Chapter 7
Metalogue: SSI in Undergraduate Science Education

Jennifer L. Eastwood, Troy D. Sadler, and María Pilar Jiménez-Aleixandre

Impacts of SSI-Based Education

Sadler: This is a very interesting chapter in that it is features several unique elements as compared to most other chapters. Most other chapters deal with researcher-designed (or at least influenced) SSI-based interventions that are relatively limited in scope on the order of weeks. The chapter by Dana Zeidler and colleagues addresses a considerably longer curriculum (1 year), but Eastwood, Schlegel, and Cook explore SSI infused across an entire 4-year program. These authors also offer the only study of SSI situated in a college context. The work associated with designing and implementing this program is obviously extensive and the multifaceted research design and execution is equally ambitious. I commend the authors on both aspects of this work and believe that the broader community interested in SSI education can learn a great deal through this presentation.

One of the study results that grabbed my attention was the comparison of reasoning between the two groups. My interpretation of the "take home message" was that the two groups did not seem to engage in reasoning that was qualitatively different (i.e., the groups did not take up significantly different positions or rely on significantly different rationales) but that the SSI group demonstrated higher quality reasoning. This was the same kind of result that we saw in a study comparing SSI reasoning between undergraduate science majors and undergraduates studying nonscience disciplines (Sadler & Zeidler, 2005). Both groups engaged in the same kinds of reasoning patterns but the science majors offered higher quality reasoning in the discussion of SSI. The chapter documents statistically significant differences in the SSI and BIO group reasoning scores on the order of about .4 standard deviations. I would be interested to hear more from Jenny in terms of how practically

J.L. Eastwood (✉) and T.D. Sadler
School of Teaching and Learning, University of Florida, Gainesville, FL, USA
e-mail: jleastwood@coe.ufl.edu

M.P. Jiménez-Aleixandre
University of Santiago de Compostela, Santiago de Compostela, Galicia, Spain

T.D. Sadler (ed.), *Socio-scientific Issues in the Classroom: Teaching, Learning and Research*, Contemporary Trends and Issues in Science Education 39,
DOI 10.1007/978-94-007-1159-4_7, © Springer Science+Business Media B.V. 2011

significant these differences are. Using conventional definitions of effect sizes, I can interpret this gain as moderate, but that clearly would not tell the whole story. Jenny was in the classes and saw the curriculum implemented; she also conducted interviews and poured through the data as the primary researcher. This puts her in a unique position with respect to the interpretation of these results. Jenny, given your vantage point, what do you see as the practical significance of these results?

Eastwood: The difference in reasoning between the two groups is not huge, but it is meaningful in light of my experiences interacting with students and being in the classroom. There are many reasons why finding a large difference between groups would have been surprising. All of the participants in the study were science majors, so they were all good students and presumably all of them cared about science and envisioned futures related to science. The students had diverse backgrounds, and as I learned in interviews, the SSI core courses were not the only courses on campus that involved SSI. Some BIO students had extensively read and discussed SSI on their own initiative and some SSI students tried to slide through their major with as little reflection as possible. Additionally, the questionnaire and rubric was limited in its ability to definitively assess students' reasoning with SSI. Participants were simply asked to take a position on questions related to scenarios and explain their reasoning. Given conditions more authentic to real-life decision-making, like more time for reflection or opportunities to discuss the issues with others, the reasoning outcomes could have been quite different. Accurately assessing reasoning with larger sample sizes is a challenge.

In light of these limitations, a statistically significant result was encouraging. Still, my impressions of the practical significance of the results are shaped more by the student and professor interviews and classroom observations. The aspect of the program that seemed most significant for gains in reasoning was the consistency of the SSI-based learning environment and the way instructors explicitly guided students on a trajectory toward better reasoning. In class, professors constantly reminded students to back up their positions with evidence and they modeled critical evaluation of evidence and conflicting viewpoints through many different examples. Students were even asked to reflect on how they learned to take committed positions on issues and advocate for particular causes.

These emphases in the SSI program came through very clearly to the students and they seemed to internalize the value placed on informed decision-making. SSI students consistently explained that the program changed the way they approached controversial science issues. They discussed being more open to carefully considering different perspectives on issues and some acknowledged that they would not even have been aware of certain controversies if they had not been in the major. They also tended to relate issues they had discussed in class to examples or questions in the interviews and questionnaires. These results taken together suggest that the program helped students learn to seek out different perspectives and use their experiences with SSI as reference points for new issues they encounter. They seemed to recognize their growth toward a more mature way of thinking about SSI.

Students interviewed from the BIO group were also very interested in SSI, but consistently reported that courses in their major were not geared toward preparing

them to make informed decisions on such issues. A common perspective (including one of the SSI professors) was that biology courses were there for learning in-depth science content and reasoning with SSI could be sought elsewhere. BIO students may have cared about SSI, but they were not consistently engaged in SSI activities, at least not in their biology courses. They did not volunteer insights on seeking out multidisciplinary perspectives and different points of view. They had varying levels of confidence in their abilities to reason with SSI but did not feel that their college major prepared them to reason with SSI.

Although I feel encouraged by the SSI students' enthusiasm and professed intellectual growth, I realize it is important to differentiate between students' self-reflections on their reasoning and "outside" assessments of their reasoning. Based on my experience with the SSI program, I would gladly advocate for SSI-based programs that build instruction around development of informed and ethical decision-making. However, even if goals of scientific literacy and responsible decision-making are embraced, I think more evidence of gains in reasoning will be needed to justify the kind of restructuring that would need to occur in colleges and universities.

