Sci & Educ (2017) 26:1–2
DOI 10.1007/s11191-017-9883-5

EDITORIAL

The "HPS dimension" of Science Education Articles

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Published online: 1 April 2017

During the last 2 years, we have been glad to see an increase in submissions to *Science & Education* by scholars who had not previously submitted articles to the journal. Many science education scholars are aware of the distinctive nature of the articles published in *Science & Education*: they should have explicit implications for science teaching and learning, as the articles published in other science education journals do; but they should also be informed by primary and secondary writings in history, philosophy, and sociology of science, in other words have what we describe as the "HPS dimension." It should be noted at this point that the journal publishes both theoretical and empirical studies, which should include both of these elements.

Prospective authors read on the *Science & Education* website:

> *Science & Education* publishes research using historical, philosophical, and sociological approaches in order to improve teaching, learning, and curricula in science and mathematics. In addition, the journal disseminates accounts of lessons, units of work, and programs at all levels of science and mathematics that have successfully utilized history and philosophy.
> This journal promotes the inclusion of history and philosophy of science and mathematics courses in science and mathematics teacher education programs. Moreover, it promotes the discussion of the philosophy and purpose of science and mathematics education and their place in and contribution to the intellectual and ethical development of individuals and cultures.
> To achieve its goals, *Science & Education* fosters collaboration among scientists, mathematicians, historians, philosophers, cognitive psychologists, sociologists, science and mathematics educators, and school and college teachers.

Let me remind to those new to the journal what HPS has to do with science teaching: among other things, it contributes substantially to the increase of the conceptual sophistication of science education, by allowing for a deeper understanding of the concepts and the methods of science. For example, in order to teach about concepts such as "adaptation" and "gene" one needs to take into account not only students' preconceptions about evolution and genetics, but also how philosophers of science have analyzed and defined these concepts. This would allow for a finer analysis of concepts and constructs, development of better items in questionnaires, and a more sophisticated analysis of students' responses. Similarly, in order to teach about

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nature of science, one can use not only simple, decontextualized activities but also highly contextualized ones. The latter not only convey a more authentic portrayal of how science has been done but also one that corrects the distortions of history often found in textbooks, e.g., that Mendel was a lonely and ignored pioneer of genetics who was ahead of his time. Therefore, one important contribution of HPS scholarship is to clarify the changing meaning of concepts and to provide an authentic image science (one can look at my own 2013 *Science & Education* articles on adaptation and Mendel as examples). There is more, of course.

Prospective authors may therefore wonder: "So do I have to read Popper and Kuhn, and other scholars in HPS, in order to get published in this journal"? My response would be "It depends." There is no question that studies that have drawn explicitly in HPS scholarship in order to develop frameworks and tools for teaching and learning science are appropriate for *Science & Education.* If you look at recent issues, we have published articles drawing on the work of scholars such as Lakatos, Toulmin, Giere, and others, or articles that have used specific historical case studies such as Pasteur and fermentation, Kettlewell and industrial melanism, and more. However, there also exist studies that are informed by such scholarship in an implicit manner. This means that they may draw on other science education studies that in turn draw on HPS scholarship. These studies are also welcome, but we encourage authors to try and enhance the "HPS dimension," and make it explicit.

However, how this should be done is not always self-evident. Therefore, sometimes the HPS dimension is underdeveloped and therefore implicit in the articles submitted to *Science & Education*. It is right here that our expert reviewers, who come from a variety of disciplines and who diligently review manuscripts, have been of enormous help. A manuscript submitted to our journal can be reviewed, e.g., by a science educator, a philosopher of science, and a historian of science. Each of these scholars can make a significant contribution that might help the authors improve their work and produce a stronger manuscript. Scholars that work on nature of science, concepts and conceptual change, argumentation, models and modeling, cognitive and conceptual development, among other topics, have already benefited from the thoughtful reviews of our expert advisors to enhance the "HPS dimension." We plan to continue in the same way.

Therefore, before you submit your article, please consider carefully whether you have really done the necessary work on the "HPS dimension." Looking at articles previously published in *Science & Education* is very important for this purpose. Not only these articles should be cited and discussed, but they can also point to important resources that would be useful for your work. In our view, drawing on the HPS scholarship is a necessity, not a luxury. Paraphrasing a well-known dictum, we believe that science concepts and methods make more sense in the light of scholarship from history, philosophy, and sociology of science. *Science & Education* is here to promote this kind of work.

Compliance with ethical standards

Conflict of Interest The author declares no conflict of interest.