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EDITORIAL

Issues of our time: science, religion, and literacy

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Science and religion: a special issue

As we go to press with the first issue of Volume 5 of *Cultural Studies of Science Education* it is timely to acknowledge the foundational efforts of Wolff-Michael Roth, who served with me for the past 4 years as founding coeditor. During this time Michael pioneered cutting-edge research, including theories and methods and ways of re-presenting research. He worked closely with numerous authors, assisting them to publish their best work in CSSE. Michael Roth's role as coeditor formally finished with the completion of Volume 4. However, in this special issue Michael returns as guest editor of a cutting edge collection on science and religion. As editor of the first 200 pages of this issue Michael presents 17 articles that explore a topic of international significance from many different standpoints. These articles have the potential to impact thinking about science and religion and associated policies throughout the world. At the same time, the many issues addressed should stimulate scholars to produce further work emerging from the overlaps and interstices between these fields. The issues associated with studies of science and religion reflect diverse standpoints and likely will differ in different parts of the globe. Which science? Which religion?

In addition to the articles that comprise the special issue there is a cluster of articles edited by Konstantinos Alexakos that is closely related to those that comprise the articles accepted under Roth's editorship. This cluster also projects diverse perspectives that originated in David Long's ethnography of a creationism museum and were elaborated in a forum that opened up the dialogue for others to join.

Publishing trends

I undertook an analysis of the papers published in CSSE. Two hundred and seventy-three authors from 24 countries have published in the Journal. Most were from the US, Australia,

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Canada, UK, Brazil, and Singapore. If editorials are excluded, 53% of the authors are female. For US authors 60% are female.

From the outset Michael and I agreed that as coeditors we would publish our work in the journal, including editorials, forum contributions, and original papers. Michael has published 27 papers in CSSE and these have been cited 33 times according to the SCOPUS database. One of these papers, co-authored with David Middleton and published in the first issue of the journal, has been cited 21 times. Google Scholar shows articles from CSSE being cited on 405 occasions, Roth's publications accounting for 82 of these citations. Clearly his work has an impact and I am grateful for his contributions to CSSE as an author as well as coeditor.

To what extent are these trends in CSSE typical of science education? A search of the ISI database using terms such as conceptual change and misconception produced 56,245 hits. Analyses based on country of the author revealed an uneven geo-distribution. Most authors were from the U.S. with 24 countries each producing more than 50 publications. There are numerous ways to search the database, but in each case a relatively large number of publications is identified and scholars from many countries are involved in ways that show the dominance in this database of English language and Western perspectives (i.e., U.S., England, Canada, Australia, Japan, Germany, France, Netherlands). An analysis of the frequency of publication since 1990 shows a steady increase in the number of publications up to about 5,000 in 2008. Publication at such a rate sets a tone in the literature that relates closely to what is accepted as common sense about learning by peer reviewers and journal editors—psychological models are dominant.

Citation trends also show that key works in science education are being accessed globally and apparently mediate the scholarly work in science education in numerous countries. The National Association for Research in Science Teaching (NARST) is the leading organization for research in science education in the world. Each year NARST awards The Distinguished Contributions to Science Education through Research Award (DCA) to honor science educators from the international community who have contributed through research over their careers. I analyzed citations in the Thomson ISI-Web of Science database to ascertain who was citing the research of the six most recent recipients of the DCA award (i.e., Wolff-Michael Roth 2009; Leonie Rennie 2009; Peter Hewson 2009; Dorothy Gabel 2008; Kenneth Tobin 2007; David Treagust 2006). I removed self-citations and summed the citing sources for each of the six scholars yielding more than 3,500 publications by authors from about 40 countries. The geographic distribution was uneven with most citations emanating from the U.S., England, Canada, Israel, Australia and Taiwan.

Another trend that has been central to science education since the post-Sputnik reforms is an emphasis on student inquiry—often translated as problem solving or participation in hands-on laboratory investigations. More than 3,000 publications in the ISI database emphasize inquiry in science. Analyses show uneven geo-distribution and support a gradual increase in emphasis from the year 2000 until the present.

In his discussion of the ways in which the Cavendish laboratory at Cambridge University influenced physics curricula in Australia, John de Laeter (1989, p. 448) argued that: "The role of the laboratory was of fundamental importance to the learning process and the 'hands on' approach adopted was a strength of the educative process." In terms of Australian science education this is an important argument because it connects doing laboratory experiments to learning physics; i.e., using experiments to produce knowledge of physics. As de Laeter explained it, the focus on laboratory work was not to connect to applications of science, but to model the way science is, in this case expressing a value for experimental over theoretical physics.

