Three ways to boost science performance in Australian schools


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The latest Trends in International Mathematics and Science Study (TIMSS) results has predictably triggered a round of national soul-searching as the realisation dawns that in both mathematics and science we are increasingly falling behind countries traditionally regarded as our inferiors.

While we can question whether such tests should be the sole arbiter of the worth of our education system, they contain important measures of our students' capabilities on agreed educational benchmarks.

We have far fewer students performing at high reasoning levels, and far more students not reaching minimum science literacy standards (a serious question of equity), than the top performing countries.

Australia’s performance in science continues to slide due to ineffective, traditional teaching practices and an outdated curriculum, which is leading to students becoming disengaged with the subject.

**Disengaged students**

We have long identified problems with engaging students in deeper learning, largely due to the way science is taught in a very abstract way in the classroom.

In this model, students are given little opportunity to express and critique ideas, or participate in discussion of evidence and explanation.
It is rare for them to seriously discuss the personal and societal entailments of science that might inspire serious commitment to scientific ways of thinking, or move them to take up further study in this subject.

Research shows that despite years of research-based advocacy of inquiry approaches, traditional teaching models prevailed.

**Old-school teaching styles**

In primary schools, science is seriously underrepresented in terms of time allocation, with mathematics and literacy dominating the curriculum.

Yet there is abundant research that says these primary school and early secondary school years are crucial for establishing strong commitments to science learning and science futures.

There is an enormous fund of enthusiasm and commitment in the science teaching profession in secondary schools, with many enthusiastic and dedicated primary teachers devoted to promoting science in their schools.

**Solutions for science**

The problem is, how do we harness this to turn around practice in effective, system-wide and sustainable ways?

There is a wealth of research here in Australia and overseas demonstrating how we can lift student performance and engagement, much of which has been collaboratively developed with committed teachers.

How do we use this to bring about a change in the culture of science teaching and learning in Australian schools?

Let’s look at some ideas for ways forward that have been based in serious research.

**Improve science teaching**

The first relates to professional learning. In a recent 26 country science, technology, engineering and maths (STEM) comparison study we found that top performing countries in the Programme for International Student Assessment (PISA) had strong national agendas for improving science and mathematics curriculum.

Their teachers had high status, strong disciplinary expertise, and continuous professional learning was an important aspect of their practice.
In a recent video-based comparison of how quality primary teachers in Australia, Taiwan and Germany supported reasoning in their science classes, it was clear that the Taiwanese teachers had a more coherent program supported by an enormous range of textual and online resources.

They demonstrated high-level knowledge and their style, while strongly teacher driven, incorporated advanced conceptual challenges for students.

The Australian teachers were impressive, but they often needed to draw on their own resources in constructing coherent sequences.

If Australia is serious about systemic change, we need a nationally agreed approach to quality science teaching, including professional learning and resources.

We need to move beyond election-cycle approaches and invest serious thinking into a longer-term strategy.

**Make science curriculum engaging and current**

Science in schools needs to better reflect science in the world.

There is considerable interest in the STEM community in engaging with education and harnessing this, through local scientists working with teachers, is one way of inspiring students.

Students can explore contemporary scientific research and societal issues through novel means such as drama, or collaborative reasoning and debate about sustainability issues.

**Get schools and scientists working together**

More than this, though, is the need to align school science practices with scientific working and thinking.

There is considerable evidence that engagement with deeper learning results when students are given the opportunity to generate their own ideas and critique and refine these with teacher guidance.

We have been working, for instance, with an inquiry approach in which students construct and refine drawings, models, or animations in response to conceptual challenges. We believe this brings the culture of science classrooms closer to authentic practice.

Teachers report increased engagement of students with high level discussion and the creation of scientific ideas. Test results consequently show substantial improvements in learning.

However, with these shifts from a focus on straightforward application of scientific knowledge to
higher level argumentation, investigative design, critique, and the exercise of imagination, we need to develop improved approaches to assessment that will clearly articulate and measure the capabilities we want to develop.