Methodological Diversity in HPS-Informed Science Education Research

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The papers in this issue cover various topics ranging from scientific literacy to scientific and religious worldviews. Empirical studies on large samples of students and adults from Colombia and Slovakia are presented, along with a thought experiment on the epistemic value of students' conceptions. Document analysis of curriculum engineering education standards from seven countries and historical analyses of computational thinking illustrate the contemporary problems in STEM education. Following a brief review of the content of the papers, I will focus on the theme of methodological diversity that is well represented in this issue.

Archila and colleagues examine what might be meant by “Covid-19 literacy” including health literacy, scientific literacy, and scientific media literacy. The authors conducted a study with 4168 students from a Colombian university. The findings suggest that the Internet was the most popular source of information. On the other hand, Bašnáková, Čavojová, and Šrol explored the scientific literacy of a general sample of the Slovak adult population and examined factors that might help or inhibit scientific reasoning. They investigated 1012 adults who completed several measures of scientific literacy. The Slovak participants' performance on scientific reasoning tasks was fairly low and dependent on the context in which the problems were presented. The value of students' conceptions is interrogated through a thought experiment by Gomez who presents an analysis of the epistemic value of the students' conceptions by using a thought experiment, adapted from Hilary Putnam's famous Twin-Earth examples. Students' conceptions are re-interpreted in terms of Putnam's stereotypes, and as a conclusion, the author argues that the role of students' conceptions is not epistemic but pragmatic.

Along with scientific literacy, STEM education research continues to preoccupy the science education community, particularly the relatively recent “engineering education” and “computing” aspects. Ekiz-Kiran and Aydin-Gunbatar analyzed the K-12 science standards of seven countries that have improved their engineering practices noticeably by integrating engineering and its elements into their science standards documents, namely, Australia, England, Estonia, Hong Kong, South Africa, Turkey, and the USA. Their results showed that the US and to some extent Turkish standards documents have placed a particular emphasis on engineering. Taking on a historical approach to computer science, Lodi and Martini trace “computational thinking” (CT) from educational and epistemological approaches and conclude that different accounts are both relevant to today's computer science education.

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The next four papers focus on themes about theory of evolution by natural selection and its interplay with religions and worldviews. Noguera-Solano, Rodríguez-Caso, and Ruiz-Gutiérrez draw on the work of Lamarck to argue that there are other important ideas in Lamarck's work that are directly related to the origin and transformation of species. The authors argue that these concepts such as causal explanations of organic nature, can be taught to students who are learning about the sources and development of evolution. Peñaloza, El-Hani, and Carlos Mosquera-Suárez present empirical research about teachers' scientific and religious worldviews in Colombia using a qualitative multiple case study involving four biology teachers. Their findings indicate that the religious teachers are not fully assuming the worldviews of their specific religions, but rather building a personal version of those worldviews. Billingsley and Nassaji report the first large-scale study on students' beliefs about the interactions between science and widely held beliefs about personhood. The paper presents findings from a survey with 530 English secondary school students aged 15–16 where students' beliefs and concepts regarding personhood and the position of science were investigated. The findings indicate that a majority of the students believe in some form of soul. Finally, Hanisch and Eirdosh focus on causal maps as teaching tools for driving conceptual change in the classroom about the role of organism behavior and other factors in evolutionary change.

Collectively, the articles illustrate the methodological diversity of research with respect to the inclusion of history, philosophy, and sociology (HPS) of science in science education. The methodological approaches include theoretical accounts drawing on history of science along with thought experiments as well as qualitative and quantitative empirical studies focusing on case study methodology and quantitative survey design. Such methodological diversity is not unfamiliar to many researchers who have long been proponents of HPS research in science education. Yet, it may come as novelty those who project misconceptions about HPS being exclusively or predominantly about theoretical and conceptual work. Likewise, the empirical and methodological components of HPS-informed science education research may appear misplaced to those who have a strong commitment to theoretical work, drawing on conceptual accounts of HPS. If research is to contribute to understanding of how to improve science education, then methodological diversity is paramount to gaining insight into the complexity of the issues involved. Science education is a complex affair after all. It is also worthwhile to note that the methodological approaches in HPS-informed research are not a simple matter of a theoretical-empirical dichotomy either, but rather a complex array of approaches that may include mixed methods with varying range of emphases depending on the research questions asked. None of the methodological approaches can take center stage in claiming superiority for HPS-informed research when the goals of the research demand variation in scope. As an interdisciplinary community, the authors and readers of *Science & Education* are well placed to appreciate the nuances of methodological diversity in science education research.

Declarations

Conflict of interest The author declares no conflict of interest.

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