaching practice. The transformation from seeing to doing is a big leap. At the end of the chapter the authors mention that Kyle tried to use another previously developed package – laser-assisted in situ keratomileusis (LASIK) – before developing his own unit with Wayne. I do not think we should underestimate the potential impact that this "trial" run had on Kyle's success with implementing the shark skin swimsuit unit. As the researchers, did you notice if any of Kyle's experiences using the LASIK package contributed to the planning discussions for the shark swimsuit unit? And did Wayne have any similar practice using one of the previously developed units prior to designing the shark swimsuit unit?

Wong: As you rightly pointed out, Kyle shared with us during his reflection on his own learning of teaching NOS that the use of LASIK package had paved way

to his own design of NOS teaching. The LASIK package along with other packages produced in an earlier project completed in summer 2007 was indeed intended to provide science teachers with some exemplars of teaching resources as references for teaching NOS.

Like Kyle, Wayne also used the LASIK package; however, I must admit that during the planning discussions on the development of the shark skin swimsuit unit, I was not aware that both of them had read and used the LASIK package. I did not become aware of these experiences until reading their reflective statements later in the process. Kyle suggested that without the reflection activities, he might not have come to realize the favorable impact of the use of the LASIK package on his own development of NOS teaching resources. His views reflected that exemplars of instructional materials provide an invaluable intermediate step to planning a more independent unit. More exposure to teaching ideas through sharing and use of well-designed resources will enhance teachers' pedagogical content knowledge in teaching NOS and SSI. They will be more sensitive to possible contexts and materials for turning them into instructional units.

SSI as a Context for Instruction

Dana: I was very interested in this chapter inasmuch as I recognize the opportunity and importance of using SSI to provide both a context for engaging students in conceptual understanding of content and for providing a framework for epistemological understanding of NOS. The tables the authors provide clearly illustrate the conceptual links between SSI and NOS. As I explored the chapter, three issues related to the connections between SSI and NOS emerged for me.

First, the authors suggest that because of a lack of conceptual understanding as to the robust epistemological nature offered by historical NOS stories, and not fully understanding the rationale behind the design of (NOS) instructional materials, teachers (and consequently their students) were not able to develop an appreciation of NOS in social contexts. While some teachers found the stories interesting, this begs the question as to whether a minimum threshold of epistemological sophistication is needed before any new curriculum or approach (e.g., NOS, SSI, STSE, Inquiry, Collaborative Learning) can be effective.

Wong: Historical stories of science and scientists are commonly found in many science textbooks in both the West and East. Yet there have been many studies reporting on teachers' and students' lack of adequate understanding of NOS. Such findings indicate that an appreciation of the embedded NOS aspects does not come naturally. Indeed, most of the NOS elements are the theorized understandings about science crystallized from years of academic studies about science. It is rather difficult for science teachers and students to figure out these ideas by themselves through just listening to the historical stories of science. Similar to the learning of scientific concepts, we are skeptical about an extreme discovery approach. We rely on a more guided approach that uses targeted activities to help teachers and students appreciate NOS in history of science or linkages between SSI and NOS.

Interestingly, but disappointingly, we found that some myths about science and distorted images of scientists were reinforced by some science stories if we did not guide or make explicit connections to help teachers see the relevant NOS features embedded in the stories. For example, when we told the story about the treatment of stomach ulcers to our preservice and in-service teachers, many of them were most attracted to the episode in which Dr. Marshall tested his hypothesis by being a clinical trial subject himself. Some comments from teachers like "See…only scientists would be so odd and crazy" reflected a reinforcement of the image of weird scientists who are detached from the world and different from normal people. Some focused on 'incidental discovery' rather than appreciating scientists' perseverance in collecting empirical evidence and the courage required in challenging long-standing beliefs when they noted clues to the cause of stomach ulcers through careful observation and attention to details. Such outcomes are not unsurprising as 'observation and data interpretation are theory-laden' – an important aspect of NOS! When teachers do not have an adequate epistemological understanding or minimum threshold of epistemological sophistication, it is very easy for them to miss the intended targets. Thus any curriculum reform with new teaching approaches will likely fail if teachers have not acquired the expected level of understanding.

After a series of projects in promoting teachers' pedagogical content knowledge (PCK) in teaching science, technology, society, and environment (STSE), NOS, SSI, and scientific inquiry, in the past decade, we also know that it is most important for teachers themselves to value such ways of teaching or approaches. In one of our ongoing projects, when teachers were encouraged to design their own teaching units, we noted different teachers have their own preference of contexts when they infused NOS aspects in their lessons. Many favored the use of history of science, some preferred doing scientific inquiry, and others tended to place NOS teaching in SSI. We are conducting interviews with these teachers to probe their perception of the value of teaching NOS. Our preliminary data suggest that there were strong linkages between their choice of contexts/instructional activities and their perceived values of teaching NOS. We also find some teachers' perceived values are influenced strongly by the rationales put forward in the new curriculum guides while some are more influenced by available instructional resources. We hope to report the full findings of these follow-up interviews in an independent article.

