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## Introduction

### Research Conference 2006 special edition

The following articles are based on papers presented at the ACER Research Conference 2006, held in Canberra, 14-15 August 2006 entitled **Boosting science learning - what will it take?**

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## 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 a visiting expert. Professor Jonathan Osborne of King's College London 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 is visiting Australia this week to deliver a keynote address to the Australian Council for Educational Research (ACER) 11th annual Research Conference entitled Boosting science learning: what will it take? In his presentation, Towards a science education for all: The role of ideas, evidence and argument, 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."

"Any education in science must attempt to communicate not only what is worth knowing, but also how such knowledge relates to other events, why it is important, and how this particular view of the world came to be. As well as teaching what we believe to be true in science there is a need to address why we believe it to be true."

Students would benefit from a science education that pursues depth rather than breadth, coherence rather than fragmentation, and insight rather than mystification. In such a curriculum, the study of the history of ideas and the evidence on which they are founded must lie at the core.

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Jonathan Osborne is holds the Chair of Science Education at the Department for Educational and Professional Studies, King's College London where has been since 1985. He is also currently head of department and President of the US National Association for Research in Science Teaching (NARST). Professor Osborne will speak at ACER Research Conference 2006 Boosting science learning – what will take?

Published August 2006

## 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.

Dr Bybee was speaking in Canberra on 15 August at the Australian Council for Educational Research (ACER) annual conference entitled Boosting Science Learning – What will it take?

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 said. "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."

The information conveyed to students must be made explicit and students must also be taught how to retrieve information.

In addition, teachers must understand the science content of the curriculum, understand the importance of the instructional sequences, make use of different teaching strategies, as well as appreciate the subtleties of responding to students' preconceptions in order to facilitate conceptual change.

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Dr Rodger W. Bybee is executive director of the Biological Sciences Curriculum Study (BSCS), a non-profit organisation in the United States that develops curriculum materials, provides professional development, and conducts research and evaluation for the science education community.

The BSCS-inspired textbook *The Web of Life* will be familiar to many students who have studied Biology in Australia over the past 30 years.

Download Professor Leonie Rennie's paper:

[The community's contribution to science learning: Making it count](#)

Published August 2006

## 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 a leading expert in science education.

Professor Léonie Rennie of Curtin University of Technology will deliver a keynote address entitled *The community's contribution to science learning: Making it count in Canberra today* at the Australian Council for Educational Research (ACER) annual conference *Boosting science learning – what will it take?*

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. Providing several examples of successful school-community partnerships, Professor Rennie argues that community resources have a critical role to play in arresting the declining interest in school science by developing students' desire to learn science.

"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.

"This is the type of learning we need to encourage at school," Professor Rennie says. "We need to boost learning and interest in science that students perceive as relevant and worthwhile, so that learning is meaningful and lasting."

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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.

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## 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.

Dr Ingvarson spoke in Canberra on 14 August at the Australian Council for Educational Research (ACER) annual conference entitled *Boosting Science Learning – What will it take?*

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.

"For these policies to work, we need credible methods not only for defining what we think good science teachers should know and be able to do, but also 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."

"These initiatives are very much in the interests of governments and others employing teachers, and should be encouraged through better remuneration and career paths that better reflect what a highly accomplished science teacher is worth, not only to their school, but to our society and our economy."

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

Download Dr Lawrence Ingvarson and Ms Anne Sempel's paper:

[How can professional standards improve the quality of teaching and learning science?](#)

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## 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 told delegates at the Australian Council for Educational Research (ACER) annual conference in Canberra on 15 August that 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 said. This requires clearly presented science related to issues of personal and social significance, with personally engaging open problems for investigation.

"Informal investigations with science teachers in Australia, have made me aware that, however weak or strong their background in science studies, many of them are seriously deficient in having any science *stories* to tell, in communicating within and from science, in knowing science as a way of thinking, and in applying science in real-world applications," Professor Fensham said.

None of these desirable aspects of science as a human endeavour had been emphasised in teachers' school or undergraduate science studies as academic science has been primarily introductory to careers in scientific research, leaving graduates for other careers such as school teaching deficient in aspects other than foundational conceptual knowledge.

Professor Fensham argued that a more humanistic approach to science learning is further constrained by the different curriculum scenarios currently being played out in Australia.

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“Neither the curriculum scenario based around ‘essentials’ found in Tasmania, Victoria and Queensland, nor the Federal Government’s National Consistency Project has taken seriously into account the crisis of interest in science..

“Rather than promoting humanistic contextual learning of science – our best understanding of how to engage more students enthusiastically with science – it seems likely that in their own way they may cement in place the view of science that I am arguing needs to be replaced.”

Peter Fensham is Emeritus Professor of Science Education at Monash University where he established a leading international research group in the teaching and learning of science. Currently he is an adjunct professor at Queensland University of Technology.

Download Professor Peter Fensam's Conference Paper:

[Research and boosting science learning: Diagnosis and potential solutions](#)

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## ACER UPDATE

### Research Conference 2007

ACER's Research Conference 2007 will take place in Melbourne from 12-14 August. The theme is The Leadership Challenge - Improving learning in schools. The conference will address key issues related to building leadership in schools that make a difference to student learning outcomes. It will:

- \* Provide news about the latest research on leadership practices that enable conditions for quality teaching and student learning.
- \* Examine the implications of this research for the recruitment and preparation of a new generation of effective school leaders and the ongoing professional learning of established school leaders.
- \* Simulate discussion about the resources and conditions that need to be in place if effective forms of leadership are to flower and be sustained in our schools.

Conference speakers will include:

- \* Professor Philip Hallinger, Mahidol University, Bangkok
- \* Dr Chris Sarra, Indigenous Education Leadership Institute, Queensland Professor Viviane Robinson, University of Auckland
- \* Dr Lawrence Ingvarson and Michelle Anderson, ACER
- \* Professor Bill Mulford, University of Tasmania
- \* Professor Sheryl Boris-Schacter, Lesley University, Massachusetts
- \* Professor Steve Dinham, University of Wollongong
- \* Professor Brian Caldwell, Educational Transformations, Victoria

Further information on Research Conference 2007 will be posted on the [conference website](#) as it becomes available.

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## Conference proceedings available online

The full conference proceedings and individual papers from Research Conference 2006 - Boosting science learning: what will it take? are now available online. The papers and some PowerPoint presentations from conference sessions can be downloaded from the [conference website](#).

## Conference opens to beat of African buckets

The beat of African “drums” sounded through Canberra's Hyatt Hotel on 14 August as delegates arrived for Research Conference 2006. Grade five students from Forrest School's Bucket Band welcomed delegates with their unique version of African percussion.

The Forrest School Bucket Band was founded in 2005 by teacher Michael Rosenberg as an alternative activity for students who had not been selected for the school band program. The children make their instruments from recycled 25 litre plaster, chlorine and nappy buckets, which have been picked up on the side of the road or donated, and sticks made from lengths of dowel with the ends rounded. Fry pans, plastic bottles and lids are also used.

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