

Theme editorial

Epistemic insight and the power and limitations of science in multidisciplinary arenas

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The June 2017 special issue of *School Science Review* focused on epistemic insight. Epistemic insight in its broadest sense refers to having the attitudes and understandings that are associated with thinking and working like a scholar. Someone with epistemic insight has a deep understanding of how knowledge works.

In the months since, a widening cohort of researchers, practitioners and policy makers have begun to discuss the importance of epistemic insight as a dimension of students' intellectual development. This is significant if – as we believe – it marks the beginning of a transition from a highly compartmentalised education system that focuses on teaching and testing individual subjects to one that also aims to nurture students' intellectual curiosity about questions that bridge subject boundaries.

With this in mind, this issue launches the Epistemic Insight initiative, which aims to develop and advocate ways to teach epistemic insight in schools. Schools are in the business of developing young people's epistemic insight and, while many objectives are met, there are also many objectives relating to attitudes and understanding that are critically important and currently widely missing. These include, for example, encouraging students to reflect on the power, relevance and limitations of science. Science teachers can do this by 'framing' – that is, by regularly acknowledging to students that a question that we have addressed scientifically could also be addressed through other disciplines.

The research that motivated the development of these ideas included the finding that big questions fascinate many young people but they choose to hide their interest and hold back from asking questions that might be deemed off-topic or sensitive. More generally, students' comments frequently reflected a perception that the science classroom operates as a silo. We note that it is common to talk about the 'nature of science', a phrase which arguably suggests that the science educator need only focus on what is taught about the 'nature of' their own discipline without looking at what makes science distinctive. This is what we are aiming to change – and these articles are key for helping to stimulate the changes. Thus it can make a difference to how we teach science when we know that in history lessons children are also being told that they are using evidence to test ideas – but now 'evidence' means something very different. This is one of many examples to illustrate the need for a greater focus on developing young people's ideas about how science relates to other areas of scholarship and learning in schools and beyond.

To work out the best ways to do this will involve research. One focus for research is to look at how to teach epistemic insight – which might include looking at how scholarship is

developed and contested, as well as recognising what is unknown. It also involves the development of pedagogies that help children to bridge boundaries and to conceptualise the limitations of science in relation to big questions. Perhaps most importantly, efforts to consider epistemic insight are focused on the learning of young people in such a way that they are able to think critically in order to connect learning in the classroom to their lives outside the science classroom.

The research done around epistemic insight to date shows that pupils often want to raise and explore big questions about human significance, moral responsibility, identity, meaning and purpose. These questions relate to their rational and emotional lives, as well as to their future aspirations. Science informs our thinking about these questions but, where it is artificially separated from other disciplines, there is a risk that young people develop misconceptions about science and scientists. This special issue of *School Science Review* seeks to support educators by provoking thought about these issues and their causes, and also by providing concrete suggestions as to how to develop epistemic insight in students.

The articles in this special issue therefore deal with three main areas. Firstly, there are three articles that emphasise the need to develop young people's epistemic insight. In the second group, there are three articles looking at how students can come to understand the nature of science and the way that knowledge claims are developed and contested (the epistemology of science). In the third group, the focus is on the relationships between science and religion and how questions about science and religion can be explored in order to address the questions that young people have. The kinds of conversations that give rise to big questions, and to developing epistemic insight, involve discussion of the nature of science and multidisciplinary perspectives. This can be tackled through collaboration across different subject disciplines, and also by subject teachers themselves engaging with these issues in their own classrooms.

We begin this special issue with three articles that build on June's special issue by further staking out the issues and engaging readers in the need for developing epistemic insight with their students. Keith Chappell considers the cycle of education, from schools to universities and teacher education, and questions how we might break the continual presentation of science as compartmentalised from other subjects, and interested only in reductionist views of the world. Berry Billingsley, Mehdi Nassaji and Manzoorul Abedin then outline some of the ways that the compartmentalisation of school subjects can influence girls' views of science. They find that many of the interests and questions that girls have suggest that they are drawn to multidisciplinary thinking, and question whether science education currently addresses this as well as it could. Matt Pritchard's short piece then gets us thinking about magic and misdirection, providing a novel and thought-provoking lens through which to reconsider science. Through these articles, we hope that readers will begin to question why science is presented as it is in education: whether (and, if so, why) the boundaries of science are characterised as fixed. Why is science shown as separate and why are subjects compartmentalised? Contemporary science is not like this and neither are the challenges that pupils will face in their personal and professional lives. This is of concern when considering the next generation of scientists, engineers and citizens of the world.

Having explored some of the issues, we then move on to considering practical ways forward in developing understanding around the nature of science and how knowledge is developed within it. As well as teaching established concepts and relationships, developing scientific literacy means learning skills and ways of thinking in science lessons that inform how we

think about the world outside the classroom. This involves seeing the strengths and limitations of science, the particular ways in which it uses evidence, and how it asks and answers questions of the world. In this context, the article by Martin Coath presents a concrete way of getting students to consider how amenable the questions they ask are to scientific investigation, and of evaluating how well answers to these questions are understood. Carole Kenrick then describes an engaging way of showing students the nature of models and simulation in science: using ‘mystery tubes’ to explore epistemology with pupils. Next, Berry Billingsley and Andrea Ramos Arias describe an intervention project that provides secondary schools with a suite of strategies that can create bridges between classrooms.

The last three articles talk about the nature of science in relation to the nature of belief. Keith Taber asks whether students can be encouraged to accept a bigger picture of science – as a powerful means of generating useful knowledge – even when for one reason or another they are resisting something in the content knowledge of science. In so doing, the relationship between knowledge and belief in science is explored. Next, Emma Newall considers the teaching of evolution, which is often seen as a key battleground between science and religion. However, she shows us that this might be only a small part of the story. Her article exemplifies the need to connect teaching with the broader experiences of students and their sense of identity in the world. The article by Tamjid Mujtaba, Michael Reiss and Alexis Stones describes a teaching intervention that saw lessons in biology and religious education engage with the relationship between these disciplines. They report fascinating results in relation to students with different views on this relationship.

Through the articles presented in this special issue we advocate guiding students to see the power, relevance and limitations of science within the wider picture and in relation to real-world contexts. This involves teachers thinking about pedagogies that recognise the boundaries between subject disciplines and the broader lives of students, which involves emotions, faith and concern for their place and role in the world. In exploring these boundaries with students, teachers will support the development of epistemic insight and the recognition that boundaries are not the same as barriers.

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