

## **Philosophy of Science and Science Teaching: Contributions from the Springer *International Handbook of Research in HPS and Science Teaching***

The three-volume handbook was published by Springer in 2014 to mark the 25 years of publication of the journal *Science & Education: Contributions from the History, Philosophy and Sociology of Science*. It has 76 chapters, written by 125 authors from 30 countries. It deals with the contribution of HPS to theoretical, curricular and pedagogical issues in science and mathematics education. The 76 chapters are grouped in four sections: Pedagogical Studies (27), Theoretical Studies (32) National Studies (10), Biographical Studies (5). The extensive scope of the work is reflected in the Subject Index of 2,000 entries, the Name Index of 3,600 entries, and evidenced in its 10,200 references.

Each chapter sets the relevant literature in its historical context, and engages in an assessment of the strengths and weakness of the research addressed, and suggests potentially fruitful avenues of future research. The 25 chapters on 'Pedagogical Studies' provide comprehensive information on the classroom utility of HPS-informed approaches to teaching standard curriculum topics in physics, chemistry, biology, earth science, cosmology and mathematics.

The 35 chapters on 'Theoretical Studies' deal with Nature of Science (NOS) research, Cultural Studies in Science Education', Naturalism, Postmodernism, Religion, Inquiry, Laws and Explanations, Thought Experiments, Values, Critical Thinking, Scientific Literacy, Argumentation, and so on.

The five 'Biographical Studies' discuss Ernst Mach, Frederick W. Westaway, E.J. Holmyard, John Dewey and Joseph Schwab. These are the 'starting five' scholars who seriously engaged with the HPS of their time and used the engagement to inform their educational work. The eleven 'Regional Studies' chapters deal with the different trajectories of HPS-informed educational interventions in European, Asian, North America and Latin America, and the educational and political lessons learnt from these interventions.

The specific chapters being presented during the session will be:

### **'Introduction and Overview of Handbook'**

Michael Matthews, School of Education, University of New South Wales, Australia  
[m.matthews@unsw.edu.au](mailto:m.matthews@unsw.edu.au)

The HPS&ST Handbook project began in the middle of 2010 in discussions about how to celebrate the then-coming 20<sup>th</sup> anniversary of the founding of *Science & Education* journal. It was quickly obvious that a HPS and Science Teaching Handbook was the best and most useful way to mark the journal's publication milestone. Organised HPS&ST research began in the nineteenth century when Ernst Mach, the great German physicist, philosopher, historian and educator, founded in 1887 the world's first science education journal - *Zeitschrift für den Physikalischen und Chemischen Unterricht*. In the US, John Dewey in the 1920s explicitly addressed HPS&ST issues; these were later taken up in the 1950s and 1960s by, among others, James Conant, Gerald Holton, Stephen G. Brush, Leo Klopfer, Robert S. Cohen, Joseph Schwab and Arnold Arons. In the UK, HPS&ST issues were addressed from the 1920s in books and articles by Frederick Westaway, Eric Holmyard and James Partington; and subsequently by John Bradley, Joan Solomon and others. The same research questions have been investigated in Spanish, Portuguese, French, German and other traditions. To the present time *Science & Education* has published about 750 articles on HPS&ST themes; when other older journals are considered it is likely that 2-3,000 such articles have been published in just the Anglo tradition; to which can be added about 50 substantial books in the same tradition. All of this constitutes a lot of material to be covered and evaluated in the HPS&ST Handbook.

Contributors were invited on the basis of their competence in philosophical and historical scholarship, and their interest in theoretical and pedagogical problems of science and mathematics teaching. The expectation was that the handbook will demonstrate that HPS contributes significantly to the

understanding and resolution of the numerous theoretical, curricular and pedagogical questions and problems that arise in science and mathematics education.

### **‘Generative Modelling in Physics and in Physics Education’**

*Ismo T. Koponen and Suvi Tala, Physics Department, University of Helsinki, Finland*

[suvi.tala@helsinki.fi](mailto:suvi.tala@helsinki.fi)

The extensive use of modelling in physics research has many implications on how it is used in physics education. An interesting case is the use of models in producing of new knowledge, which we here refer to as generative modelling. Generative modelling can serve as a cognitive tool bridging conceptual reality and real phenomena by mutually fitting of simulations and experiments. In this fitting process of fitting pursuing partial mimetic similarity in simulations and experiments acquires a central epistemological role. At the core of generative modelling is the creative use of theoretical and empirical elements of modelling as well as the explorative manipulation of real conditions to fit the models. We argue here that such modelling is also identifiable as authentic by the modelling practitioners themselves and that such a modelling approach supports constructively oriented and creative teaching solutions.

### **‘The History and Philosophy of Science and Science Teaching in Mexico’**

*Ana Barahona, Biology Department, Autonomous University Mexico, Mexico*

[ana.barahona@ciencias.unam.mx](mailto:ana.barahona@ciencias.unam.mx)

*Abstract* Science is one of the main attributes of the contemporary world, and more than any other human activity, characterizes the current period from previous centuries. Great advances in the field of science and technology deeply influence natural and social processes. There has been a worldwide recognition of the role of science in modern societies, along with an urgent need to move towards more and better scientific education, particularly in developing countries. It becomes fundamental to modify the current education system regarding science and technology in countries like Mexico, where a cornerstone has been the inclusion of the reflections that historical and philosophical studies have produced in the last three decades. This article discusses the importance of recent history and philosophy of science studies for Science education in Mexico. The educational reforms in 1993 and 2006 acknowledge the advances in science teaching in basic education (elementary and junior high schools) as well as the inclusion of history and philosophy of science in official curricula.

### **‘HPS and Challenges of Multiculturalism in Science Education’**

*Kai Horsthemke, School of Education, University of the Witwatersrand, South Africa*

[kai.horsthemke@wits.ac.za](mailto:kai.horsthemke@wits.ac.za)

*Abstract.* The biggest challenges facing science education have possibly been accessibility and relevance to its target audiences—challenges that have become more pronounced with the increasingly multicultural nature of teaching and learning environments. How does one render accessible a field of inquiry that has often been viewed as unnatural, difficult, or the intellectual playground of a select few? How does one instil in students a sense of relevance of science to their own lives and experiences, especially as science has its own culture with a special language, traditions, conventions, beliefs, and values; and if teaching and learning take place in a language and culture other than their home language and culture, and if it does not seem to engage, respect, and honour their prior knowledge, past experiences, and cultural perspectives? Recent decades have seen various approaches to multicultural education, the transformation of science education, and the learning of scientific knowledge, concepts, and practices in non-Western or indigenous societies. Chief among these approaches are the drives toward indigenisation, on the one hand, and toward internationalisation, on the other. After reflecting on lessons from Africa regarding the debates around

Africanisation and globalisation, we examine the idea of *Transkulturalität* [transculturality]—as contrasted with multiculturalism and interculturality.