Science inquiry, as it has been incorporated into many science education curricula around the world, appears to embrace the connection between doing science as a hands on activity and learning science, even though research on this issue has been non-conclusive. For example, using a nationally representative sample of eighth-grade students Patricia Stohr-Hunt (1996) reported that students who participated regularly in hands-on activities achieved at a higher level on a standardized science test than students who engaged less frequently, or never in hands-on activities. In contrast, Clare von Secker (2002) reported that despite the call for reforms to change from teacher-centered, textbook-based curricula to student-centered, inquiry-based forms there is limited empirical evidence that these reforms will achieve national goals of academic excellence and equity. Her research concluded that teaching practices that improve achievement are as likely to increase achievement gaps among more and less advantaged students, as they are to reduce them.

Adults learning science: a priority for research

Douglas Roberts (2007) made the distinction between science as canon and science as it is embedded in the everyday practices of the citizenry. This distinction is reflected in the use of scientific literacy to refer to science as it is incorporated in the everyday practices and lives of people. Of course, embedded practices that have a scientific character are developed in society generally, not just in school and not just by engaging in school science. Broad interdisciplinary understandings are necessary in order to be scientifically literate in the way Roberts envisions in what he refers to as vision II. For example, a glance at the issues in the news on the first day of 2010 highlights the salience of having basic understandings of science. Today's headlines include articles about destructive bombs made from plastic like substances (PETN), full body scanners that see through clothes and detect substances attached to the body etc., colonizing the moon, saving the earth from a destructive collision with an asteroid, extracting DNA from 30,000 year old human remains, reducing global warming, allergens in the air, obesity, protecting the food supply, safe water, species extinction, alternative energy resources, and use of cryogenics to sustain life after critical injuries. Each day news media describe an array of science related events that closely connect to the living environment. Arguably all citizens should have opportunities through schooling and ongoing education to become sufficiently literate to understand everyday life through the lenses of science, especially to analyze policy standpoints taken by political adversaries. A critical ingredient of responsible participation in democratic society is to weigh evidence for and against tough choices made by self and others. Science education is not only necessary for economic competitiveness, but also for the development and maintenance of a literate citizenry, which is the foundation of a functioning democracy. With the goal of producing and maintaining a literate citizenry it is time for science educators to re-examine the priorities embedded in current practices and policies that produce and reproduce school science.

If literate citizenry is a goal it makes sense for scholars to examine science education continuously across the lifespan. Science education beyond the age of compulsory schooling is an area of neglect. After a person exits the formal educational system how does science education occur? Speaking for myself, I spend a considerable amount of time reading science related material from two websites, CNN and the BBC. Each month I also read National Geographic, finding much of its content to be science related. Perhaps I am unusual in where I go to learn about science. Where do adults learn science? To what extent are the available resources dependable for learning science (that is viable)? Are there readily available resources to produce and sustain a literate citizenry and thereby to maintain an effective democracy? Given the science related issues that pervade today's social life perhaps the time is past due for seriously studying the scientific literacy of adults from the moment they leave high school until death. Issues such as global warming, H1N1 vaccination, obesity, diet and food allergies, sexually transmitted diseases etc. require levels of literacy that many adults do not possess. What institutions are most appropriate for educating an adult population in science? So many questions can be asked about what is happening and why is it happening. At least from my vantage point the answers to such questions are unknown. On the one hand I ask, could we afford to have a public education system for adults? On the other hand it seems just as prudent to ask can we afford not to have a public education system for adults? Perhaps I am in a minority when I assert that a lack of scientific literacy among the adult population of the United States is a concern. I hesitate to make this claim, mainly because it is just a hunch. My sense is that science educators should sketch the landscape of scientific literacy in adult populations. Also, it might be useful to identify resources that adults currently access in a quest for knowledge that is related to science. In my community there are numerous clubs that cater to the leisure time interests of adults, however, it would be a stretch to claim that many of these have a primary goal of science education.

Would adults have the interest to learn science if it were not compulsory? What can science educators do to promote sufficient public interest in science to sustain science education institutions and programs for adult populations? As we give thought to the shape of science education in the next decade it seems imperative that we extend our vision beyond the K-12 system. If sustainability is the primary quest of the next decade, then the quest must be supported by literate citizens willing to adapt personal lifestyles for the benefit of the planet and its ecosystems.

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