Controversial or Sensitive Topics in Science Education: A Literature Review

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Science education in the USA underwent dramatic curriculum reforms in the 1950s and 1960s (DoBoer, 1991). DeBoer stated that these curriculum reforms were "an approach to science education that was focused on the logical structure of the disciplines and on the processes of science" (p. 147). However, by the end of the 1960s, many science educators grew dissatisfied with the curriculum reforms because they ignored the important goal of social relevance. During the 1970s and early 1980s, science educators used the term "scientific literacy" and the initiative called "Science-Technology-Society" (STS) to represent a broader focus of science education emphasizing the relationships between science and society. In this area, topics of relevance and of interest by learners have occasionally been controversial.

"Scientific literacy" has never had a precise definition. Roberts (2007) commented, "there is a veritable deluge of definitions" (p. 729). However, in the 1970s, the term was generally associated with a functional and socially relevant understanding of science (DoBoer, 1991). Scientific literacy also involved themes of student interest, connections across the curriculum, and the more human aspects of science. When the National Science Teachers Association (NSTA) embraced scientific literacy as the major goal of science education for the 1970s, the organization was making a clear shift away from learning science for its own sake. Instead, the primary purpose of science education was to better understand the world and to learn how to acquire new science knowledge.

The "Science-Technology-Society" (STS) initiative emerged in the early 1970s as a formal heading for the relationships between science and society (DoBoer, 1991). In 1982, the NSTA embraced the STS theme in their position statement about science education for the 1980s, building on their earlier statement concerning scientific literacy. By the mid 1980s, the STS theme had become a prominent force in the science education literature. "According to STS advocates," DoBoer wrote, "science education in the 1970s and 1980s was to be humanistic, value-oriented, and relevant to a wide range of personal, societal, and environmental concerns" (p. 179). One particularly controversial area of the STS initiative was values education, which introduced students to controversial moral dilemmas in science and instructed students about the valuing process. For example students might learn how to evaluate the environmental dilemmas caused by increased agricultural production.

Effective teaching strategies for controversial values education topics were important. DoBoer (1991) explained,

> Most strategies for teaching students about values issues during the 1970s and 1980s followed the same basic rule: *Present the students with the dilemma, give them rational processes for thinking through the dilemma, but do not try to impose your own values on them*. (p. 181)

It was critical for teachers to remain value-neutral in a pluralistic society where its members often clashed over political and religious issues. In general, STS advocates welcomed classroom debate and expected disagreements. However, they emphasized the importance of information gathering and keeping an open mind—the goal was never to reach a definite conclusion on a values issue. Critics of this approach argued that it encouraged moral relativism because each

student was encouraged to come to their own conclusion. Unfortunately, the science education literature of the 1970s and 1980s largely avoided the dilemma of how to emphasize the rights of individuals to hold their own beliefs while teaching students important values.

Bringing social issues into the science classroom posed challenges. McGinnis and Simmons (1999) argued, "In many instances, the STS initiative does not play a significant role in the science teaching of practicing teachers because they perceived many topics as controversial" (p. 179). The authors asserted that teacher perceptions about job security and their status as outsiders to the local community decreased the practice of teaching of controversial issues. McGinnis and Simmons reflected that science teachers often avoid teaching the STS topics that are most relevant for students because they are perceived as too controversial.

For science teachers, teaching controversial topics, such as evolution, may induce tension between beliefs and practices (Jones & Carter, 2007). Yet, they can also enable teachers to help students appreciate civic decision-making, build science skills, and improve scientific understanding (Cannard, 2005). Not to mention, teaching controversial issues can improve student motivation (Cannard; Schwizer & Kelly, 2005). This is important because, as Aikenhead (2007) explained, "Most research into the science curriculum [from 1984 to 2002] concluded that school science transmits content that is socially sterile, impersonal, frustrating, intellectually boring, and/or dismissive of students' life-worlds" (p. 886). Introducing controversial science topics into the science curriculum introduces social relevance and a humanistic perspective, which possibly improves the recruitment of science students.

However, science teachers must be careful when introducing controversial or sensitive issues into the curriculum. As Hart (2007) explained, "In practice, many educators have developed professional strategies that have safeguarded students from forms of indoctrination or unethical teaching practices" (p. 694). Hart argued that teachers should not be considered coercive if they adopt teaching practices that promote active student engagement in decision-making about controversial issues. These teaching practices should encourage students to adopt a critical stance, support their views through argumentation, and tolerate alternative opinions.

Cannard (2005) suggested a five-tiered approach to discussing controversial topics with middle school children that provides students with "solid background information, multiple perspectives, guidelines for discussing issues as a group, substantive discussion questions, and strong follow-up" (p. 15). Solid background information can be collected from reputable websites maintained by organizations like science museums, research institutions, and reliable news media. Cannard suggested having students interview friends, family, or community members in order to obtain at least three different perspectives about the controversial issue.

When introducing controversial environmental issues, Kirk (2011) recommended that teachers begin by teaching relevant science content. Then, they should discuss related policy or economic issues and end by having students explore their own personal stances. Kirk also suggested having students analyze the scientific data themselves. During this data analysis, teachers might incorporate manipulatives into small group cooperative learning experiences (McGinnis & Simmons, 1999; McGinnis, Hestness & Riedinger, 2011). Besides building student critical thinking and data analysis skills, these practices allow the teacher to avoid making statements about controversial issues that may arouse negative emotions in students (Kirk, 2011).

Kirk (2011) also encouraged teachers to engage students in active learning with role-playing activities and debates. According to Schwizer and Kelly (2005), having students formulate evidence-based arguments "has been identified as a pedagogically inventive way to engage students in meaningful discussions related to controversial issues such as global climate

change" (p. 75). The ability to create and evaluate evidence-based arguments is critical to civic participation in democratic society, which is a widely accepted goal of science education (Jones & Carter, 2007; Hart, 2007; Cannard, 2005).

Recently, McGinnis, Hestness, and Riedinger (in press, 2011) advocated a story-telling approach for teaching the socioscientific issue (SSI) topic global climate change (the SSI initiative has superseded the STS initiative; SSI includes the essence of the STC initiative, but also includes consideration for additional concerns such as morality). Global climate change is an emerging prominent controversial topic in the USA. The researchers explained that stories help students handle issues that might initially seem overwhelming. Their story-telling perspective valued a diversity of opinions about the issue and aimed to help students make informed decisions about climate change. McGinnis, Hestness, and Riedinger used the structure of a story to design a curriculum module for preservice elementary teachers. The module included student drawings of climate change, interviews with elementary students, small group discussions, current events reading assignments, and authentic data analysis activities. The data analysis took place in small groups, and each group received a large poster that presented the data. Findings suggest that the strategy was effective in teaching the global climate change topic to elementary teacher education candidates (Hestness, McGinnis, Riedinger, & Marbach-Ad, 2011).

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