SSI and Interdisciplinary Education

Eastwood: Interdisciplinary education is a popular theme now, especially in college education circles, but little empirical research currently exists on the topic. SSI is by nature interdisciplinary science education that is developing a distinct discourse. However, from my perspective, the term, "socioscientific issues" does not seem to go beyond the science education community, even where interdisciplinary science teaching and learning is discussed. Although the human biology program discussed in this chapter was clearly doing SSI very effectively, the term "SSI" and the related literature was unfamiliar to the faculty involved. Another example is the NSF-funded project, Science Education for New Civic Engagements and Responsibilities (SENCER), which has sought to "improve undergraduate STEM (science, technology, engineering and mathematics) education by connecting learning to critical civic questions" (http://www.sencer.net/About/projectoverview.cfm). The organization provides faculty development opportunities and excellent resources like issues-based course models and encourages educational research. Although this project is also very consistent with the goals of SSI, I found no references to SSI in documents available from the SENCER website. Clearly both the SSI community and members of other disciplines who are carrying out and conducting research on interdisciplinary, issues-based science education can benefit from each others' work. My question is how the SSI community, which values integration of different perspectives to address problems, can become more connected with others who are trying to accomplish many of the same goals for college students. What do you see as hindering these connections?

Sadler: The issue raised here points to the insularity of academic disciplines and is certainly not just a problem for SSI and interdisciplinary education. The lack of

communication across disciplines is a problem for many areas; although, it is somewhat ironic that in this case, in particular, more interdisciplinary collaboration is not seen. The "academy" and the established norms and expectations for researchers are structured in ways that work against cross-disciplinary communication. This is not to say that cross-disciplinary approaches cannot or do not exist. I see the recent emergence of the learning sciences as a very nice example of how scholars can create opportunities to draw on the expertise of multiple, previously isolated disciplines or subdisciplines. The learning science movement has created space for scholars to build on research in the cognitive sciences, information and communications technology, science and mathematics education, and instructional design in productive ways. In the case of SSI and interdisciplinary education, I think it will take the efforts of a few dedicated scholars well-grounded in both communities to show how drawing from the two strengthens efforts in either community and ultimately moves the broader field of education toward goals associated with improving science education and promoting scientific literacy.

Jiménez-Aleixandre: I have been involved in interdisciplinary programs when I was a high school teacher, but carrying them out at the university level is exceedingly difficult. Interdisciplinary programs pose many challenges, some related to their implementation, and others to research about them. The chapter authors explicitly identify some of the challenges:

> Many factors contribute to the complex learning environment of an SSI unit or course. In the SSI classroom context, variables contributing to student outcomes cannot be easily isolated to reveal their direct contributions to student outcomes. Particular aspects of instruction can influence students' knowledge and perceptions to different degrees and complicate findings.

This is a very important point. Even in courses focusing on just one subject, learning environments are complex, and interactions among students, teacher, curriculum, and social context are difficult to unravel. Therefore, as the authors say, variables cannot be easily isolated.

HIV/AIDS as SSI Content

Jiménez-Aleixandre: The SSI course was structured into three modules: death and dying, infectious disease, and HIV and AIDS. I think that the HIV/AIDS case offers a very productive context for SSI-based education. The case raised by the authors, in which scientists have disagreed about the causal mechanism of AIDS, provides on interesting avenue for science education. Another topic-related issue that we have used in biology education courses is the claim by Pope Benedict XVI in March 2009 about the AIDS epidemics in Africa. At the outset of his first visit to the continent as Pope, he claimed that condoms were not the answer to the continent's fight against HIV and AIDS and that condom use could even make the problem worse (Butt, 2009). He recommended sexual abstinence and fidelity

as means of preventing HIV and AIDS. This claim, which was contested by health agencies as well as Catholic priests and nuns working in Africa, illustrate the interactions between beliefs grounded in ideological stances and health-care recommendations based on scientific evidence. In the more fundamentalist strands of Catholicism, the Pope is perceived to be infallible, and although this infallibility only affects his theological productions, the implication is that whatever he claims is true. On the other hand, the claim seems to support the reservations about the causal relationship between HIV and AIDS, casting doubts about the process of infection and how to prevent it. The Pope never offered scientific justifications for his position. This case could be a used as an example illustrating the difference science and religion and criteria for claims made in either domain. The situation becomes problematic when ideological positions, like the one made by the Pope, are interpreted as a claim based on scientific evidence, as is the case with many SSI.

The senior course also offers an interesting example of integration, not just of content, but also of action, engaging students in community service. It is an exemplary model for environmental education courses. Another feature of the paper that has potential to be useful for researchers is the rubric combining reasoning and perspectives presented in Tables 6.2, 6.3, and 6.4. The study may help us to understand and decide how SSI learning environments (and related communities of practice) should be structured.

References

Butt, R. (2009). *Pope claims condoms could make African AIDS crisis worse – guardian.co.uk.* Accessed from http://www.guardian.co.uk/world/2009/mar/17/pope-africa-condoms-aids

Sadler, T. D., & Zeidler, D. L. (2005). The significance of content knowledge for informal reasoning regarding socioscientific issues: Applying genetics knowledge to genetic engineering issues. *Science Education, 89*, 71–93.