


Chapter 2

Integrating Scientific Modeling and Socio–Scientific Reasoning to Promote Scientific Literacy

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ABSTRACT

Socio-scientific issues (SSI) are widely advocated as a productive context for promoting scientific literacy that aims to prepare responsible citizens who can use science in their daily lives. However, many teachers find it challenging to enact SSI and consider SSI and discipline-based instruction as mutually exclusive approaches to science teaching. In this chapter, the authors present their framework for SSI instruction, socio-scientific issue and model-based learning (SIMBL), that emphasizes both disciplinary knowledge and its social implications. In particular, the authors argue that the integration of scientific modeling and socio-scientific reasoning (SSR) can advance students' competencies in both areas, thus promoting students' scientific literacy. The authors use an illustrative example from their work with elementary students to demonstrate the connection between students' modeling practice and their SSR. The authors conclude the chapter by introducing the epistemic tools developed to support students' modeling practice and SSR as well as implications for classroom enactments.

DOI: 10.4018/978-1-7998-4558-4.ch002

INTRODUCTION

Over the past several decades different reform efforts have advocated that scientific literacy is the primary goal of school science. The term scientific literacy has been used to describe a general and functional understanding of science on the part of the general public (DeBoer, 2000). Yet, like other constructs such as inquiry, scientific literacy has been broadly used and variedly interpreted so that its meaning and purpose has become unclear. Roberts (2007) and Roberts and Bybee (2014) synthesized the extant literature on the construct and proposed a heuristic framework useful for understanding different perspectives on scientific literacy (SL) as a way of framing the purposes for science education. The SL framework is a continuum between two extremes, which Roberts (2007) called Vision I and Vision II. At one extreme, Vision I tends to prioritize a well-defined body of academic knowledge and practices associated with the discipline of science. That is, achievement of Vision I requires that students develop understandings of science content and how science works with an aim to prepare future scientists. At the other extreme, Vision II highlights scientific knowledge and perspectives relevant in society that go beyond the boundaries of scientific disciplines. Under Vision II, the goal is for students to become responsible citizens who can use science and make informed decisions in their lives.

Previous research on socio-scientific issues (SSI) has shown that engaging students in the negotiation of complex societal issues is an effective way to address the learning goals aligned with Vision II (see the review by Zeidler, 2014). SSI instruction provides students with meaningful contexts to reflect on how science may relate to their own lives and society. It also prompts students to consider the moral and ethical implications of complex societal issues that are central in personal judgement and decision-making in everyday life. In addition to achieving the goals for Vision II, an issue-based approach has been linked with improvement in learning outcomes associated with Vision I. Learning science in the context of SSI can promote students' understandings of scientific content knowledge and ideas about the nature of science (Khishfe, 2014; Sadler, Romine & Topcu, 2016; Zohar & Nemet, 2002).

Despite the potential for addressing both visions of SL, the promise of SSI demonstrated in the literature is rarely translated into science classrooms. Many teachers find it challenging to enact SSI in their classrooms for various reasons such as their discomfort with discussions about global problems without clear solutions (Ekborg, Ottander, Silfver, & Simon, 2013; Hancock, Friedrichsen, Kinslow & Sadler, 2019; Lee, Abd-El-Khalick, & Choi, 2006). In particular, teachers often hold a content-centered view of SSI and background the social-political aspects of the SSI approach (Lazarowitz & Bloch, 2005; Tidemand & Nielsen, 2017). For some teachers, a lack of instructional focus on the social dimensions of the issue is

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