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Boosting science learning - what will it take?

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Russell Tytler, Professor of Science Education at Deakin University, Melbourne has been involved over many years with Victorian curriculum development and professional development projects. He was principal researcher for the highly successful School Innovation in Science initiative, which developed a framework for describing effective science teaching and learning, and a strategy for supporting school and teacher change. His research interests also include student learning, student reasoning and investigating in science, and public understanding of science.

David Symington

Deakin University

David Symington spent 14 years as a teacher in Victorian schools followed by several decades engaged in the education of teachers and in research in science education. Adjunct Professor Symington later worked for 8 years at the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in several positions, where he learned a good deal about the path from the laboratory bench to the marketplace. Presently, he is engaged with Russell Tytler and others in a number of research and development activities at Deakin University.

Abstract

In this session Russell Tytler and David Symington will present some data they have gathered from three sources: scientists working in some of Australia's Research Priority Areas, science graduates working in positions outside their discipline specialisation, and students studying sciences at Year 11. The presenters will explain why they chose to interview these quite different groups of people and give some indication of why they believe the data is relevant to the question driving the conference: Boosting science learning – what will it take? There will then be group discussion drawing on the views and experiences of the group members and the data to suggest ways to boost science engagement and learning.

There is growing concern in Australia, and in post-industrial countries generally, about a perceived crisis in science education. This relates to lack of engagement of school students with science and claims of diminished learning outcomes; a decreasing proportion of students taking post-compulsory science; low levels of participation in tertiary courses in physics and chemistry and higher mathematics; a shortage of graduates and research students in key areas; and a shortage of science teachers. The question for us, then, is how do we boost student engagement, learning and participation in science?

The starting point for any discussion on this topic is to recognise that there will be no simple answer to this question. Nor will it be possible to sheet home responsibility for addressing the problem to any one group, teachers, educational administrators, government, university lecturers, or students. It is going to require action by all of these groups acting on many fronts to make progress. It may well require a rethinking of the nature and purpose of science education in a post-industrial world.

However, by examining evidence together in this forum, including pooling our experience of successful practices in school science, we believe that we will be able to identify some promising leads and suggest how we could build on what we do know to boost science learning. The speakers at this conference will be bringing research evidence they and colleagues have generated to cast some light on this issue of learning and engagement. We will also present, for consideration by the group, data we have gathered that we believe suggests some exciting possibilities. This was research done in an attempt to rethink science teacher education.

Our data came from three sources.

The world of science

First, we gathered information about what is happening in the world of science. We ran focus groups involving mainly scientists working in areas identified as Australia's Research Priorities, such as 'frontier technologies' and 'protecting our borders from infectious diseases and pests' and 'climate change'. One clear and compelling point emerging from these focus groups was the importance of public perspectives and understandings to the advancement of science and technology. It is really important that educators know how passionately people working at the frontiers of science and technology feel about this.

A second thing we learned from these groups was the extent to which a common set of competencies required of people working in these science fields could be established. Further, these are capabilities that can easily be stimulated by appropriate science education at all levels of education. They include being able to communicate effectively with multiple audiences, having well-developed analytical thinking and problem-solving

skills, and being able to work in teams across disciplinary boundaries. We need to explore the implications of this for the curriculum and for teaching.

Although we didn't intend to engage these people in discussion of school science, they brought it up. Many had experience of school science through their children, or through working with schools on science-related projects. So what did they say about school science? A number of the focus groups noted a disjunction between traditional images of science, particularly represented in science education, and the way contemporary science operates, and the abilities required of those working in the field. They argued for a science education less focused on knowledge structures, and more on skills, thinking, preparing for lifelong learning and engagement with science.

The world of work for many science graduates

We conducted interviews with science graduates not working in their specialist fields – some are employed in science-based enterprises, others are not. Why would we want to do that? Most commentators and politicians are worried about the lack of people moving into the more traditional science positions. This is certainly a cause of major concern, but the problem is wider than this. We believe that in the present science-based world there is also a need for more science-educated people in decision-making positions in government and industry. At present about 40 per cent of science graduates are employed in positions that are not specific to their discipline specialisation. Accordingly, we wanted to find out what insights people in such positions could bring to our considerations of science education. As it turned out, they had much to say that we believe to be of relevance to our discussions. Some of these data will be shared to stimulate our thinking. Interestingly, and encouragingly, we found that this group of people stressed the importance of many of the same capabilities identified by the scientists in the focus groups.

The world of school students thinking about further studies

Our third source of data was students doing science studies in Year 11. We explored what would encourage them to enrol in a science degree at university. From them, we gained insight into how they regard science particularly in relation to career options. For example, the feature of a science degree course most likely to encourage more students to enrol is that, at the completion of the course, they would have a chance to pursue a variety of career possibilities and get a job where they will be working with people. The features least likely to encourage student entry are that the degree leads you to become a science researcher, work in a laboratory, or become a science teacher.

The data challenge us on a number of fronts. First, there is the image of science generated at school. Then, there is the information students have about science careers. The data also have implications for the way school and university systems market science degrees. Finally, of major concern, in an era when a significant shortage of appropriately qualified science teachers is looming is the lack of appeal of science teaching. Within the forum we will have the opportunity to discuss some of these issues.

Possible questions to be discussed in the forum include:

- How can we ensure that school science programs reflect contemporary science?
- How do we ensure that citizens are able to engage with, and are interested in engaging with, social and ethical issues around applications of science?
- What image of potential careers do our science programs present? Is this an issue we should think about? What should be done?
- Given the issues and perspectives raised at this conference, how might we boost student engagement and learning in science?
- What are the key points at which we need to exert pressure for change?
- What examples can we find in current practice that might give us directions for ways forward?