



International mathematics and science study shows mixed results for Australia

Sue Thomson outlines the key findings from the Trends in International Mathematics and Science Study 2007 and identifies some areas where Australia could do better.



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The Trends in International Mathematics and Science Study (TIMSS) collects educational achievement data at Year 4 and Year 8 from countries across the globe.

TIMSS is the world's longest running mathematics and science study and one of the world's most influential global assessments of student achievement in maths and science. Carried out every four years, TIMSS provides data about trends in mathematics and science achievement over time.

TIMSS 2007 was the fourth in this cycle of internationally comparative assessments, with earlier assessments conducted in 1995, 1999 and 2003.

With more than 60 participating countries and 425,000 students assessed, TIMSS 2007 also was the largest study of student maths and science achievement in the world.

In Australia, a nationally representative sample of more than 8,000 students in 457 schools participated in the main sample of the TIMSS assessments in late 2006. In addition, an extra sample of Indigenous students in all participating schools was collected to provide a more detailed examination of the achievements of Australia's Indigenous students.

The release of findings from each cycle of TIMSS is eagerly anticipated and the release of the Australian national report by ACER in December 2008 was no exception. The results show that while Australian students' results in Year 4 mathematics improved since 2003, achievement levels remained essentially static in Year 8 mathematics and Year 4 science, and declined significantly in Year 8 science.

One of the great strengths of TIMSS is the ability to monitor progress in educational improvement over time. Such trend information is crucial in helping policy makers understand the impact of decisions about investment in education, curricular reform, and initiatives to improve instruction. The

TIMSS 2007 results show that at the Year 4 level, in both mathematics and science, more countries showed improvement than decline. At the Year 8 level, the pattern was less pronounced. Although close to a dozen countries showed improvements, most countries either showed little change or declined.

For Australia, the TIMSS results suggest an overall maintenance of performance over time. However, other countries, including England and the United States, have progressed since 2003. The Russian Federation and Slovenia have also shown strong improvement since the last administration of TIMSS. Both of these countries have undergone recent system and curricular reform.

International benchmarks

TIMSS 2007 measured student performance internationally at four benchmarks: advanced, high, intermediate and low. The proportion of Australian students achieving results at the advanced international benchmark set for TIMSS fell well short of the leading Asian nations. Countries such as Singapore, Hong Kong, Chinese Taipei, Japan and Korea showed exceptional performance at the high end of achievement. In Singapore, for example, more than 30 per cent of students in each category achieved the advanced benchmark. In contrast, less than 10 per cent of Australian students in each category performed at this level.

At the opposite end of the scale, less than five per cent of students in Chinese Taipei, Japan and Korea failed to reach the lowest benchmark in each category. In Australia, between seven and 11 per cent of students failed to meet the lowest benchmark. Australia's performance at the lowest end of achievement is about the same as the international median for Year 4 maths and Year 4 science, and better than average internationally for Year 8 maths and Year 8 science; however, this still represents a significant proportion

Key findings about Australia's performance in TIMSS 2007

Year 4 mathematics

Australian students' average scores in Year 4 mathematics have increased significantly by 17 points since 2003. In terms of relative position internationally, Australia was again outperformed by all of the Asian countries as well as England and the United States – a similar position to that obtained in 2003.

Year 8 mathematics

The result for Australia is similar to 2003 but achievement scores have decreased since the first administration of TIMSS in 1995. Increases in scores achieved by students from England, the United States, Lithuania and the Russian Federation, in combination with a decrease in Australia's score, resulted in those countries significantly outperforming Australia in 2007. Overall, Australian students performed poorly in the areas of geometry and algebra.

Year 4 science

Australia's performance has remained relatively unchanged since the first administration of TIMSS in 1995. Australia's relative position compared to other countries is much the same in 2007 as it was in 2003.

Year 8 science

Australia's average score has declined by 12 score points since TIMSS 2003. This combined with significant improvements by the Russian Federation and Slovenia has moved Australia a little downwards in relative terms.

Indigenous students

Once again the results of an international study highlight that little has changed in regard to educational outcomes for Indigenous students. At Year 4 the average score for Indigenous students in both mathematics and science was around 90 score points lower than that of their non-Indigenous counterparts. This gap has actually increased over time. Similar results were found at Year 8.

Gender

In Australia, boys generally outperformed girls in both Mathematics and Science at each year level. This is in contrast to the international trend for girls to outperform boys.

of students who are failing to reach the minimum standards in maths and science as defined by the international benchmarks.

In Australia, in each category, the greatest proportion of students achieved in the intermediate range. These results show that, overall, Australia is doing a very good job at educating students to an average standard. However, we need to ask ourselves: in an increasingly competitive global economy, is average good enough?

In addition to assessing students' knowledge of mathematics and science curricula, TIMSS collects a rich array of background information about mathematics and science curriculum coverage and implementation, as well as teacher preparation, resource availability and the use of technology. This background data can help us to identify areas of the curriculum and teacher preparation that may require attention.

Curriculum reform

TIMSS 2007 shows that at both grades, students with higher achievement in mathematics and science had more positive attitudes toward these subjects, reported a higher level of self-confidence in learning mathematics and science,

and placed a higher value on them as important to future success.

These findings are consistent with information on student engagement from other international surveys. According to 2006 results from the Organisation for Economic Cooperation and Development's Programme for International Student Assessment (PISA), Australian students are less interested in science and less concerned about environmental issues than students from other countries. A little more than half of the students surveyed for PISA indicated that science was very relevant to them while fewer than half were happy doing science problems and reading about science.

The findings from TIMSS 2007 suggest that urgent reform of primary and junior secondary science curriculum and teaching is needed. Of particular concern is the Australian students' relatively poor performance in several key areas of maths and science, particularly algebra and geometry and physics and chemistry. Increasing students' interest in science and mathematics must be a priority.

Teacher preparation

The TIMSS findings also highlight teacher preparation for science and maths subjects as an area in need of attention. Most Year 8 teachers had

studied mathematics or science and reported feeling very well prepared to teach the topics in the TIMSS assessment. In contrast, Grade 4 teachers reported little specific training or specialised education to teach the TIMSS assessment topics, especially in science. Just half of the Australian Grade 4 students who took part in TIMSS 2007 had teachers who reported feeling very well prepared to teach the TIMSS science topics.

Conclusions

Overall, while Australia's performance in TIMSS 2007 does not indicate a major decline, it does highlight a range of areas for improvement. In primary and junior secondary science and maths, we need to find ways to increase the amount of teaching expertise available in schools, increase the small amount of time given to the teaching of science and maths, and implement curricula that enable classroom teachers to demonstrate in engaging and meaningful ways the application of science and maths to the phenomena that students encounter in their lives.

The report, *TIMSS 2007: Taking a closer look at mathematics and science in Australia* by Sue Thomson, Nicole Wernert, Catherine Underwood and Marina Nicholas, is available for download from the ACER website at www.acer.edu.au ■

