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Preface to the special issue on socioscientific issues in education

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In an era defined by rapid scientific advancements and pressing societal challenges, the intersection of science, society, and ethics has never been more vital. Socioscientific issues (SSI) provide a dynamic framework for addressing these complexities, enabling researchers, educators, and students to engage with real-world problems embedded in science from diverse perspectives. Through SSI, learners explore, analyze, and discuss these challenges with a sense of compassion, care, and empathy, considering the ethical implications for both people and the environment (Karisan et al., 2017). Doing so may be thought of as an activity aimed at a special kind of moral inquiry which requires the spread of virtue when confronted with conflicting or unclear moral judgements impacting the quality of our social and physical world (Zeidler, 2024). This approach, embedded in SSI education, equips students to tackle complex societal issues using scientific inquiry and evidence-based reasoning (Zeidler et al., 2005).

Beyond deepening students' understanding of scientific content, SSI aligns with the broader goals of promoting scientific literacy and fostering responsible citizenship (Zeidler & Sadler, 2023). By integrating scientific topics with moral and ethical considerations, SSI encourages students to appreciate how science interacts with societal values (Sadler et al., 2007). This approach cultivates critical thinking and multidimensional evaluation skills, empowering students to assess the social and ethical dimensions of scientific issues (Leung, 2020).

SSI also supports interdisciplinary learning by integrating perspectives from science, mathematics, social sciences and the arts, enabling students to grasp complex concepts more effectively from a varitey of perspectives. (Abrori et al., 2023). Exposure to varied SSI topics helps students develop socioscientific reasoning, an essential skill for navigating contemporary challenges. This, in turn, provides valuable insights for educators in designing and implementing meaningful SSI-focused lessons (Cian, 2020).

In conclusion, socioscientific issues offer a transformative framework for science education, fostering scientific literacy, critical thinking, and social responsibility. However, effectively teaching these topics requires dedicated professional development and support for educators. By empowering teachers with the tools and training they need, SSI can play a pivotal role in shaping informed, ethical, and socially responsible future citizens.

Building on this foundation, this special issue aims to expand the discourse around socioscientific issues by exploring their potential to address multifaceted sociocultural challenges in education. The papers selected for this issue reflect the dynamic nature of SSI and its transformative potential for both science educators and students. Each contribution illuminates the role of SSI-based teaching and learning in fostering critical thinking, ethical reasoning, and informed decision-making, while emphasizing the importance of collaborative and contextually relevant approaches.

In the first study, Sema Öztürk and Hamdi Karakaş examine how scenario-based SSI instruction enhances decision-making skills, attitudes towards the course, and the academic achievement of primary school

students. It highlights the importance of integrating real-life issues into curricula making science more relevant and impactful for young learners.

The second paper, by Ümran Betül Cebesoy and Banuçiçek Seyhan, explores the quality of arguments made by pre-service teachers across various SSI contexts. The study emphasizes the critical role that contextualized SSI instruction plays in fostering high-quality argumentation, a fundamental skill for future educators navigating the complexities of science education.

In the third study, Augusto Macalalag et. al., take a broader look at how educators develop the knowledge needed to teach SSI in ways that intersect with important aspects of social justice. This contribution underscores the critical role that teacher education plays in preparing those in who work with children to address ethical and justice-related dimensions in science teaching instruction.

Next, in the forth contribution, Becky Mothers et al., showcase how authentic SSI applications empowers students to take ownership of their learning and decision-making processes. This research reveals the potential for SSI to cultivate student agency and engagement in STEM subjects, demonstrating that such issues provide meaningful, relevant contexts for inquiry and problem-solving.

In the fifth investigation, Özge Hazal Aydın et al. explore the learning outcomes of teachers involved in professional development programs focused on SSI. Through collaboration, preservice and mentor teachers deepen their understanding of SSI, gaining valuable insights into teaching practices and professional growth.

In the final study, Ayşenur Eker and Ahmet Taşdere investigate how middle school students reason informally about a locally-relevant socioscientific issue. This paper illustrates the power of context-specific SSI in stimulating students' reasoning and engagement with real-world problems.

As guest editors, we are delighted to present this collection of scholarship that collectively advances the ongoing dialogue related to socioscientific issues in science education. We believe this work, being instantiated in a sociocultural understanding of education, is important to cultivate humanistically functional scientific literacy. We extend our deepest gratitude to the authors for their invaluable contributions and to the reviewers for their thoughtful feedback. We hope that the insights shared in this special issue will inspire further research and educational innovations that address the ongoing present and future socioscientific challenges of our time.

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