Chapter 2

SOCIOSCIENTIFIC ISSUES IN PRE-COLLEGE SCIENCE CLASSROOMS

The Primacy of Learners' Epistemological Orientations and Views of Nature of Science

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INTRODUCTION

Scientific literacy is a complex, multidimensional construct that lies at the heart of recent national reform documents in science education (e.g., American Association for the Advancement of Science [AAAS], 1990, 1993; Council of Ministers of Education Canada (CMEC) Pan-Canadian Science Project, 1997; Millar and Osborne, 1998; National Research Council [NRC], 1996). Conceptualizing scientific literacy and delineating the specific understandings, ways of thinking, skills, and attitudes that are necessary for preparing a scientifically literate populace are, to say the least, challenging undertakings (see for e.g., DeBoer, 2000; Hurd, 1998; Laugksch, 2000). Nonetheless, the aforementioned reform documents seem to be in agreement about some general components, which are deemed central to scientific literacy. Zeidler and Keefer (this volume) highlighted one of these common components, namely, the need to address the social functions of science in any conceptualization of functional scientific literacy. They further identified, and rightly so, the ability to make informed decisions regarding science-related personal and societal issues as a significant component and outcome of scientific literacy.

To provide students with opportunities to engage in, and practice, this kind of "messy" decision-making, Zeidler and Keefer (this volume) argued for the inclusion of controversial socioscientific issues in an interdisciplinary science curriculum (see also Kolstø, 2001). The authors, nonetheless, were quick to point out that bringing

D.L. Zeidler (ed.),
The Role of Moral Reasoning on Socioscientific Issues and Discourse in Science Education, 41-61.

socioscientific issues into the science classroom entails factoring in issues, such as ethical and moral considerations, and engaging in practices, such as the construction of reasoned arguments and moral judgments through social interaction, which are not typically part of the considerations, practices, and social discourse characteristic of the overwhelming majority of pre-college science classrooms. While necessarily challenging at the theoretical, curricular, pedagogical, and instructional levels, efforts directed toward transforming the science classroom into a "social microcosm," to use Zeidler and Keefer's terms, that promotes the holistic development of learners at the cognitive, social, moral, ethical, and emotional levels are surely a worthwhile undertaking. From an educational research perspective, Zeidler and Keefer continued, the actualization of such a vision for science education necessitates the exploration of issues related to nature of science (NOS), classroom discourse, culture, and case-based and science-technology-society-and-environment (STSE) issues. The authors also invoked several developmental schemes – including moral, cognitive, and discourse development, and their interactions with the aforementioned issues as plausible entry points for developing a research programme that would shed light on the complexities associated with creating and sustaining science classrooms in which the sort of teaching and learning portrayed here would come to fruition in helping students achieve a functional form of scientific literacy.

The present chapter aims to explore the relationship between making informed decisions regarding socioscientific issues and possessing informed views of NOS; the latter being another agreed-upon and central component of scientific literacy (AAAS, 1990; NRC, 1996). In exploring this relationship I will argue that it would be fruitful to reconsider conceptualizations of NOS in current reform and research efforts. At the reforms level, there is a need to address what seems to be the vestiges of the long-standing distinction between the context of discovery and context of justification, which while admitting personal and social factors into the production of scientific knowledge (e.g., intuition, creativity) still portrays decision-making regarding the justification of such knowledge as rather unproblematic (e.g., rational social discourse). At the level of empirical research, there is a need to supplement thinking about NOS from an "aspects" perspective (e.g., inferential, tentative, empirical, and creative NOS) with a consideration of learners' and science teachers' underlying global and scientific epistemological orientations. All this will lead me to argue that the framework developed by Zeidler and Keefer (see Figure 1, this volume) needs to incorporate "epistemological development" as another central axis in addition to moral, cognitive, and discourse development, in order to fruitfully guide the sort of empirical research needed to understand the complexities related to bringing socioscientific issues into the pre-college science classroom.

Before proceeding along the above-outlined lines, a significant question should be asked: Are students' and teachers' epistemological perspectives and views of NOS even relevant to meaningful discussions of socioscientific issues in the classroom? The answer is a straightforward "yes." To illustrate how the two aspects are related, I will refer to a couple of vignettes derived from my research into students' and teachers' views of NOS.

SOCIOSCIENTIFIC ISSUES IN THE CLASSROOM: COMPARTMENTALIZING AND DISMISSING THE DISCOURSE

Science interfaces and interacts with other domains of human activity and thought including the technological, economical, social, cultural, and religious spheres. This multifaceted reciprocity brings about a host of personal and societal issues, which often require a response from individuals in the form of decision-making. Decisions could take the form of making personal choices, such as avoiding the consumption of certain foods with the aim of minimizing one's daily fat intake, or engaging in political public discourse, such as campaigning against the production and/or sale of genetically manufactured foods. Socioscientific issues are markedly different from the sort of end-of-chapter-problems that are usually addressed in science classrooms. These latter problems are usually fully defined, driven by available and focused disciplinary knowledge, algorithmic, and objectively oriented. Engaging the "right" procedure(s) often results in a single right/wrong answer. By comparison, socio-scientific problems are ill defined, multidisciplinary, heuristic, value-laden (invoking aesthetic, ecological, economic, moral, educational, cultural, religious, and recreational values), and constrained by missing knowledge (Chiappetta, Koballa, & Collette, 1998). Engaging the problem most likely would lead to several alternative "solutions" each with an incomplete set of burdens and benefits. Next, an *informed* decision (including not making one) is made. However, given the lack of any algorithms to go about weighing the identified burdens and benefits, a decision regarding socioscientific issues necessarily involves a *judgment call*, which could be an agonizing undertaking. As Zeidler and Keefer (this volume) noted, "in the real world of dirty sinks, and messy reasoning, arriving at... decisions through objective evaluation of neutral evidence is a phantom image" (p. 2).

By bringing socioscientific issues into the science classroom, science educators hope to engage learners in the sort of "real world" problem-solving in which scientific knowledge and ways of thinking are brought to bear on discussing, and making decisions regarding, issues that are immediately relevant to students' lives. It could be seen that such an undertaking would at once allow science educators to achieve several desired goals and outcomes (helping students appreciate the relevancy and social functions of science, engaging students in decision-making and problem-solving, etc.). But would students draw on science to engage socioscientific issues? If yes, how would they use the knowledge and skills they acquire in science classrooms for that purpose? Would science teachers react favorably to incorporating socioscientific issues in their curriculum? Would teachers use such issues as organizing themes to guide their teaching and instructional practices? The answer to each of these questions, I believe, depends to a significant extent on answers to another question: What are those students' and science teachers' epistemological orientations and views of NOS?

In a recent study (Abd-El-Khalick, 2001), I assessed the impact of an explicit, activity-based, reflective NOS instructional approach on elementary teachers views' of the scientific enterprise. NOS instruction was embedded in a physics course for elementary teachers taught by the author. Most of the participants were in their freshman year in college and, thus, were very similar to senior high school students. The *Views of nature of Science Questionnaire–Form C* (VNOS–C) (Abd-El-

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