
Improving

science learning

By Dr John Ainley

John is Deputy CEO (Research) and Research Director of the National and International Surveys research program.

Science education experts have called for an urgent re-thinking of the way science is taught in Australia arguing that a greater focus on enquiry and reasoning is needed to boost students' waning interest in science as ***John Ainley*** *explains.*

The recent ACER conference *Boosting science learning: what will it take?* concluded with a session led by a panel of experts developing a three-point proposal for science education. Those attending the conference endorsed the proposal that:

- We need to re-imagine science education, accepting a shift that is occurring, and must occur, in the way we think of its nature and purposes.
- To achieve this re-imagined science education we need to develop:
  - a new metaphor for science education that will capture its nature; and
  - rigorous assessment processes appropriate to this re-imagined science education.
- There needs to be a national teacher education agenda focusing on re-imagining the role of the science teacher and developing teachers' capabilities (knowledge, pedagogy, and disposition) that enable the support of the new directions.

A desire to have a focus on science enquiry and reasoning in science education came through in many of the papers delivered at the conference. Speakers and delegates agreed that science education must be connected to students' interests and priorities with a greater focus on ideas, evidence and argument.

Any moves towards a national agenda for science curriculum and assessment need to take this re-imagined way of teaching science into account. Changes might include making learning more relevant to real life issues, more debate and research in the classroom, and more student choice about topics studied.

Science teachers would require new pedagogies, knowledge and commitments in order to undertake some of the innovative projects and directions described at the conference. Teacher training would be vital in creating engaging and dynamic teachers. They would need to be supported to take risks in a new kind of science education.

ACER chief executive officer, Professor Geoff Masters concluded the conference by calling on the federal, state and territory governments to make a national response to address students' declining interest in science.

Earlier presentations at the conference leading to these proposals included:

Crisis of interest in science needs humanistic approach

A humanistic approach to curriculum is urgently required in order to address the current crisis of interest in science. Despite an apparently rich set of positive options for increasing student interest in science a number of constraints imposed by science teachers, academic science and competing systemic demands stand in the way of implementing them.

Professor Peter Fensham of Queensland University of Technology said students are not enjoying studying science. Most have concluded that post-compulsory science studies should be avoided unless needed for some career purpose.

International research suggests that students' interest in science could be heightened if curricula and assessment requirements made it possible for students to learn science as a story involving people, situations and actions, real world situations that students can engage with, Professor Fensham says.

Peter Fensham is Emeritus Professor of Science Education at Monash University and is an adjunct professor at Queensland University of Technology.

Science curriculum must focus on ideas, evidence and argument

Current practices in science education may be leaving many students poorly educated about science and with an ambivalent or negative attitude towards science according

to Professor Jonathan Osborne of King's College London. He argues that science education requires a shift in focus towards ideas, evidence and argument that is more appropriate to the needs of the future citizen and the values of contemporary youth.

Professor Osborne argues by presenting science to young students as a body of knowledge that is unequivocal, uncontested and unquestioned, educators may be putting young students off studying science beyond the compulsory years.

"There is a growing recognition that we need to educate our students and citizens about how we know, and why we believe in the scientific world view," Professor Osborne says. "Teaching science needs to accomplish much more than simply detailing what we know."

Jonathan Osborne holds the Chair of Science Education at the Department for Educational and Professional Studies, King's College London. He is also currently head of department and President of the US National Association for Research in Science Teaching (NARST).

Science curriculum requires greater focus on community

If science education is to remain useful to students outside of school the curriculum must move beyond the textbook, using community resources to explore science-related community issues according to Professor Léonie Rennie of Curtin University of Technology.

Research studies have shown consistently that the majority of our high school students find school science to be unimportant, unengaging and irrelevant to their life interests and priorities. For them science has little personal or cultural value.

"Our challenge is to turn around this disinterested majority by making it worth students' while to learn science in a meaningful way," Professor Rennie says.

This requires changing the curriculum so that it has demonstrable relevance and value to these students. A powerful avenue to achieve this involves bringing science at school and science in the community much closer together. Using community resources to complement those in school increases the variety of stimuli and sources of information available to students and promotes learning that is self motivated, voluntary and guided by learners' needs and interests.

Léonie Rennie is Professor of Science and Technology Education at the Science and Mathematics Education Centre and Dean, Graduate Studies at Curtin University in Western Australia.

Boosting science learning through curriculum materials

Effective curriculum materials are central to enhancing science teaching and learning, according to visiting expert Dr Rodger Bybee of the US Biological Sciences Curriculum Study.

In his keynote address Dr Bybee argued that curriculum developers must:

- pay close attention to the criteria for student learning and the appropriate translation of those requirements to curriculum materials;
- use an instructional model that provides opportunities and time for conceptual change and development of cognitive abilities;
- use 'backward design' for the process of designing and developing the scope and sequence of the curriculum; and
- incorporate a means to enhance teachers' knowledge base, including subject matter, pedagogical content knowledge, and teaching strategies.

"In the end, we want to provide curriculum materials that enhance science teaching and student learning," Dr Bybee says. "Science curriculum and instruction should facilitate conceptual change and instruction should be based on fundamental concepts and complementary facts and provide opportunities for students to learn and develop metacognitive strategies."

Dr Rodger W. Bybee is executive director of the Biological Sciences Curriculum Study (BSCS), a non-profit organisation in the United States.

Highly accomplished science teachers deserve higher pay

The quality of science teaching and learning in our schools would be improved if science teachers were assessed and highly accomplished teachers rewarded with a higher salary, according to a paper by Dr Lawrence Ingvarson and Ms Anne Semple.

ACER, in conjunction with the Australian Science Teachers' Association, conducted preliminary research to develop new methods for gathering evidence about teaching performance that might be used in a system for providing recognition to highly accomplished science teachers. This involves collecting a professional portfolio of items to provide evidence of capability in relation to professional standards.

Dr Ingvarson said improving the quality of science learning in our schools will require more effective policies and career pathways for attracting, developing and retaining effective science teachers.

"We need credible methods for defining what we think good science teachers should know and be able to do, for gathering evidence about performance and assessing whether that evidence indicates that the standards have been met," Dr Ingvarson said. "Our research shows that we can define good science teaching, we can gather valid evidence of good teaching, and we can assess that evidence reliably."

Dr Lawrence Ingvarson is a Principal Research Fellow at ACER. Co-author Ms Anne Semple is a past president of the Australian Science Teachers' Association and an independent education consultant. ■

The full conference proceedings are available in the Professional Learning section of the ACER web site ***www.acer.edu.au***