Zeidler: Second, you cite Hodson's (2006) claim that in order for curriculum materials (NOS, STSE, SSI, etc.) to have "street credibility" – it needs to be "developed by teachers, for teachers." I think much of this is true for most professional development settings. Owning horses, I also know that the most nutritious food is of little consequence if it is also not palatable. If the horses won't eat it, it matters not how good it is for them! While I am not equating students to livestock, our research has shown that for SSI to be effective, students must find the ideas contained therein personally relevant and meaningful. Therefore, I would like to suggest that we be sensitive to providing the opportunity and conditions necessary for students to raise their own questions and develop their own units of study within the goals of the curriculum. Given certain parameters and guidance, they can often do this quite well – and move a little further down the trail.

Wong: I like the suggestion of providing students opportunity and necessary conditions to raise their own questions and develop their own units as much as I like your analogy of feeding horses. Your suggestion reminds me of a few lessons I observed some years ago in Wayne and Kyle's school by their vice-principal, Larry. Larry is an experienced physics teacher who was one of the recipients of the Award for Teaching Excellence organized by the Hong Kong Education Bureau. He has a practice of letting his students take up the teaching of selected physics topics in turn. I was in one of these lessons when a group of students were explaining how lenses are used for correction of eye defects. Apparently this was a topic highly relevant to students (over 80% of Hong Kong students by the age of 16 suffer from nearsightedness and many of their grandparents also rely on reading glasses). I was impressed by Larry's patience and 'tolerance' in keeping quiet when the students-in-charge of the lesson got the concepts wrong about presbyopia (lack of accommodation of near objects upon advancing age). His tolerance was paid off after the 'incorrect' explanation went on for about 5–10 min when a few of their fellow students started to raise questions based on observations of the glasses of their grandparents. The inaccurate concepts were corrected through active interaction, negotiation of conflicts, and provision of evidence in support of one's arguments. I was convinced then that when students got interested in a topic, self- and peer-learning could be more fun and effective. Although the lessons I observed in the school were mainly on subject knowledge, I can imagine when students are encouraged to go beyond subject knowledge to integrate related NOS/STSE/SSI, their enthusiasm in preparing materials for teaching and learning of the topics will be even greater.

Zeidler: The third issue I will raise here deals with the framing of SSI. You properly suggest that SSI are controversial and can provide a context for epistemological understanding of NOS. However, I also think it important that SSI contain some feature of ethical tension – to create some degree of moral dissonance. This is important in terms of generating interest, resolving conflict, challenging presuppositions of evidence and norms, creating character, advancing developmental reasoning, and the like. I can see the potential in using the SARS scenario of where this may exist (e.g., Tragic Outbreak at Amoy Gardens), but am left wanting to know more about how this potential was leveraged and tapped? This is a key element of SSI, as I envision it.

Klosterman: I would like to extend Dana's third comment and ask: What do we consider SSI as? This article raises the issue that STS issues and SSI are related, but to what extent? As those interested in SSI-based instruction and outcomes, I think we need to be careful that we clearly define the differences between SSI, STS, and even problem-based learning (PBL) scenarios.

Wong: We agree with your views that many SSI can provide good contexts to induce moral dissonance which challenges preconceptions and norms, encourages reasoning and balance of pros and cons, inculcate values for character-building. Your questions prompted us to consider if the Tragic Outbreak at Amoy Gardens, which aroused intense ethical tension among different stakeholders (regarding the unprecedented government order to quarantine the residents of the

seriously infected block to a rural camp site), could serve as a good context to create moral dissonance and subsequently achieve a number of invaluable learning outcomes. Upon reflection, our team considered the tragic outbreak might not be as effective when compared with other SSI that deal with situations that are still unfolding. For the Amoy Gardens incident, all stakeholders including those who strongly disagreed with the government's order initially could see that the government order turned out to be effective in terms of halting the mysterious spread even if it was not the best decision. Due to the known outcomes, this issue did not generate the ethical tension Dana references.

Dana: These responses were quite illuminating and provided much insight into this important area. It seems the authors agree, in principle, with the conceptual notion of a "Threshold Model" of epistemological understanding that drives subsequent socioscientific reasoning, NOS understanding, and the like. I look forward to your further work on how teachers' perceived values are influenced either wittingly or unwittingly by knowledge of instructional contexts and pedagogy.

Your were truly fortunate to have someone like Larry work with your students and be able to take a "back seat" to the ideas that students were generating in class. Your anecdotal observations of increased student interest and participation are consistent with our observations of student engagement with a robust SSI approach. In our case, a perceptive teacher, like Larry, was able to honor the students' ability to propose their own arguments and subtlety guide them when necessary. It is sometimes difficult to turn over the reigns to students in pursuit of their own understanding but the dividends can pay off in terms of engagement and authentic learning.

I also appreciated the author's nuanced interpretation of how ethical tensions – an important part of SSI, may be ameliorated by the known outcomes of historical events. This is something I will personally give more thought to and it has important implications. It would seem that moral dissonance – hence ethical tensions – central to SSI, is more gripping when the outcomes are ambiguous, uncertain, probabilistic in nature, and where "experts" have fundamental disagreements – all the proper precursors for an effective SSI.

Reference

Hodson, D. (2006). Why we should prioritize learning about science. *Canadian Journal of Science, Mathematics and Technology Education, 6*, 293–311.